

RHODE ISLAND 2020 FOREST ACTION PLAN ASSESSMENT Part 1: Introduction, Forests & Benefits

Department of Environmental Management
Division of Forest Environment
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Acknowledgements

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All maps, figures, tables and photos are RIDEM products unless specifically noted.

Executive Summary

Rhode Island's forests blanket over more than 50% of the state. This forest cover, both private and public, offers a myriad of benefits to all Rhode Island citizens. While forested lands play an important role in providing materials for building homes and other wood products, forests also protect vital soils, preserve and improve air and water quality, and capture carbon emissions. Trees contribute to the quality of life in urban settings, play an important role in outdoor recreations and aesthetics, and are essential tools for storm water management and reducing temperatures. The relationship between forests, biological diversity, and habitat for wildlife is as equally important.

Forests provide these commodities and all their conservation roles, functions, and outputs without the care and management required by traditional infrastructure.

RIDEM's [Division of Forest Environment](#) (DFE) currently receives approximately 23% of its funding through the [Cooperative Forestry Assistance Act](#) (CFAA) through the [State and Private Forestry](#) programs (S&PF), leveraging the federal resources and partnerships in collaboration with private and public stakeholders. These programs are important components of DFE's mission and help protect public resources, support forest landowners and managers, and help to prevent the spread of wildfires:

- Cooperative Fire Program (State Fire Assistance (SFA) and Volunteer Fire Assistance (VFA))
- Cooperative Forest Health Program
- Forest Stewardship Program
- Urban and Community Forestry Program
- Forest Legacy Program

These programs contribute to the Rhode Island's Department of Environmental Management [strategic goals](#), as well as the national priorities:

1. **Conserve and Manage Working Forest Landscapes for Multiple Values and Uses**
Forest landscapes, whether under public or private management must be conserved to protect landscape functionality, habitat and environmental benefits.
2. **Protect Forests from Threats**
Rhode Island's forests face threats on multiple fronts: development leading to the loss and fragmentation, ease of spread of invasive plants and pests/diseases, loss of habitat, loss of economic and environmental benefits, and wildfire risk.
3. **Enhance Public Benefits from Trees and Forests**
Support and promote the management and retention of forest lands for multiple benefits, including water and air quality, carbon sinks and sequestration, temperature moderation, forest products, wildlife habitat, outdoor recreation, and human health.

The Rhode Island 2020 Forest Action Plan discusses facts, trends, benefits and issues of concern, as well as priorities, goals, and strategies for the management of forest land. Five issues of concern are identified as having significant impact on the extent of forest land and its resilience:

- **Forest Loss, Fragmentation, and Parcelization** – wildlife habitat, landscape functionality and sustainability, interface and intermix, and invasive species
- **Forest Health** – invasive plants, wildlife habitat, diversity and resiliency, pests and diseases
- **Water** – stormwater, riverine/wetlands, water quality
- **Fire** – increasing intermix and expanding interface combined with increasing fuel loading
- **Climate Change** – increasing disturbances, alterations in species distributions and relationships, and compounding forest health threats

For four CFAA programs, the priority service areas are within the Wildland-Urban Interface/Intermix although their target audiences may differ somewhat:

- **Stewardship** works with landowners to manage their forests, and keep their property as working lands;
- **Forest Health** focuses on introduced and invasive pests/diseases/plants, since the interface is often where they appear and are more easily spread via human transport and developed corridors;
- **Fire** targets wildfire risk planning since most fires in Rhode Island are ignited by humans in the interface and intermix;
- **Urban & Community Forestry** conveys the importance of maintaining and planning for green space to limit the negative effects of landscape use change.

The **Forest Legacy** Program's priority parameters are not the same as the other four programs, but the general area is quite similar, mainly the forests within the western and eastern areas of Rhode Island and has not changed from the boundaries initially established in 1993.

Highlights from the Rhode Island 2020 Forest Action Plan include:

- Rhode Island's forest land began to increase in the late 1800s until the mid-1900s as livelihoods shifted from farming to industry and manufacturing. A slow decrease in forest land acres has occurred since the 1970s due to permanent land-use conversions for development and infrastructure.
- 75% of Rhode Island's trees range from 40-80 years old with only 2% between 0-20 years. This disparity affects wildlife needing early successional habitat, and also indicates fewer landowners are harvesting for timber production.
- An average acre of Rhode Island forest land absorbs 1.3 metric tons of atmospheric carbon.
- Rhode Island's forest land is predominantly held in private ownership. An estimated 38,000 families and individuals own 68% of Rhode Island's forest land.
- 70% of Rhode Islanders get their drinking water from reservoirs protected by forests.
- RIDEM's Divisions of **Forest Environment** (DFE) and **Fish and Wildlife** (DFW) manage more than 57,000 acres of state-owned forests.
- DFE provides services to private landowners with a field staff of 11:
 - 1 State Lands Forester in DFE
 - 1 Stewardship Forester working with private landowners
 - 1 Forest Health Program Coordinator
 - 1 Urban and Community Forestry Program Coordinator
 - 3 staff to maintain of DFE-managed Management Area trails, roads and campgrounds
 - 4 Forest Fire staff delivering training, outreach, plans and prescribed fire, and assisting DFW with prescribed fire
- Invasive pests continue to challenge forest management, whether gypsy moth outbreaks, new arrivals like emerald ash borer in 2018, or looming pests like spotted lanternfly presently spreading aggressively through PA and recently confirmed in NY.
- Of the many benefits provided by green space and natural areas is the human health effects (air quality and urban heat islands) which is important considering that Rhode Island is 11th nationally in ADHD/ADD, and 9th in asthma conditions per capita. (Covid-19 has recently emphasized the impact of impaired lung capacity and has highlighted economic disparities in community impact.)

There are many challenges facing Rhode Island, and the Division of Forest Environment, to meet the goals set out in this Forest Action Plan; most significantly, the lack of adequate funding and sufficient staffing levels. But the magnitude of the challenges to the State are beyond the actions on any one Division or Department, requiring collective commitment and action.

Rhode Island's Challenge

Concerted action is needed to keep one of the state's signature resources – its forests – intact, financially viable, and contributing the many values and public goods they provide. In the face of anticipated changes in the global climate and economy, each extant acre of forest is important, having intrinsic value, and contributing to the sustained health and well-being of the state's citizens, communities, forest products industry and forest-based tourism, and ecosystems.

Healthy forests are inextricably linked to healthy urban and rural communities and an intact natural landscape offers the best opportunity for both mitigating and adapting to climate change. A top priority for all Rhode Islanders must be to ensure that this regionally important forest resource will remain intact, healthy, productive, profitably and sustainably managed, and accessible to all segments of society.

Resources are needed to ensure that forest land is sustainably managed and maintained for the benefits to all residents. This is not something that can be accomplished by the Division of Forest Environment alone, nor even Rhode Island's Department of Environmental Management. This action requires the continuing financial commitment of federal, state, local, private, and philanthropic partners, all having a substantial stake in the outcomes, as noted in the [Blue Ribbon Commission on Land Conservation: 2010 Report to the Governors](#) and adapted below.

PRIMARY PRIORITY: Keeping forests as forests

FUND & SUPPORT

1. Promote and fund state-wide forest planning with emphasis on sustainable private forest conservation and management.
2. Make the working lands of Rhode Island more profitable and financially viable by growing more wood, cultivating new businesses, and creating and strengthening markets for their products.
3. Mindful of global economic and climate change: enhance economic, environmental, and social resilience across the state, to create more prosperous and sustainable industries and communities throughout Rhode Island.
4. Serve the interests of environmental justice, making the landscape and all its benefits more accessible to underserved populations; and our settled places, more livable and healthier, to discourage sprawling development patterns.
5. Provide technical assistance to the DEM Land Acquisition Committee, supporting protection of critical forest habitat, particularly larger intact blocks of high value forests for multiple benefits including connectivity and protection of wildlife habitat, and reduction in forest fragmentation.

EDUCATE & PARTNER

6. Strengthen the connections in the daily lives of the people of Rhode Island, whether residents, landowners, farms or businesses, and the land that supports them, to the mutual benefit of each.
7. Encourage the public to see themselves as part of, and not apart from, Rhode Island's natural heritage; educate them to its many values and public benefits and wise uses; and cultivate a conservation ethic as an active duty of citizenship.
8. Recognize the values and contributions of our urban forests and assure coordination and collaboration with this community to realize their full complement of benefits.

Rhode Island has a wealth of engaged and passionate natural resource professionals, non-profits, landowners, and residents involved in private forest land conservation and management. It is hoped that the 2020 Forest Action Plan will serve as a platform to build support, action and funding for state-wide forest planning and management beyond RIDEM's Division of Forest Environment.

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Rhode Island 2020 State Forest Action Plan

INTRODUCTION

The Rhode Island 2020 Forest Action Plan is part of a nationwide strategy that codifies the national priorities of federal and state private forestry programs. The [Cooperative Forestry Assistance Act \(CFAA\)](#) was amended by the [Food, Conservation, and Energy Act of 2008](#), commonly referred to as the 2008 Farm Bill, to require that states and territories assess all forest land within their boundaries, and develop strategies to improve the health, resiliency, and productivity of their forests, starting in 2010.

These statewide forest assessments, or forest action plans (SFAP), are required for maintaining eligibility to receive funds under the authorities of the Act, through the USDA Forest Service [State and Private Forestry \(S&PF\)](#), and must be updated every 10 years. The SFAPs provide an analysis of forest conditions and trends, identify issues and priorities, and outline strategies to ensure healthy trees and forests into the future. The SFAP must also address the three national S&PF priorities included in the 2008 Farm Bill:

- **Conserve** and Manage Working Forest Landscapes for Multiple Values and Uses
- **Protect** Forests from Threats
- **Enhance** Public Benefits from Trees and Forests

The Rhode Island 2020 State Forest Action Plan is comprised of two distinct sections:

1. **ASSESSMENT**

The Assessment section provides a discussion of Rhode Island's forest-related conditions, trends, and opportunities and is aimed at ensuring that federal and state resources are being focused on high priority areas with the greatest opportunity to achieve meaningful outcomes.

- a. **Forests, Conditions & Trends** contains current information and data, discusses current forest conditions, ownership and use trends, and the benefits derived from healthy forests.
- b. **Issues, Threats & Opportunities** discusses the priority issues impacting the health and management of forests and forest land.
- c. **Priority Landscape Areas in Rhode Island** identifies the target areas for the programmatic cooperative forestry activities.
- d. **Multi-State Priorities** lists Rhode Island's regional and national engagement efforts.
- e. **Stakeholder Engagement** describes the input into the SFAP priorities and stakeholder process.

2. **STRATEGIES**

The Strategies section provides short- and long-term plans for investing state, federal, and other resources to where it can most effectively stimulate or leverage desired action and engage multiple partners. The strategies are built on the understanding that forests are long-term investments that need near term actions to contribute to progress over decades with which a comprehensive and coordinated approach will improve effective progress.

- a. Goals and Objectives, addressing the three national priorities, have been developed for each of the cooperative programs of Fire, Forest Health, Stewardship, and Urban Forestry. Each program has identified strategies within its capacity and its priority areas.
 - i. A summary matrix is provided in this section.
 - ii. A matrix of the correlation of the Goals and Objectives with the Department of Environmental Management's *Strategic Plan 2019-2022* is in [Appendix D](#).
- b. The Forest Legacy Program's *Assessment of Need* is attached as [Appendix F](#).

Taken together, Rhode Island will use the State Forest Resource Assessments and Strategies to target program delivery and develop competitive proposals for addressing priority landscape areas and issues.

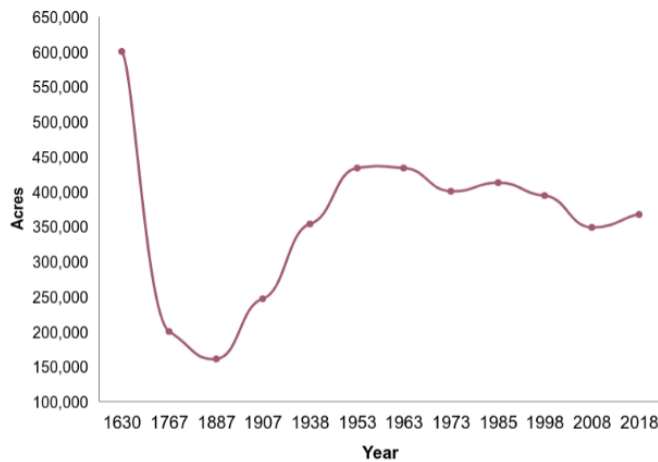
Rhode Island

2020 State Forest Action Plan: Assessment

FOREST CONDITIONS & TRENDS

Forest management planning is not a static process; it is a dynamic one, responding to changes wrought by:

- events that transcend local forest systems, like hurricanes, droughts, and other natural disasters;
- pests or diseases, such as gypsy moth or emerald ash borer, that impact trees directly, threatening the forest health or productivity; and
- invasive plants, changes in weather and precipitation patterns, or wildlife browse, that impact the growing conditions and success of tree establishment and growth.

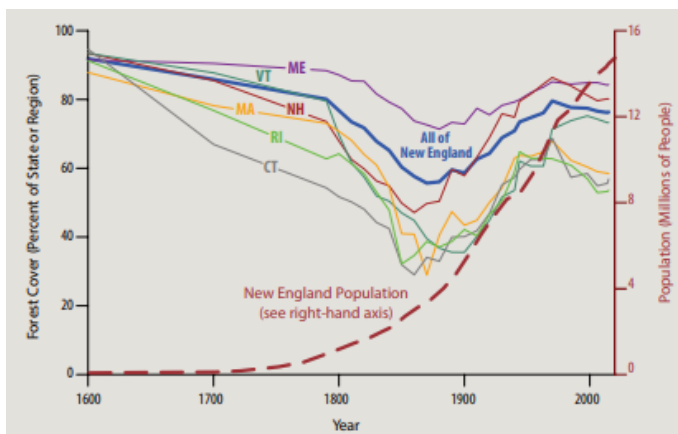


Approximate Forest Area in Rhode Island 1630-2018

Sources: *RI Wildlife Action Plan*; *Forests of Rhode Island, 2018*

Some of these events are abrupt, showing consequences in hours or days, while others progress for years with increasing impact and management implications.

Historically, Rhode Island was mostly forested by deciduous trees, primarily oaks, hickories, and red maple, with ~15% being coniferous forests comprised of white pine, pitch pine, and hemlock. This forest acreage has waxed and waned over the history of human residence. Native American forest activities on and within the forests impacted land cover significantly less than natural events like wildfire. By comparison, colonization in the early 1600s resulted in nearly 100% of forest land being cleared over the next ~125 years, reaching its lowest point in the late 1800s.



New England Forest Cover and Human Population

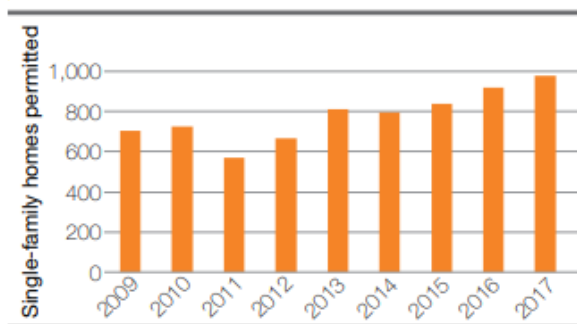
Source: *Wildlands and Woodlands, Farmlands and Communities: Broadening the Vision for New England*

Not solely confined to Rhode Island, this pattern of land clearing occurred throughout New England: a decrease in forest land associated with population growth, followed by a rebound in forest land as farmland was abandoned, populations migrated, and social shifts like wars, the Great Depression, and industrialization occurred. By the mid-20th century, the reforestation of 67% of Rhode Island had occurred, as small-scale farming as a livelihood did not recover in the post-war, post-industrial years.

However, forest land acreage began to shrink again in the 1970s, which the [Department of Administration Division of Statewide Planning](#) attributes to changing development patterns:

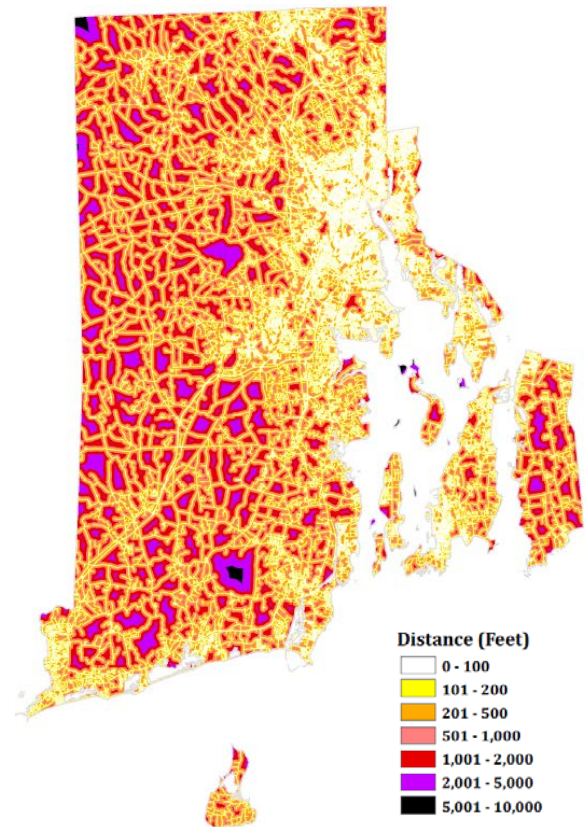
- smaller households but larger houses, consuming more land per house;
- population movement from urban to rural areas, expanding the impacts of development into rural and forested areas; and
- commercial land use, which has almost doubled, extending into less developed parts of the state and concentrated along heavily traveled roadways.

Historical information and aerial photography shows that the rate of permanent land conversion in Rhode Island has been [increasing since the 1960s](#) with more development of residential, commercial, and industrial land between 1970 and 1995 than in the previous 325 years. Even as recovery from the Great Recession has been slow, single home construction has increased by [9% yearly since 2011](#). Rhode Island already has [6,027 miles of permanent roads](#), as communities expand and increase, the supporting gray infrastructure must also increase to support the population (schools, roads, businesses, etc.), which comes at an environmental cost.



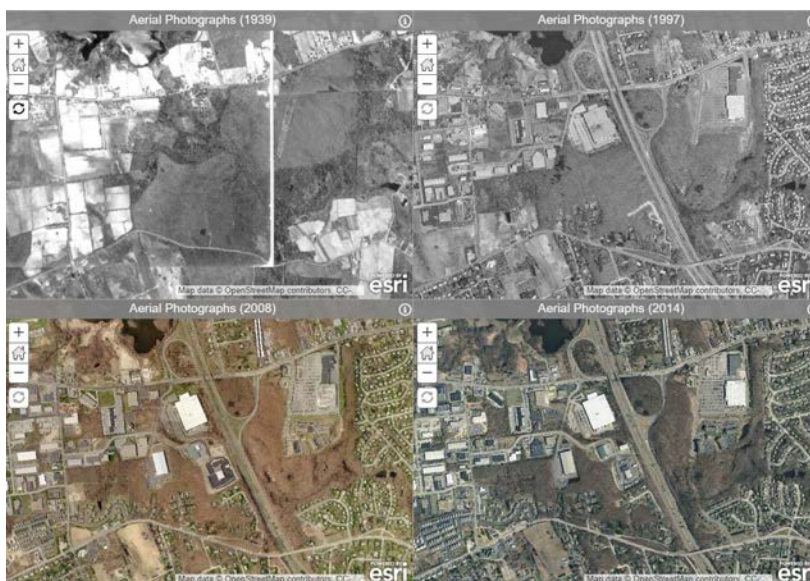
On average, single-family home construction in Rhode Island has increased since 2012.

Source: [HUD PD&R Housing Market Profiles: RI](#)



Distance to Nearest Road

Source: Peter August, Department of Natural Resources Science, University of Rhode Island



The photo series on the left depicting land use change along Interstate I295 at Plainfield Pike (Route 14) (years: 1939, 1997, 2008, 2014), clearly shows the increase in gray infrastructure needed to support increasing populations and residents, services and transportation.

Rhode Island Forests

The *Rhode Island 2020 Forest Action Plan: Assessment* utilizes historical [USDA Forest Service \(USFS\) Forest Inventory Analysis \(FIA\)](#) data to maintain a consistent description and to directly compare historical acreage estimates to the present. The Rhode Island [Department of Environmental Management](#) is moving towards land-use estimates, assumptions, and definitions based on the DOA/DEM/RIGIS 2011 Landuse/Landcover (LULC) data and DEM land records, as used in the 2015 Division of Fish & Wildlife's [Wildlife Action Plan \(RI WAP\)](#), for future statewide forest management estimations, as new mapping methods and technology become available to the Department. [Appendix A](#) describes these methodology differences.

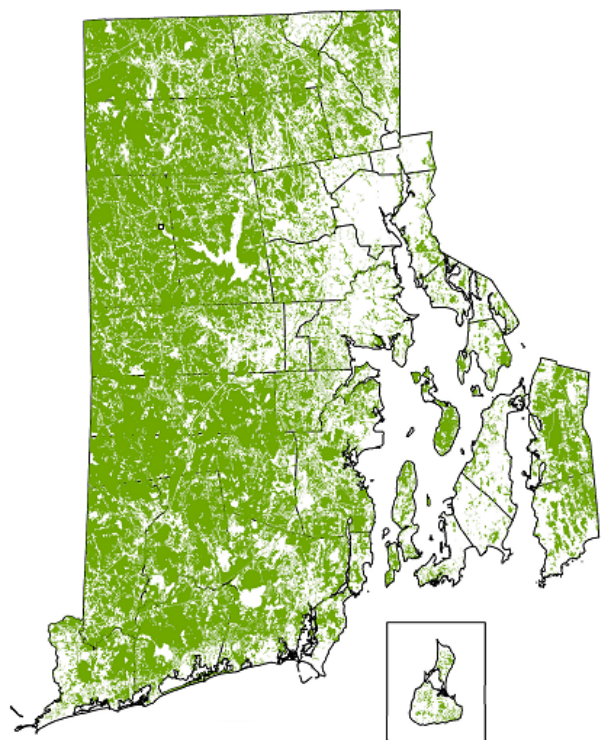
The first USFS FIA survey in Rhode Island was completed in the 1950s. Since 2003, annual FIA sampling updates and reports have included data on the status and trends in forest area and location, estimation of species, tree size, and health of trees; total tree growth, mortality, and removals by harvest; wood production and utilization rates by various products; and forest land ownership.

The status of Rhode Island's forests is based on FIA estimates, where 1/7th of the permanent plots are assessed each year. This [annualized forest census](#), carried out nationally, projects how forests are likely to appear 10 to 50 years from now and enables evaluation of the sustainability of current forest management practices.

According to the most recent FIA report, [Forests of Rhode Island, 2018](#), Rhode Island contains an estimated 366,958 acres of forest land – 53% of the total land area of the state. Rhode Island's forests are considered second growth and approximately 96% is classified as timberland, forest land that exceeds the minimum level of productivity and is available to harvest.

Since FIA collects data on a rolling average the data may be affected by denial of access to properties, the spreading out of mortality and recovery updates, or changes to data collection protocols as technology and applications advance. Rhode Island, a small state, is subject to a higher sampling error (3.5 - 4.0% typically for forest land estimates) than larger states. These factors must be kept in mind when viewing the change in the acres of forest land in the state. The estimated 356,000 acres of forest land discussed in the [2010 State Forest Action Plan](#) is now estimated to be ~367,000 acres in the [Forests of Rhode Island, 2018](#) report.

While the 2018 FIA forest land estimate of 367,000 acres shows an increase from 356,000 acres in 2007, this may be partly accounted for by the explanation of changes in FIA protocols. This estimated increase in acres should not be assumed to indicate that forest land and habitat have increased (or are increasing) and are not at risk.



Extent of Forests in Rhode Island

FOREST TYPES & SPECIES COMPOSITION

Undisturbed forest composition tends to change slowly, with forest succession as the main agent of change, barring large-scale tree loss events, such as wildfires or storms. Rhode Island forests have not been

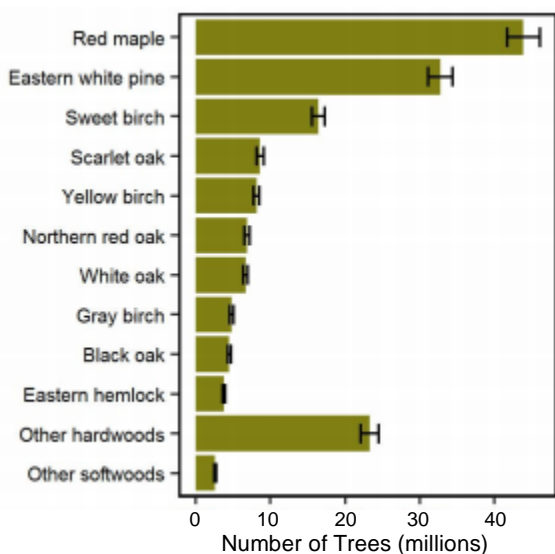
substantially affected by such catastrophic events since the 1960s. However, forest composition has been affected by widespread pests and diseases, including chestnut blight (*Cryphonectria parasitica*) and Dutch elm disease (*Ophiostoma ulmi*). More recently, the gypsy moth infestations from 1980-86 impacted ~3/4s of Rhode Island's canopy, contributing to a subsequent documented increase in the number of red maples reported in USFS FIA data. The recent gypsy moth outbreaks (2015-2018) and the occurrence of emerald ash borer (confirmed 2018) is anticipated to affect forest species composition, resulting in a decrease in the overall presence of oak species and of all ash species being extirpated. The impact on future forest composition is expected to increase in the proportion of pioneer species such as red maple, black cherry and black birch in the future forests of Rhode Island.

The significance of the most recent mortality events on forest species composition may not be completely apparent until a full 7-year panel of FIA data has been collected, post gypsy moth outbreak. As EAB spreads throughout the state and mortality is documented, the full impact of the loss of multiple species of ash in natural and urban areas will take time to be fully realized and assessed.

These mortality events will also impact sawtimber volume and numbers, with additional impact from the expected heavy deer browse on future forests. USFS FIA surveys have noted a lack of understory seedlings in the permanent sample plots revisited, which suggests that there may be an effect on the establishment of tree species regeneration.

Rhode Island's forests contain a wide variety of tree species with over 46 species sampled in 2017. Red maple is the dominant tree species by number, comprising 27% of the tree stems in the state. Other common species include eastern white pine, black birch, scarlet oak, and yellow birch, accounting for 67% of the trees by number. The most commercially valuable species are Eastern white pine and red oak, making up 56% of the wood volume.

With respect to forest type, oak-hickory forest (dominated by red, black, scarlet, and white oak) comprises 61% of the forest, decreasing from earlier FIA data (66 % in 1972). Red pine/white pine forests have also decreased (from 12 % to 9 %) in that same timeframe. This decrease coincides with increased harvesting activity shown in DFE *Intent to Cut* records as red pine plantations were salvaged, due to the effect of the red pine scale. By 2010, the "other softwoods" category had almost disappeared from harvesting reports. Other forest types, like pitch pine and Atlantic white cedar, make up a small percentage (~3+%) of Rhode Island's forest but have high importance due to their value as wildlife habitat.



Number of Trees ≥ 1-inch DBH by Species
Source: *Forests of Rhode Island, 2017*

Forest-type group	All size classes of forestland (% of land cover?)
White / red / jack pine	8.8%
pitch pine	3.2%
Oak / pine	5.3%
Oak / hickory	61.0%
Oak / gum / cypress	6.3%
Elm / ash / cottonwood	4.7%
Maple / beech / birch	6.4%
Aspen / birch	1.9%
Other hardwoods	1.5%
Nonstocked*	0.9%
Total	100.0%

* Nonstocked Areas: Timberland Less Than 10% Stocked with All Live Trees
Source: *Forests of Rhode Island, 2017*

USFS FIA FOREST TYPE DESCRIPTIONS

White-red-jack pine: Forests in which eastern white pine, red pine, or jack pine, singly or in combination, comprise a plurality of the stocking. Common associates include hemlock, aspen, birch, and maple.

Pitch pine: not an FIA forest-type group, but pitch pine falls under the loblolly/shortleaf pine group and it would be misleading to use that name when neither of those species are present in Rhode Island.

Oak-pine: Forests in which hardwoods (usually upland oaks) comprise a plurality of the stocking, but in which pine or eastern redcedar comprises 25-50 percent of the stocking. Common associates include gum, hickory, and yellow-poplar.

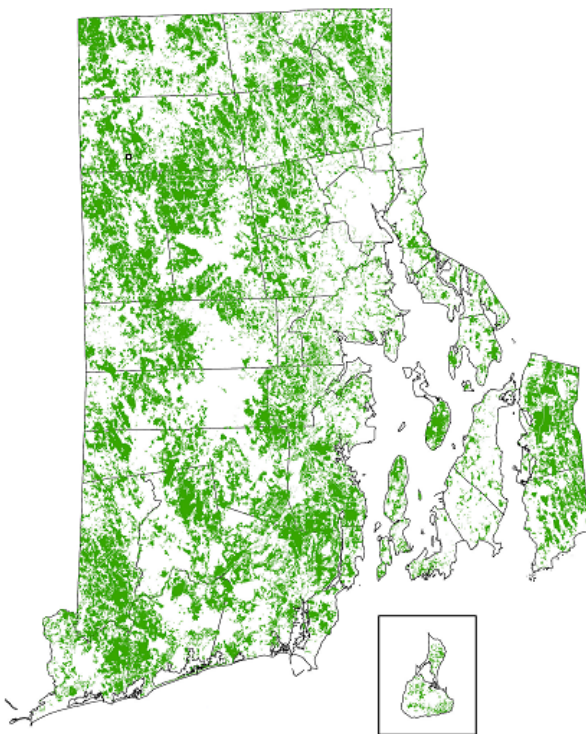
Oak-hickory: Forests in which upland oaks or hickory, singly or in combination, comprise a plurality of the stocking except where pines comprise 25-50 percent, in which case the stand is classified as oak-pine. Common associates include yellow-poplar, elm, maple, and black walnut.

Elm-ash-cottonwood: Forests in which elm, ash, or cottonwood, singly or in combination, comprise a plurality of the stocking. Common associates include willow, sycamore, beech, and maple.

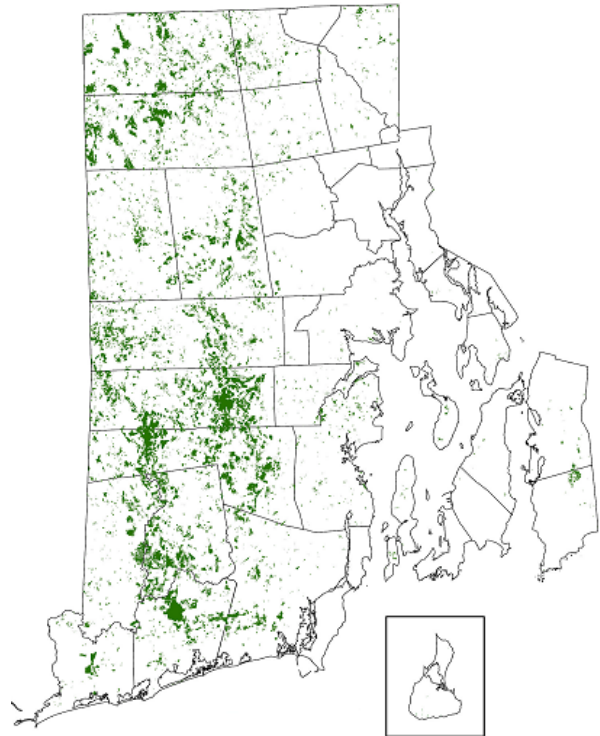
Oak-gum-cypress: Bottomland forests in which tupelo, blackgum, sweetgum, oaks, or southern cypress, singly or in combination, comprise a plurality of the stocking except where pines comprise 25-50 percent, in which case the stand is classified as oak-pine. Common associates include cottonwood, willow, ash, elm, hackberry, and maple.

Maple-beech-birch: Forests in which maple, beech, or yellow birch, singly or in combination, comprise a plurality of the stocking. Common associates include hemlock, elm, basswood, and white pine.

Aspen-birch: Forests in which aspen, balsam poplar, paper birch, or gray birch, singly or in combination, comprise a plurality of the stocking. Common associates include maple and balsam fir.



Distribution of Deciduous Forests

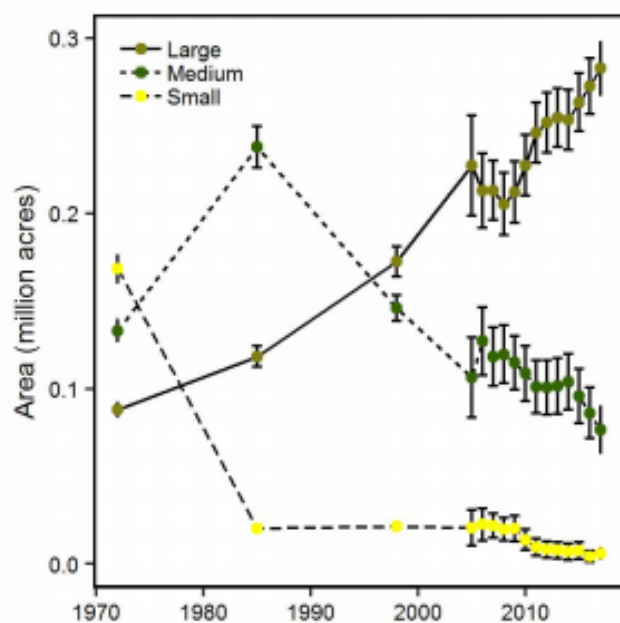


Distribution of Coniferous Forests

FOREST AGE/MATURITY

The [Forest Futures Dashboard](#), using 2007 FIA data, estimates that northern forests, as a whole, lacks age-class diversity. In Rhode Island over 75% of its trees are 40-80 years old. Only 1% of RI's trees are estimated to be older than 100 years which, given the potential longevity of most tree species, is still comparatively young. Of greater concern is the extremely low 2% of trees in the 0 to 20-year range – the future forest. In fact, Rhode Island has the lowest proportion of old and young trees of any of the 20 northern states included in the assessment. Depending on the level of regeneration success, over time we expect to see an increase in acres of early successional habitat due to mortality and crown opening caused by the 2015-18 gypsy moth outbreak.

Age of Timberland	
More than 100 yrs	1 %
81-100 years old	11 % █
61-80 years old	54 % ██████████
41-60 years old	23 % ████████
21-40 years old	9 % █
1-20 years old	2 %



Area of Timberland by Stand-Size Class

Source: [Forests of Rhode Island, 2017](#)

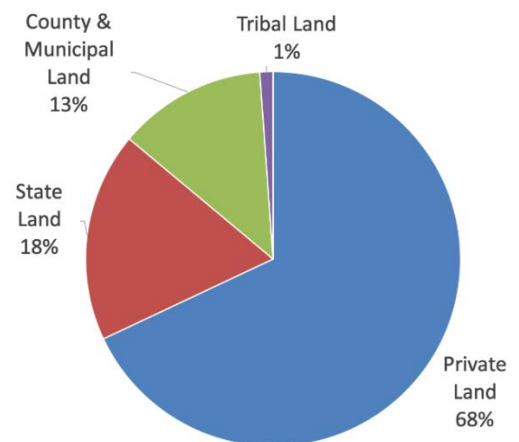
Ten years later, the [Forests of Rhode Island, 2017](#) report indicates that the trend continues with 77% of the timberland large or sawtimber size (over 9 inches in diameter at breast height for softwoods and 11 inches for hardwoods), 21% medium or pole size (5 to 10.9 inches) and 2% small, or young, regenerating trees (less than 0.5 inches).

Rhode Island has had relatively few stand replacing events over the past few decades contributing to the overall maturing of Rhode Island's forests; a large percentage of the forest land is in the largest stand size class and steadily increasing. This has significant implications for forest resilience (i.e., the ability of the forests to withstand severe weather events or insect infestations), wildlife habitat/diversity, and other ecological functions.

Forest Ownership

Rhode Island's forests are owned and managed by a combination of federal agencies and programs, state agencies and programs, national and local land trusts and other conservation organizations, and private landowners.

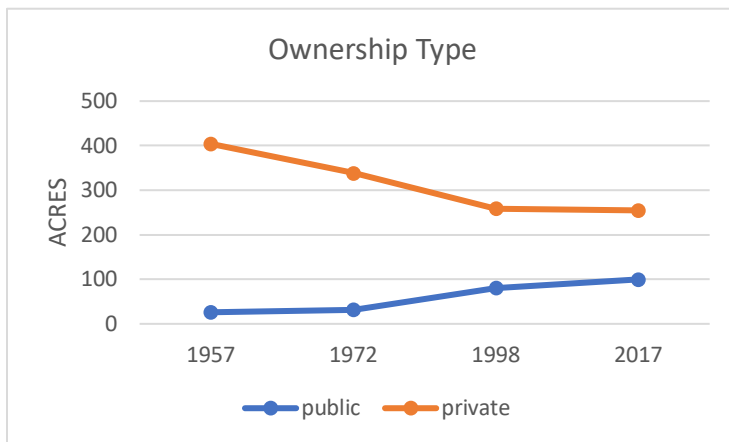
A [USDA Forest Service Report from 1957](#) estimated that 94% of Rhode Island's forests were privately owned. [By the late 1980s](#) private ownership had decreased to 85% and continues to decrease. The [2020 State and Private Forestry Fact Sheet](#) for Rhode Island states that approximately 68% of forest land is privately owned and managed by an estimated 38,000 landowners, including conservation organizations and nonprofits.



Forest Ownership in Rhode Island

Sources: [Forests of Rhode Island, 2017](#) and [USFS FIA Estimate Tables](#)

This decrease in privately owned forest can be attributed to both conservation efforts by public agencies, and the pattern of land ownership shifting from subdivisions of large ownerships (with an average parcel size of 26 acres in 1973 to 17 acres in 2012). The [2012 Forests of Southern New England](#) report estimates that evaluating only privately-owned parcels greater than 10 acres in Rhode Island, parcel size is about 27 acres, lower than in the past, and lower than the average size in southern New England of 34 acres.



Total Public and Private Ownership

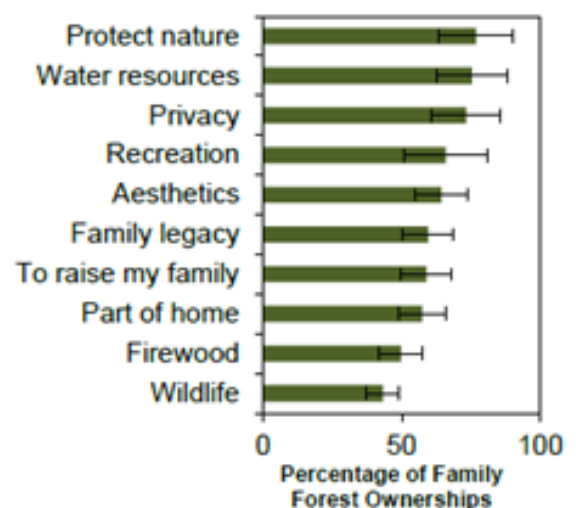
Source: [Forests of Southern New England, 2012](#)

The 2003 Statewide Planning Analysis of land use found 15 communities in Rhode Island with less than 25% developed land area, classifying them as rural. The analysis included a [survey of landowners](#) owning more than 10 acres:

- 37% owned less than 20 acres
- 22% owned less than 30 acres.

The 2003 survey found most Rhode Island forest owners live on their land and 90% of respondents agreed that a place of residence was the most important reason for owning forest land. Other popular reasons for owning forest included investment (42%), recreational use (41%), forest products (33%), and hunting/fishing (19%).

Ten years later, a comparison to the USFS [2013 National Woodland Owner Survey](#) shows that the reasons for owning and retaining forest land has not changed, with owners still primarily concerned with beauty, nature, legacy, privacy, and investment:



Reasons for Owning Forest Land, Family Forest Ownerships 10+ Acres, 2011-2013

Source: [Forests of Rhode Island, 2013](#)

- Most respondents lived on their land (64%) and owned it for the lifestyle it provided (enjoying beauty and scenery)
- Harvesting wood products were not as important as the other amenities (36%)
- Using it for timber products was even less important (18%)
- Other reasons for owning were to protect water (73%), protect nature and biologic diversity (73%), and protect wildlife (55%)

[Additional research](#) by the American Forest Foundation suggests that landowners who are actively involved with their land are less likely to engage in activities that often have negative conservation impacts (such as selling, subdividing, or developing land).

FOREST OWNERSHIP & PARTNERSHIPS: FEDERAL, STATE, LOCAL AND OTHER ORGANIZATIONS

Federal Agencies

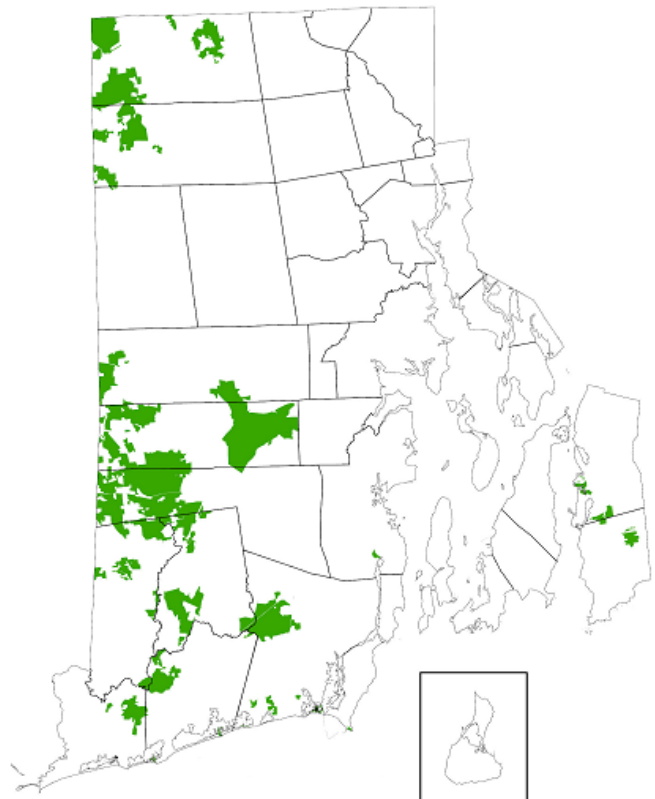
The [USDA Forest Service](#) (USFS) and the [USDA Natural Resources Conservation Service](#) (NRCS) are the main federal agencies responsible for providing or administering funding, research, educational and technical assistance to the state and private citizens for the management of rural and urban forests, as authorized by the Farm Bill ([Agricultural Act of 2014 \(P.L. 113-79\)](#)). The Rhode Island [Department of Environmental Management](#) (RIDEM) delivers programs related to Forest Health, Fire, Forest Stewardship, Urban Forestry, and Forest Legacy supported by USFS grant funding. The USFS Northern Research Station is responsible for the FIA program in Rhode Island. NRCS works directly with private landowners providing funding and technical support.

State Agencies

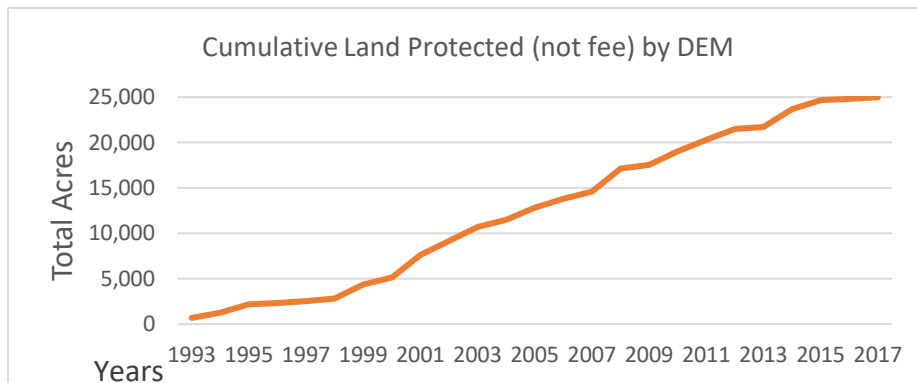
RIDEM permanently protects 73,324 acres of forest land, owning 47,384 acres of forest land in fee, and holding additional interests on 25,940 acres through conservation easements, deeds to development rights, and recreation easements. This protection includes 22 parcels, encompassing 3,583 acres, protected through conservation easement or fee purchase by the Forest Legacy Program, overseen by the Division of Planning and Development. DFE is represented on the DEM Land Acquisition Committee and advocates for the acquisition of large forested parcels, as prioritized in the DEM Land Conservation Plan.

The Division of Forest Environment (DFE) is the main agency charged with overseeing the state’s forest resources, managing 40,000 acres of state-owned forests. Through DFE, federal funds and state match are used to administer the [Farm, Forest and Open Space](#) (FFOS) Program to meet national priorities for the management of private forest land; for fire protection-related planning and activities; for forest health monitoring and response to insects and disease; and for delivery of an Urban & Community Forestry Program.

The graph on the right shows trends in land acquisition by DEM although most of the acquired land DEM is farmland or open space with recreational potential.



RI DEM Management Areas



Total Acres Owned by DEM from 1993 to 2017

Municipal and Local Governments

Based on [2010 census](#) data, Rhode Island is ranked the second-most densely populated state after New Jersey. Forest land owned by local government is important when considering the full picture of forest cover in Rhode Island as it includes [urban forests](#) as well. In 2006, the Statewide Planning Program developed the [Urban Services Boundary](#) as a GIS overlay, defined as the general extent of the area where public services supporting urban development presently exist, or are likely to be provided, through 2025. Comprising 13% of land ownership in Rhode Island, natural areas owned by local governments may be held for expansion or buffering of existing natural resources, or set aside for future parks, cemeteries, hospital grounds, schoolyards. Urban forests are not defined as an ecological community, overlooked as a natural resource, but are increasingly identified as contributing to the well-being and environmental goals of residents.

Land Conservation Organizations and Other Public Institutions

Land conservation organizations and agencies – including [The Nature Conservancy](#) (TNC), [Audubon Society of RI](#) (ASRI), municipal and private land trusts, municipal governments, private homeowner associations, [Providence Water](#), and the [University of Rhode Island W. Alton Jones Campus](#) – hold varying degrees of protection on 51,616 acres. Most of this land is permanently protected in fee or through easements, but some land held by land conservation organizations or other institutions has no legal mechanism in place for permanent protection.

Rhode Island has over 45 active land trusts (community-based organizations which protect farms, forest land and open spaces by purchasing easements and/or acquiring land). Supported by the Rhode Island Land Trust Council, a statewide coalition, land trusts monitor their properties and easements to ensure that the lands are being properly conserved and managed.

Non-Profit Organizations and Other Assistance

Private landowners work with several organizations and programs that provide financial and technical assistance to help with the management and stewardship of their forests including:

[Rhode Island Forest Conservators Organization](#) (RIFCO) – RIFCO is dedicated to the protection and wise use of Rhode Island’s woodland resources, promoting stewardship of Rhode Island’s wooded lands and watersheds and better awareness of the role of a healthy forest and provides information and education to the public on issues affecting forest land. RIFCO members include natural resource professionals, land trust and forest product industry representatives, and citizens concerned with forest conservation issues.

[Rhode Island Association of Conservation Districts](#) (RIACD) – RIACD supports the three conservation districts in the state ([Northern](#), [Southern](#) and [Eastern](#)).

The [Rhode Island Tree Council](#) (RITC) – RITC cooperates closely with USFS and DFE, supporting the Urban and Community Forestry program through partnership and collaboration. RITC also works with businesses and municipalities to implement tree planting and stewardship programs across the state.

[Rhode Island Resource Conservation & Development Area Council](#) (RIRC&D) – Among the many efforts of RIRC&D supporting state landowner programs, includes education to benefit forest landowners such as the RI Coverts Project, Small-scale Forestry Project, Forestry for the Birds, and Women Owning Woodland.

The [Rhode Island Woodland Partnership](#) (RIWP) – RIWP is becoming an integral part of DFE’s delivery and engagement. The goal of the Partnership is to collaborate, sharing support and expertise to advance the stewardship and long-term protection of Rhode Island’s woodlands for the benefit of the local economy, ecological values, and community enjoyment and health. RIWP is comprised of foresters, landowners, non-profit organizations, small businesses, conservationists, and professionals who represent public agencies. The nature of the RIWP membership, and the small size of the state, allows RIWP to act as both the Stewardship Advisory Council and the [Forest Ecosystem Monitoring Cooperative’s](#) (FEMC) State Partnership Committee. RIWP is also actively involved with the [Regional Conservation Partnership](#) network.

[American Tree Farm System](#) – The ATF Program certifies private landowners actively managing their forests and promoting sustainable stewardship on their lands. In Rhode Island, this is currently a recognition-only program, without certification. The [RI Tree Farm Database](#) currently lists 250 Tree Farms in Rhode Island with a total of 18,112 acres certified. 140 of the 250 Tree Farms are listed under FFOS, with 9,595 acres managed under both programs.

The [Sustainable Forestry Initiative](#) (SFI) and the [Forest Stewardship Council](#) (FSC) – SFI and FSC provide certification programs intended to ensure that forest products come from responsibly managed forests using sustainable methods. Both organizations provide standards and certification for forest management and chain of custody, tracing the path of forest products through the supply chain. In Rhode Island, 1,783 acres of forest land are managed sustainably under FSC certification. Four Rhode Island-based companies are certified under SFI for sourcing and Chain of Custody.



Photo credit: Megan Ruggieri

Forest Resource Management

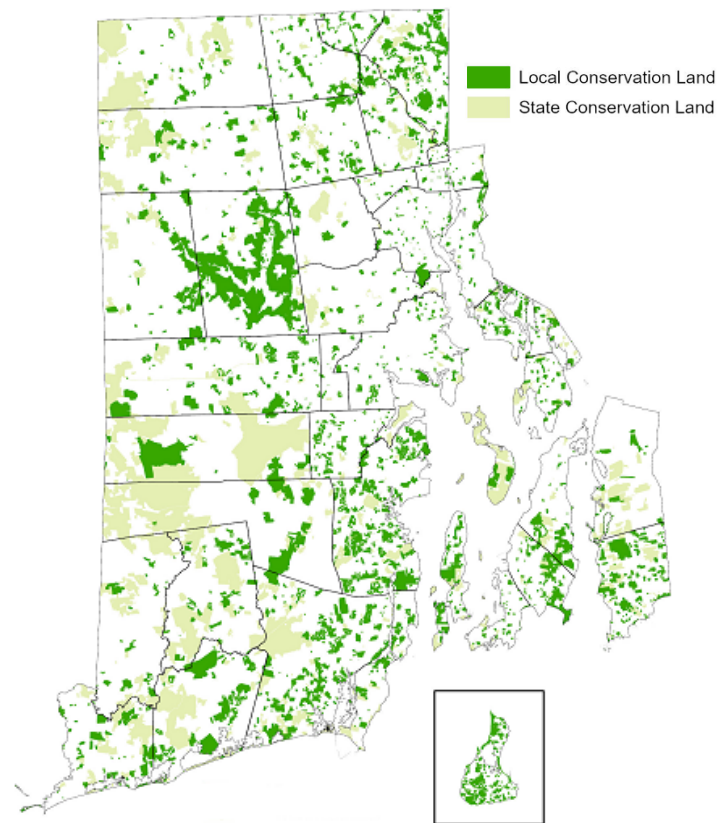
Given that much of Rhode Island's exurban and rural forests are still privately owned, they provide the greatest land area opportunity for active management. As noted previously, landowner surveys indicate that family landowners care about the value of their land for wildlife habitat, as compared to traditional uses such as hunting and cutting firewood. However, timber harvesting and other products can earn landowners' income to offset property taxes and land management costs. A lack of awareness and education may serve as an initial barrier to engaging in active management. Access to technical expertise and financial resources can also be challenges for private landowners pursuing active stewardship of their land.

Professionals or specialists are more commonly involved with managing public and institutional lands than for smaller private properties though budget levels and funding constraints can similarly limit active forest management on these larger properties as on privately owned ones. While the management of public forests typically depend on staffing and budget levels, some public and institutional owners do not actively manage their forest lands simply because there are other pressing priorities. Municipalities typically lack professional natural resources managers, resulting in forest management being a lower priority compared to other public services. This leaves management projects dependent on grants or periodic funding, and available staff to administer.

Conservation land in Rhode Island includes both small tracts and larger properties. A few large conservation organizations such as TNC and ASRI own reserves in Rhode Island, but the majority of private conservation land is held by small land trusts, many of which do not have paid staff. Therefore, conservation landowners can have much in common with smaller private landowners when it comes to land stewardship.

RIDEM's Divisions of [Forest Environment](#) (DFE) and [Fish and Wildlife](#) (DFW) manage more than 40,000 acres of state-owned forests, and the DFE is further taxed with providing services to private landowners with a field staff of 11, reduced significantly in recent years through attrition:

- 1 State Lands Forester in DFE who also works with DFW with forest management and harvesting
- 1 Stewardship Forester working with private landowners and FFOS
- 1 Forest Health Program Coordinator
- 1 U&CF Program Coordinator
- 3 staff to maintain of DFE-managed Management Area trails, roads and campgrounds
- 4 Forest Fire staff delivering training, outreach, plans and prescribed fire, and assisting DFW with prescribed fire



State and Local Conservation Land

FOREST RESOURCES ECONOMIC IMPACT

The wood products sector and the forest-based recreation sector both derive economic benefits from forest land. Rhode Island’s forest and wood products sector include commercial loggers, arborists, foresters and forestry consultants, sawmills, wood products manufacturers, wood workers, and tree farms.

One measure of active forest management is the amount of timber harvesting on forest land. Net growth in Rhode Island’s forests exceeds removals from timber harvests, according to [Forests of Rhode Island, 2017](#):

Annual net growth of live trees ≥5 in d.b.h. (thousand ft ³ /yr)	14,811
Annual mortality of live trees ≥5 in d.b.h. (thousand ft ³ /yr)	6,419
Annual removals of live trees ≥5 in d.b.h. (thousand ft ³ /yr)	2,939

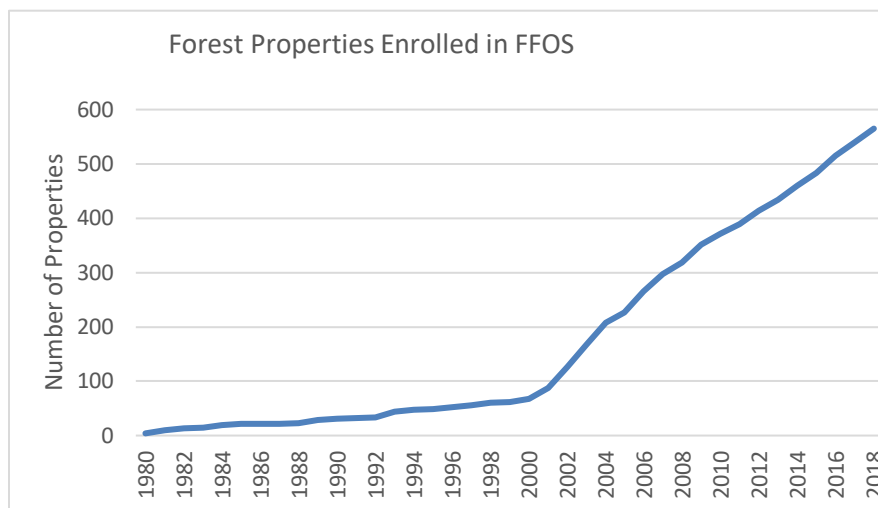
RIDEM has collected data on commercial timber harvests since 1997 through its *Intent to Cut* notification process. Over the 21-year period from 1997-2017, an average year reported harvesting on 2,068 acres, removing 3 million board feet of sawtimber and 3,824 cords of low-grade wood per year. The average harvest occurred on 33 acres and yielded 56,000 board feet and 71 cords. The *Intent to Cut* data indicates low levels of active forest management on private lands, suggesting several possible issues:

- lack of financial and technical knowledge barriers
- lack of markets
- lack of interest or awareness of the potential benefits.

Rhode Island’s forest-based economy does not receive the same support or attention that other agricultural-based businesses do, even though the forest industry and forest products are considered an agricultural commodity. For example, the [Local Agricultural Seafood Act \(LASA\)](#) funded through a public/private partnership between the state and three private foundations, created a small grant program to support the growth, development, and marketing of local food and seafood in Rhode Island by providing farmers with funding for equipment, organizational capacity-building, and marketing of their operations. Absent from the LASA is support for Rhode Island’s local forest-based products industry.

The [Farm, Forest, and Open Space \(FFOS\)](#) Program, which offers lower tax assessment based on current land use, is the main support for forest landowners. Managed through the Forest Stewardship Program, the forest land component of the FFOS allows local governments to reduce property taxes for forest landowners who implement an approved Forest Stewardship or Forest Management Plan. Interest in this program has increased as property tax assessments increase.

Of the 2,500 eligible landowners (with forest land of 10 acres or more) who can enroll in the FFOS current use tax program under Forest Land Classification, 571 are currently enrolled. As of 2019, over 45,549 acres are managed by private landowners through this program. This does not include adjacent forest land on properties classified under the Farm or Open Space components of the program.



Cumulative Number of Properties Enrolled in FFOS as Forests

More information about the FFOS program can be found in [Appendix B](#).

National, and local efforts, through NRCS and RIDEM also promote forest management on private lands. In addition, the [Forestry Best Management Practices for Water Quality Protection](#) are required to limit non-point source (NPS) pollution from forestry activities but still allow low impact timber harvesting operations on forested wetlands, riverbank wetlands, and perimeter wetlands.

Wood Products

Lumber production in Rhode Island peaked at the turn of the century with [33 sawmills](#) in operation. As late as 1988 there were [16 local sawmills](#) producing 6.6 million board feet of lumber, which decreased to six by 2003. Presently, Rhode Island has three active sawmills and eight portable sawmill operators working around the state. Although the number of local sawmills has decreased, sawmills in neighboring states, and shipment to northern New England and Canada, provide additional markets for Rhode Island forest products. An average of 3.0 million board feet of sawtimber was harvested state-wide per year from 1997 through 2017.

The principal use of harvested trees is for sawtimber, primarily industrial pallets, with the highest quality wood exported for other uses. Softwood logs are processed in state or exported while firewood production provides a market for low quality hardwood trees, harvesting over 3,800 cords per year. The sole pulp mill in Rhode Island closed in 1980 and the distance to out of state mills makes harvesting pulpwood uneconomical. Based on analysis of DFE *Intent to Cut* data (1997-2017), the average commercial harvest in Rhode Island during the last 20 years involved about 56,000 board feet of sawtimber and 71 cords of wood on 33 acres.

The 2019 [Economic Impact of Rhode Island's Forestry and Wood Products Sector](#) reported that the annual gross output of Rhode Island's forestry and wood products sector totals over \$7.2 million and employs 4,844, workers including the spillover effects across all sectors of the state economy. Employment in the forestry and logging sectors is estimated at 90 jobs with gross annual sales of 11.6 million.

Fuelwood

As discussed in the 2015 [Rhode Island Forest Based Economy](#) report, the value to the forest landowner from harvesting trees for fuelwood is very low relative to other products, such as sawlogs. Harvesting and processing firewood can be time consuming and does not yield a substantial return in the market, with firewood averaging around \$200/cord to consumers. With that being said, a [2014 report](#) compiled from census data by the US Energy Information Administration showed a 160% increase in wood used for heating in Rhode Island from 2005 to 2012. The increase may be attributed to the rise in the cost of propane and home heating oil, and the financial crisis of 2008. 2017 Census data estimates 7,145 households (1.7%) in Rhode Island using wood or pellets to heat or augment home heating (*browser search for 2017 link: House Heating Fuel Universe: Occupied housing units 2013-2017 American Community Survey 5-year Estimates*).

Specialty Products

Specialty wood products include trees, or parts of trees, that are not usually considered valuable due to the tree species or low volume. These materials can be turned into valuable products by skilled artisans using materials unutilized by traditional forestry operations. The eight portable sawmills in Rhode Island and additional sawmills in nearby states service a niche market to process trees unmarketable through traditional means into specialty forest products.

While suburbanization and the small size of most parcels make management for traditional wood products difficult for the typical Rhode Island forest owner, a [2003 landowner survey](#) reported that 1% to 5% of landowners have commercially harvested an alternative product such as maple syrup, mushrooms, floral greens, or witch hazel. Witch hazel, a shrub with astringent properties and used in the cosmetics industry, is cut and chipped, and the chips transported to the American Distilling facility in East Hampton, Connecticut for processing. The shrub regenerates readily and can be sustainably harvested for decades generating at least enough revenue to partially offset property ownership expenses.

Sugar maple, the primary tree species used to produce maple products, is not as common in Rhode Island, usually only found along roads and in association with old farmsteads. Still, there are 19 operations that process and sell maple syrup. Red maple, the Rhode Island state tree, is most commonly tapped to produce maple syrup locally, but it has a much lower sugar content and requires more processing. Norway maple, native to Europe, has been widely planted in Rhode Island as an ornamental and street tree and is commonly tapped in Rhode Island because it grows to a large size.

FOREST RESOURCES & RECREATION

Forests play an important role in outdoor recreation throughout the state, supporting both physical exercise and mental health. State Management Areas also provide numerous recreational opportunities such as hiking, hunting, fishing, camping, bird watching, horseback riding trails, etc.



Arcadia Management Area walk-in backpack campsite. *Photo credit: Megan Ruggieri*

A [2018 Parks Study](#) reported that Rhode Island Parks and Management Areas receive over 9 million visitors each year, contributing an estimated \$312 million of economic output and support for over 3,700 jobs. In a survey for the [2019 Ocean State Outdoors State Guide Plan](#), Rhode Islanders expressed a preference for a wide range of outdoor recreation resources. When asked to indicate how important it is to provide various types of park and recreation facilities, Rhode Islanders showed the greatest preference for:

- Wilderness: very important 64%
- Environmental and outdoor education: very important 58%
- Recreation at lakes and ponds: very important 51%
- Trails for nonmotorized activities: very important 50%
- Boat launches: very important 45%

State-owned Management Areas, land trusts, federal wildlife refuges, hunting clubs, and private and non-profit preserves all provide year-round access to forest-based recreational opportunities. The 2015 report [assessing the economic importance Rhode Island's forests](#) estimated that wildlife-based recreational activities contribute an estimated \$375 million dollars in sales annually to the Rhode Island economy and 1,500 jobs with an estimated \$37 million payroll annually. Fall foliage viewing is the largest contributor with 25% of the total sales, followed by: camping, hiking, wildlife viewing, snowmobiling, and downhill skiing.

According to the [2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation](#), approximately 402,000 residents/non-residents participated in wildlife-related recreation (hunting, fishing, and wildlife-watching) in Rhode Island during 2011, spending an estimated \$360 million, with approximately 308,000 residents/non-residents spending \$200 million on wildlife-watching alone. The study also revealed that approximately 36% of Rhode Islanders participated in some form of wildlife-related recreation in that same year. But, as noted in the [RI WAP](#), efforts to estimate the true value of wildlife in monetary terms (not solely by income generated), as with most natural resources, have been met with limited success and significant information gaps, and research needs remain.

Revenue generated from license and permit sales for hunting and fishing, and excise taxes from sporting goods is the easiest to track. These sales support state fish and wildlife conservation programs and are leveraged to match federal Wildlife and Sport Fish Restoration Program dollars, which in turn support outdoor recreational opportunities for hunting, fishing, and boating in Rhode Island. According to DEM [Fish & Wildlife](#), fishers and hunters purchase around 70,000 licenses, permits, stamps, and tags each year, contributing more than \$235 million to the Rhode Island economy.

Interestingly, DFE does not charge fees for the 2 campsites it manages (Backpack and Frosty Hollow). Meanwhile demand is increasing while staff availability to manage, monitor, and maintain sites is severely restricted due to staffing limitations.

Campgrounds

2017 - 326 users
2018 - 486 users
2019 - 678 users

Larger events requiring special permits:

2018 - 155 permits for 75 groups serving 5,963 participants
2019 - 175 permits for 77 groups serving 7,384 participants



Picnic shelter constructed by DFE and the Appalachian Mountain Club at the backpack campsite. Photo credit: Megan Ruggieri

ECONOMIC IMPACT OF LAND CONSERVATION

It is a common argument, in Rhode Island and beyond, that conserving open spaces and forest land decreases revenue to cities and towns by taking those properties off the tax rolls and reducing land available for development in cities and towns. The [American Farmland Trust](#) identified the three common misconceptions regarding working lands within municipal boundaries:

1. Working lands—including productive farms and forests— are an interim land use, not the “highest and best use.”
2. Property tax at the current use value (such as Rhode Island’s FFOS) gives agricultural land an unfair tax break, as opposed to its potential use value for residential or commercial development.
3. Residential development will lower property taxes by increasing the tax base.

However, numerous studies suggest that protecting forest land, farmland and open spaces can generate economic tax benefits that improve the local tax base by bringing in more revenue than is used to provide services to those properties. A [compilation of data from across the US](#) shows that community revenues benefit by having working lands, such as farms and forests, because they require less in service expenditures than residential. While Rhode Island’s data is about 25 years old, recent data compiled from MA and CT show that those trends have continued.

REVENUE-TO-EXPENDITURE RATIOS IN DOLLARS				
Community	Residential including farm houses	Commercial & Industrial	Working & Open Land	Source
Rhode Island				
Hopkinton	1 : 1.08	1 : 0.31	1 : 0.31	Southern New England Forest Consortium, 1995
Little Compton	1 : 1.05	1 : 0.56	1 : 0.37	Southern New England Forest consortium, 1995
West Greenwich	1 : 1.46	1 : 0.40	1 : 0.46	Southern New England Forest Consortium, 1995

Although there may be short-term impacts through a tax shift for permanently protected or conserved lands, the long-term benefits have been shown to outweigh any short-term losses. Supporting working lands, and conserving greenspace has been shown to actually generate revenue benefits, through avoided service costs and by increasing value and revenue of developed property.

The idea that traditional residential or commercial development yields the highest and best use for increasing municipal revenues by growing the tax base and lowering individual property taxes is contradicted by evidence from [local communities](#). Property taxes generally increase because the cost of providing services increases for the municipality. Even new commercial development, which can bring economic growth without significantly increasing the cost of services to the municipality, tends to bring new jobs and new residents who rely on those same municipal services. Managing that growth requires a thoughtful, proactive planning approach to maximize the benefits of development for all residents. When communities are highly reliant on property taxes to fund local government and lack comprehensive planning guidelines, it is often difficult to incorporate land conservation as part of the larger development picture and managing the future character of the community.

The economic benefits of planned development that takes advantage of the benefits of conserved land and well-placed development and service corridors include:

- Open spaces are not anti-development: with planning, conserving open spaces doesn’t reduce housing development, but redirects the density or the location;
- Studies have shown that [open spaces enhance community property values](#), leading to increased property tax revenue: properties located near parks and open spaces are assessed at higher rates and sell for more than comparable properties located elsewhere in the community;
- Open spaces in cities and towns contribute to the quality of life and health of residents: both an affordable tool in addressing environmental health and justice outcomes, and aiding in the achievement of meeting federal and state environmental standards; and
- As land protection and conservation increase, studies have also shown that [employment rates tend to increase](#) over the next five-year period, with jobs focused mainly in tourism and recreation sectors, with amenity-related growth likely the factor driving positive long-term impacts.

Benefits

Benefits can be described as being environmental, economic or social, but the reality is that the benefits provided often address the three types of benefits simultaneously. The exhaustive list of benefits provided by traditional and urban forests and green spaces can simultaneously calm traffic, reduce peak stormwater flows, capture particulate pollution, provide mental relief, reduce UV exposure, protect drinking water, and improve air quality, all for pennies a day.

The benefits provided by traditional and urban forests are significant for all aspects of habitat for humans and wildlife. The comprehensive benefits are summarized well in [BANKING ON GREEN: A Look at How Green Infrastructure Can Save Municipalities Money and Provide Economic Benefits Community-wide](#), which compiled the economic arguments for retaining and managing [green infrastructure](#). But the benefits to human health are becoming another compelling argument for recognizing the significance of that same green infrastructure.

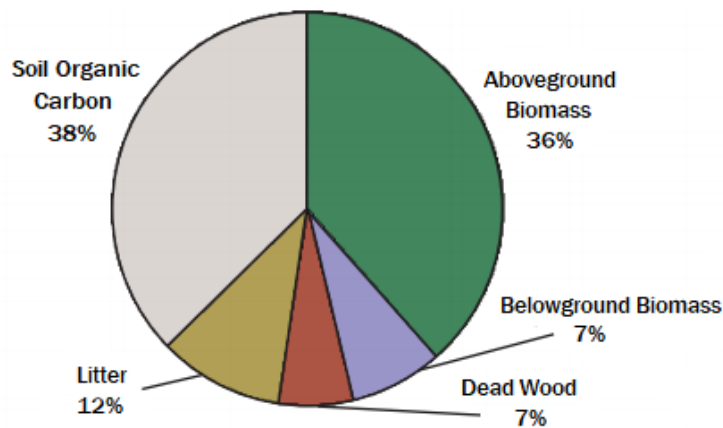
CLIMATE CHANGE MITIGATION

Rhode Island is already experiencing the impacts of climate change in the form of increasing temperatures, rising sea levels, and more intense rain and flood events. These and other climate changes are having and will continue to have profound effects on natural ecosystems as well as human ecosystems. Forest management practices are increasingly being designed in response to these pressures to help ecosystems adapt (see Issue: Climate Change, [page 49](#)). Further, the role of forests and other green spaces— whether managed, unmanaged, or built—are gaining greater acknowledgement for their essential role in the mitigation of climate change through the sequestration and storage of carbon dioxide. A 2017 study by The Nature Conservancy, [Natural Climate Solutions](#), found that natural and working lands have the capacity to provide 37% of the mitigation needed between 2017 and 2030 to keep global temperature rise below 2° Celsius. The researchers examined strategies that are available now, scalable, cost-effective, and provide other benefits to communities. Recent analyses point to several cost-effective pathways for using trees and forests to reduce atmospheric greenhouse gases, including avoided deforestation (i.e. land use change and fragmentation), urban reforestation, and improved forest management.

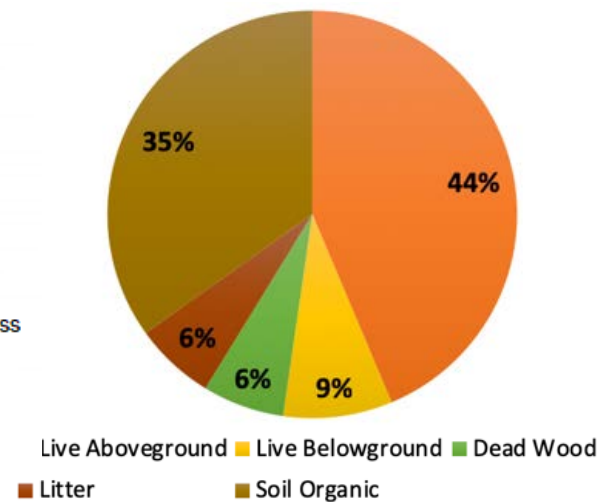
Rhode Island loses [838 acres per year](#) of forest from conversion of forest to other land uses, which also results in carbon losses since natural ecosystems store more carbon than developed lands (See Issue: Forest Loss and Fragmentation, [page 28](#)). In 2016, the [Rhode Island Greenhouse Gas Emissions Reduction Plan](#), prepared by the Executive Climate Change Coordinating Council, advised that meeting the state’s emissions goals could be compromised by continued loss of forested land and recommended exploring a “no net-loss of forests” policy, from the [2 acres per day average](#) experienced in Rhode Island from 1990-2010. The 2018 Statewide Climate Resilience Action Strategy ([Resilient Rhody](#)) identifies forests as a natural system that provides crucial services to communities and recommends that Rhode Island protect remaining forest cover, particularly large, unbroken tracts of forested land, and support the development of Forest Management Plans to guide landowners in healthy forest management practices.

There are two aspects of forest carbon: how much carbon is contained within forest ecosystems (storage) and how much forest carbon is changing over time (sequestration). Both carbon storage and sequestration are influenced by numerous local conditions, including the age and species of the forest, soil characteristics, past land-use, and natural and human disturbances. Discussions about forest carbon storage typically considers the above ground component of carbon. However, forest soils are also an important carbon pool, and minimizing heavy soil disturbance and conversion to other land uses is key to maintaining carbon storage in forest soils.

The [2019 report on Forest Carbon](#) by UMass Amherst and the University of Vermont reported that an average acre of Northeastern forest holds 77 metric tons/acre (t/ac), as shown in the chart on the left below. Similarly, carbon storage in Rhode Island’s forests averages 76 metric tons per acre (and 26.7 million metric tons statewide), shown on the right.

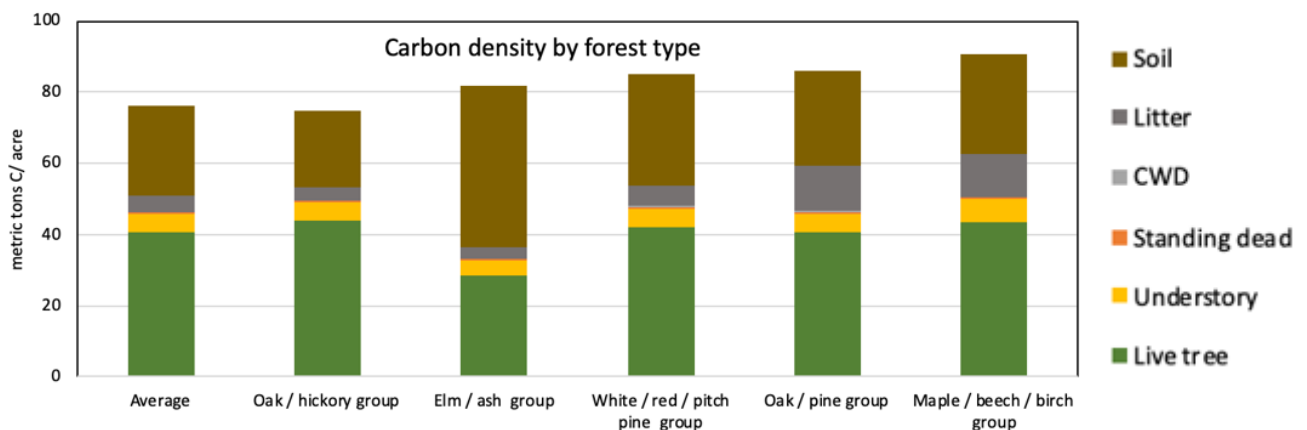


Northeast Forest Carbon Stocks Averaged
 Source: *Forest Carbon: An essential natural solution for climate change*



Rhode Island Forest Carbon Storage
 Source: *FIA Data*

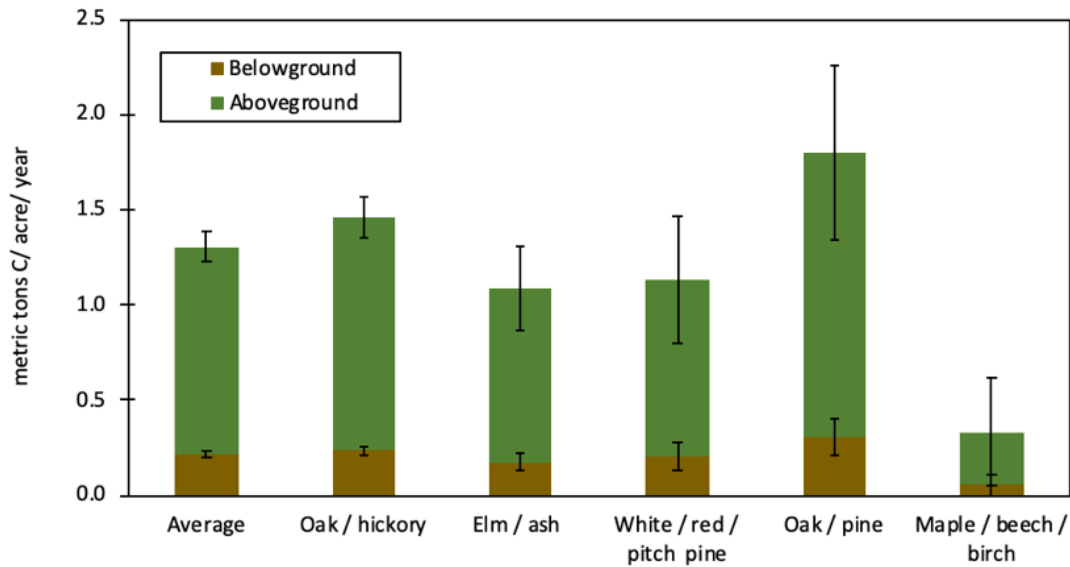
Carbon storage varies not only by species, size, maturity, and growth rate, but can also be related to soil type and depth. The different forest types in Rhode Island range in average carbon storage from 75 to 91 metric tons per acre. It’s important to note that the small size of Rhode Island provides some limitations to the use of national data from the US Forest Service Forest Inventory and Analysis program, particularly for less common forest communities. But more recent data for Rhode Island show that the Northeastern percentages are relatively consistent with RI’s state-specific data, calculated using the [Forest Inventory and Analysis Program](#), [Forest Inventory EVALIDator](#), as shown below:



Statistics for Forest Carbon Density (Storage) Among Different Forest Types
 Source: *The Value of Rhode Island Forests*

The average acre of Rhode Island forest absorbs 1.3 metric tons of carbon per year from the atmosphere. The roughly 367,000 acres of forest land in Rhode Island sequester nearly 500,000 metric ton of carbon dioxide each year. Collectively, Rhode Island’s forests offset the annual emissions of more than 100,000 passenger vehicles each year (EPA [Greenhouse Gas Emissions from a Typical Passenger Vehicle](#)), equivalent to a significant percentage of Rhode Island passenger vehicle emissions. Available transportation statistics

indicate that nearly 429,000 automobiles (not including buses, trucks, etc.) were [registered in Rhode Island in 2016](#). This suggests that the state’s forests are capable of offsetting roughly one quarter of the annual emissions of the state’s registered passenger vehicles.



Annual Carbon Sequestration by Forest Type
 Source: *The Value of Rhode Island Forests*

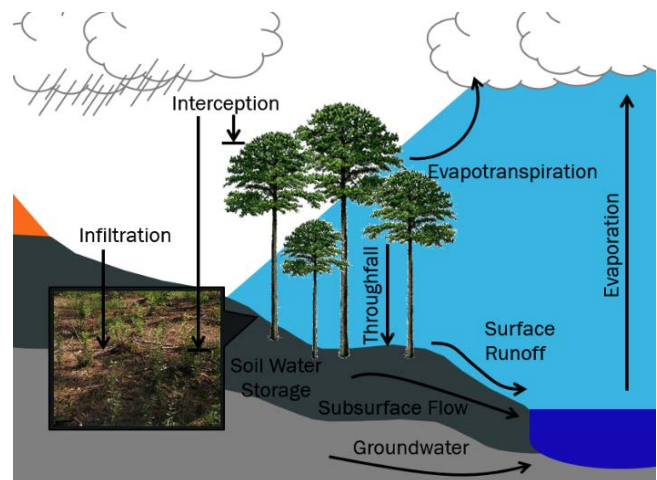
Additional information on the carbon sequestration using the [Forest Inventory EVALIDator web-application Version 1.8.0.00](#) is in [Appendix C](#).

STORMWATER MITIGATION

Rhode Island relies on surface reservoirs and groundwater for potable water supplies; land use influences water quality for both sources. Forests serve as natural filters and are the most effective land cover for maintenance of water quality and quantity, providing a quantifiable economic benefit by filtering sediments and other pollutants from the water in the soil before it reaches a water source, thereby reducing treatment costs. These forests also mitigate impacts from severe storms and flooding by slowing water flow and buffering waterbodies. Maintaining forest cover and practicing forest stewardship help ensure cleaner water is available from water supply sources.

The impact of forest loss and, most notably, permanent land conversion from [green infrastructure](#) to grey infrastructure or developed uses, is particularly dramatic for stormwater flow. The loss of soil permeability due to the installation of hardscape and changes in site gradient requires costly stormwater management systems that need long-term maintenance and are not built to withstand increasingly frequent extreme rainfall events.

Impeding the infiltration of water into the soil and subsurface flows keeps stormwater on the surface where peak flows and flow rates are increased, leading to more frequent and more damaging flood



Precipitation Movement in the Landscape
 Source: *How Trees & Forests Really Affect Stormwater*

events. Stormwater management planning to include the retention of natural areas and trees in the built landscape provide mitigation of storm flow. Even seemingly positive efforts to encourage alternative energy sources can have a negative impact on water movement in the landscape, when trees are cut, topsoil is removed, land is graded and compacted, and equipment is installed.

While much of the western part of Rhode Island is forested, the higher population and densely urbanized areas of the state are in close proximity to water, whether Narragansett Bay or the many rivers that flow through the state.

Providence, shown on the right, is a local example of the high percentage of hardscape and impervious surfaces typical of the dense urban development in the eastern area of the state. The area in pink shows the extent of impervious surfaces. Here water is unable to infiltrate into the soil and precipitation washes pollutants, oils, and trash into storm drains and waterways.



The effects of impervious surfaces were evident in Rhode Island in 2010 when heavy rains impacted the lower Woonasquatucket River, where the river corridor flows through a densely developed landscape. The lower river valley experienced dramatic flooding that led to evacuations, property damage, and loss of business. A major component of the [Woonasquatucket Vision Plan](#), a recent project of the City of Providence and the Woonasquatucket River Watershed Council, is to [restore](#) green infrastructure along the river, including trees and vegetation, to improve the natural capacity to absorb the impact of future storms.

HUMAN HEALTH

Research has continued to advance, refining and quantifying our understanding of the contribution of green spaces, and trees in particular, to human health:

- [Urban Nature for Human Health and Well-Being](#): a research summary for communicating the health benefits of urban trees and green space
- [The Human Health and Social Benefits of Urban Forests](#)
- [Human Dimensions of Urban Forestry and Urban Greening](#)

Mental health support as an ecosystem service is critically needed in Rhode Island. According to the 2015 [RI Behavioral Health Project: Final Report](#), mental health statistics show that there are unmet needs for mental health support in the state, including:

- Higher state spending than the national average for behavioral health services as a percentage of state GDP, but adults reporting unmet behavioral health needs at a higher rate than adults in other New England states; and
- Children in Rhode Island are at a greater risk for developing mental health and substance use disorders than children in other New England states.

CDC resources ([High School Youth Risk Behavior Surveillance](#) and [ADHD Prevalence](#) respectively) show that 29% of Rhode Island high school students (grades 9-12) have experienced depression symptoms and 16% have seriously considering attempting suicide in the past year. Rhode Island ranks 11th among U.S. States for Attention-deficit disorder (ADD) or attention-deficit/hyperactivity disorder (ADHD) in children, with parent reports showing that 11.1% of children in Rhode Island currently have the disorder.

Utilization of Rhode Island’s natural areas is highly valued. Increasing access and exposure to green space in urbanized areas is a priority and is supported by recommendations in the [RI Behavioral Health Project: Final Report](#) to shift mental health treatment away from costly, reactive services and towards evidence-based, community-centered strategies for promoting and managing mental health care. Given the many values that forests, and other green spaces, provide to Rhode Island communities, maintaining forests to support mental well-being should be part of a community-centered health care strategy.

The benefits of forests and green spaces extend beyond mental well-being to physical health. The Rhode Island Land Trust Council has adopted a [program](#) that encourages people to take walks and spend time outdoors in nature for their health. The Council is partnering with the healthcare community to “prescribe” walks through [Park Rx](#) and [RI Walks](#) program and to raise awareness about the connection between forests and other natural areas and human health.

DFE is a partner in the American Forests project, [Urban Forests for Climate and Health Initiative](#), to develop tools that assist communities to address the issues of climate and public health. The project, funded by the Doris Duke Charitable Foundation, is developing a Tree Equity Score and a GIS-based decision-support tool that uses urban forestry to reduce the impacts of climate change and to improve public health outcomes. Rhode Island’s Department of Health and the [Health Equity Zones](#) (HEZ) are also involved in this effort, as is the USFS [Northern Institute of Applied Climate Science](#) (NIACS).

AIR QUALITY

Air quality also plays a significant role in health outcomes. National air quality standards were established by the US Environmental Protection Agency (US EPA) under the federal [Clean Air Act](#) in order to maintain safe levels of “criteria pollutants” that include ozone, particulate matter, nitrogen dioxide, sulfur dioxide, carbon monoxide, and lead.

RIDEM’s [Division of Air Resources](#) monitors air quality in Rhode Island via a network of monitoring stations and submits an annual air quality report to the US EPA. Most criteria pollutants have remained within the safe levels, but the [2018 RI Annual Monitoring Network Plan](#) reported that measured ozone levels have exceeded safe standards in Rhode Island in recent years. According to the [2019 State of the Air](#) report by the American Lung Association, all three reporting counties in Rhode Island (Kent, Washington, and Providence Counties) received failing grades for air quality based on high ozone days.

Research shows that air pollutants have been shown to have a range of negative, and compounding, impacts:

- [A Framework for Examining Social Stress and Susceptibility to Air Pollution in Respiratory Health](#): The impact of air pollutants is exacerbated in low-income communities, where its impacts are often concentrated and combined with other social stressors.
- [Outdoor Air Pollution and Asthma](#): Poor air quality has been linked to asthma exacerbation and onset.
- [The medications that change who we are](#): Medications used to treat asthma are sometimes associated with behavioral changes, e.g. an increase in hyperactivity and the development of ADHD.

According to [RIDOH data](#), Rhode Island has the ninth-highest prevalence of children with asthma, 10.9%. According to self-reported data collected by the [Henry J Kaiser Family Foundation](#), more than 1 in 10 adults (12%) in Rhode Island had asthma in 2018. Black and Hispanic children are more likely to visit the emergency room or to be hospitalized due to asthma. Medical conditions caused by air pollution, like asthma, come with significant costs to quality of life and economic costs to afflicted individuals and the local medical system. A 2017 study published in the [Annals of the American Thoracic Society](#) reported that the economic cost of asthma is \$3,266 per asthmatic person per year.

Trees contribute to cleaner air by absorbing gaseous pollutants through leaf stomata and intercepting particulate matter on tree surfaces, including carbon monoxide, nitrogen dioxide, ozone, lead, sulfur dioxide, and particulate matter. Even with the variability in absorption among species, the emission of volatile organic compounds (VOCs), and pollen production, trees have an overall positive impact on human health. [Recent research](#) is showing that trees planted in urban areas, even when still relatively small, have an impact on air pollution.

A 2014 [i-Tree Canopy](#) assessment of all 39 municipalities in Rhode Island estimated that Rhode Island’s entire population of trees (natural areas, green spaces and urban trees) provide more than \$30 million annually in pollution removal benefits. Trees in Rhode Island remove an estimated 13,800 tons of dangerous air pollutants from the atmosphere each year. The value of pollution-removal provided is greater than \$38 million annually when considering the removal of carbon monoxide, nitrogen dioxide, ozone, and small and large particulate matter (not including the benefits of carbon dioxide removal). While a large portion of Rhode Island is considered [rural](#) and may not actually see \$38 million in pollution removal, the benefit to the region as a whole is significant. It is where dense and healthy tree cover is located closer to pollution sources and to population centers that trees can provide the most pollution-removal benefits to the most people.

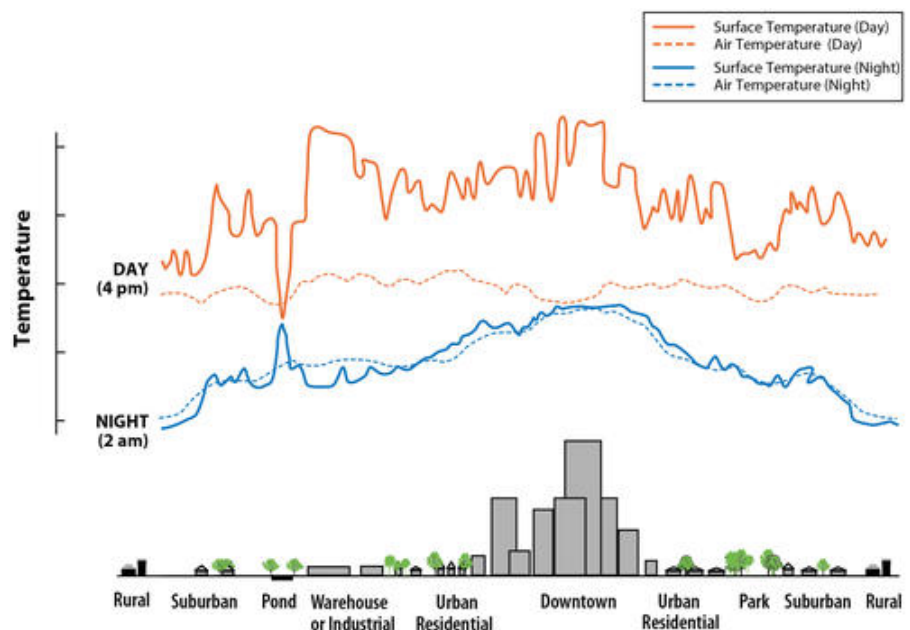
Published in 2013, [Tree and forest effects on air quality and human health in the United States](#) assessed 2010 data for air pollutants, not including large particulate matter (between 2.5 and 10 microns and calculated that Rhode Island trees removed 10,500 tons of air pollutants, to a value of \$33.6 million in avoided human health costs. This includes 2,900 tons of pollution removed by trees on urban land (\$27.9 million value) and 7,600 tons of pollution removed by trees in the state’s rural land (\$5.7 million value).

TEMPERATURE MODERATION & URBAN HEAT ISLAND MITIGATION

Forest cover plays a significant role in moderating local temperatures; the combination of shade and transpiration cooling the air can reduce temperature extremes. [Development and refinement of modeling tools](#) are valuable to effectively assess and communicate the impact of trees: a large tree can transpire as much as 100 gallons per day in a hot, dry climate, providing the cooling equivalent of five air conditioners running for 20 hours.

Urban areas, with their dense development and grey infrastructure, are warmer than greener areas both in the daytime under direct sun, and at night when the stored heat is released. This [urban heat island effect](#) increases energy use and associated greenhouse gas emissions, mainly through air conditioning cooling, as well as affecting air quality.

[Research](#) shows that electricity demand for cooling increases 1.5–2.0% for every 1°F (0.6°C) increase in air temperatures, starting from 68 to 77°F (20 to 25°C), suggesting that 5–10% of community-wide demand for

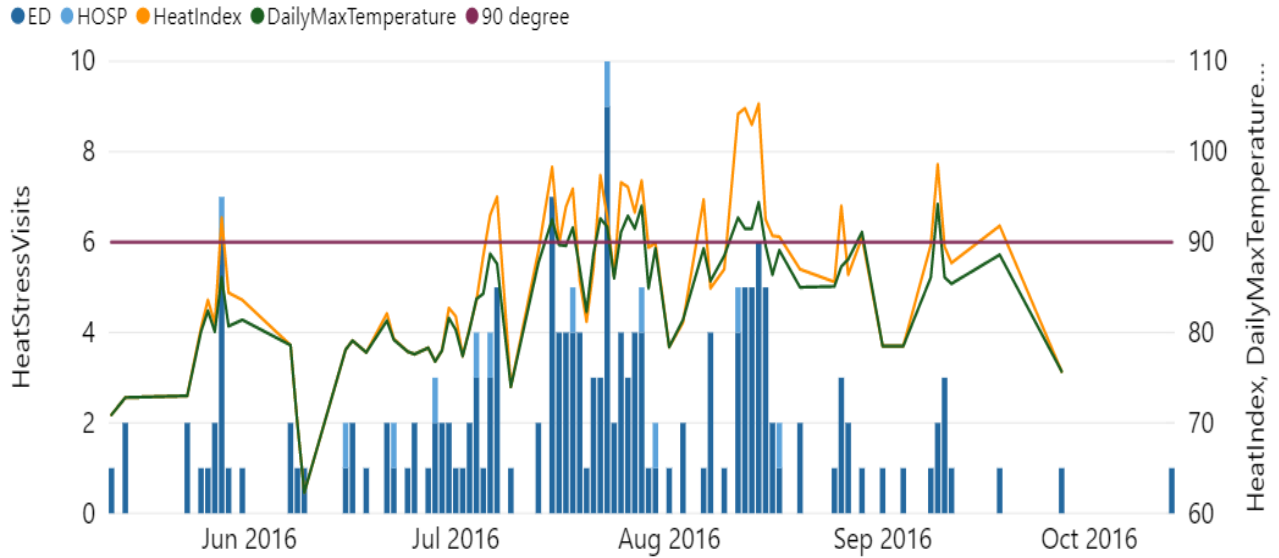


Heat Island Impacts

Source: USGS.gov

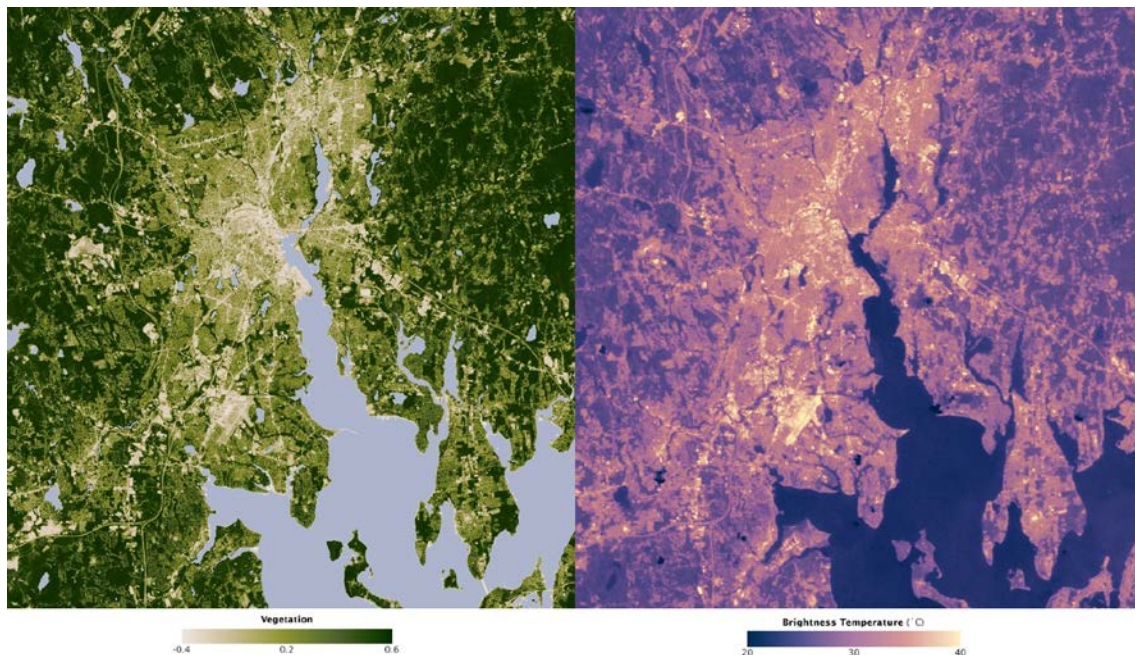
electricity is used to compensate for the heat island effect. Meanwhile, a 2010 study on [urban greening to cool towns and cities](#) estimated a 2°F reduction in ambient air temperature for every 10% increase in urban tree canopy.

High temperatures are associated with negative health impacts, including heat cramps, exhaustion and stroke, and even heat-related death. Data from the Rhode Island [Department of Health \(DOH\)](#) shows that this relationship between [extreme heat and negative health outcomes](#) is borne out at the state level – emergency department and hospital visits spike as temperatures increase.



Rhode Island Heat Index Compared to Emergency Room and Hospital Visits. *Source: RIDOH*

A 2002 NASA report on [Drivers of Urban Heat Islands](#) used satellite imagery to demonstrate the relationship between acute heat island effects and vegetation. The results for Providence, shown below, displayed the expected inverse relationship between temperature, shown on the right, and vegetation, on the left.



Satellite Images of Vegetation and Temperature in Providence, Rhode Island. *Source: NASA*

Low-income communities are those often most acutely impacted by the urban heat island effect. The DOH [Climate Change Program](#) partnered with Rhode Island's [Health Equity Zones \(HEZ\)](#) in 2019 to identify places in the state's HEZ with an above average risk for heat-related illness during extreme heat events. This understanding of where increased temperatures will most impact human health can direct resources and outreach to these communities. Increasing and maintaining green space and access to green space is a logical part of any solution to address the dangerous effects of extreme heat.

Since 2015, DFE and the Arbor Day Foundation have partnered to deliver the state's [Energy-Saving Trees](#) program. This popular program funds the annual distribution of 2,000 tree saplings to homeowners to help them conserve energy, reduce utility costs, and mitigate stormwater runoff while beautifying their neighborhoods.

WILDLIFE HABITAT

The state's varied soil, vegetation and hydrology support almost 100 natural vegetative communities that support a wide range of wildlife. According to the 2015 [RI WAP](#), Rhode Island supports 92 species of mammals, 431 species of birds, 306 species of fish (freshwater and saltwater), and 36 species of amphibians and reptiles; 236 are considered to be [Species of Greatest Conservation Need \(SGCN\)](#) in Rhode Island.

For many of these species, forests provide the necessary habitat required for robust and resilient populations. Of the [84 key habitat profiles](#) identified, 21 are forest types, from pitch pine barrens and maritime forest, to forests representative of the Appalachians in the south or the Laurentians in the north, and the familiar oak forests of the northeast. Not only is this range of forest types needed to support the multitude of wildlife species, but age class diversity is also necessary. As noted earlier in this report, the percentage of young (0-20 years) and old (>100 years) forests is very low in Rhode Island. So, while there may be an increase in the upper age classes if harvesting levels remain low, the lack of early successional stands requires management intervention by DFW and DFE working together, and the development of tools such as the [silvicultural recommendations for supporting bird habitat](#) that target landowners and consulting foresters are needed.

The distribution and abundance of Rhode Island's forest dwelling wildlife is affected by the characteristics of the forest cover and their specific requirements. Some of Rhode Island's forest dwelling creatures are generalists and can be found in a variety of habitats, including human habitats periodically or seasonally, while others are specialists requiring a single habitat type or a much-reduced variability, and thus are far more susceptible to changes in forest cover. And, while some species can get by with fragmented patches interspersed with development, area-sensitive species need large, unfragmented forest blocks to thrive.

Examples of species that have grown accustomed to human proximity and proven more adaptable in fragmented landscapes include white-tailed deer treating the suburbs as a buffet, rose-breasted grosbeak using suburban feeders during migration, and red foxes and coyotes using local green spaces and taking advantage of intentional and unintentional human subsidies.

Examples of species needing large patches of intact forest to thrive include northern goshawk, scarlet tanager, red-spotted newt, marbled salamander and, because they depend upon increasingly rare cold-water streams for survival, brook trout.

Some species require young forests, or a matrix of older forest and more open habitats (which may or may not include young forest), but landscape fragmentation by roads and other development can be highly detrimental to such species as New England cottontail, Eastern box turtle, woodcock, and numerous songbirds.

Still other species are even more specific, relying on only one or a few host plants to complete their life cycle, such as the state-threatened frosted elfin butterfly, which relies on wild indigo or wild lupine, and the state-concern sleepy duskywing, whose host plant is scrub oak. Given that these plant hosts are found in the pitch pine woodlands and barrens, the decrease of that forest type to about 1/5th of their original range through land conversion means that any further loss of that forest type is a significant concern.

Rhode Island's wildlife needs forests of all stages, and the state's human residents benefit from robust and healthy wildlife living in those habitats. Wildlife resources play a direct and critical role in how the ecosystem functions through the complex services that they provide to humans and the landscape. Pollinators (not only bees but birds, moths, butterflies, wasps, flies) are critical in the reproduction process of countless plants including those important to human food systems. According to the [Food and Agriculture Organization of the United Nations](#), three out of four crops across the globe producing fruits or seeds for human use as food depend, at least in part, on pollinators. As noted in [The Value of Rhode Island Forests](#), other beneficial wildlife species include birds, mammals and insects dispersing seeds through their movements and droppings; and squirrels inadvertently planting trees by forgetting where they buried their acorns. Even the less charismatic species have a role to play: all resident bat species are insectivores; scavengers, like the turkey vulture, clean up roadsides by consuming road killed animals; and the opossum's diverse diet includes insects, beetles, ticks, and roadkill.



Photo credit: Megan Ruggieri