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Southern New England Forests 2017: Summary Report



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Abstract

This executive summary summarizes the results of the seventh inventory of the forests of Southern New England, defined as Connecticut, Massachusetts, and Rhode Island, conducted by the USDA Forest Service, Forest Inventory and Analysis program. Previous inventories were conducted in 2012, 2007, 1998, 1985, 1972, and 1953. Information in this report includes forest context, forest features, forest health, and ecosystem services. There are an estimated 5.2 million acres of forest land across the region: 3.0 million acres in Massachusetts, 1.8 million acres in Connecticut, and 370 thousand acres in Rhode Island. This amount has not changed substantially since the last inventory was completed in 2012. There are 2.5 billion trees on this forest land that have a total volume of 14.2 billion cubic feet. Red maple and eastern white pine are the most common species in terms of both numbers of trees and volume. Nearly half (48.7 percent) of the forest land is classified as the oak-hickory forest type group. A detailed interactive report is available at <https://doi.org/10.2737/NRS-RB-125-INT>, and supplemental information, including (1) tables summarizing quality assurance, (2) a core set of tabular estimates for forest resources, and (3) user and database guides for P2 and P2+ protocols, can be accessed at <https://doi.org/10.2737/NRS-RB-125>.

KEY WORDS: inventory, forest statistics, forest land, land use, ownership, volume, forest health

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Cover photo: Sawmill River in near Montague in western Massachusetts. USDA photo by Brett J. Butler.

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Contents

[Highlights](#) 1

[What is This Report?](#)..... 2

[What is FIA?](#)..... 3

[Forest Area](#) 3

[Species Composition](#) 5

[Invasive Forest Insects](#)..... 7

[Ecosystem Services](#) 10

[Literature Cited](#) 12

[Appendix](#) 14

Interactive Report <https://doi.org/10.2737/NRS-RB-125-INT>

Summary Tables <https://doi.org/10.2737/NRS-RB-125>

Additional Resources <https://doi.org/10.2737/NRS-RB-125>



Sawmill River in near Montague in western Massachusetts. USDA photo by Brett J. Butler.

Highlights

Many of the issues listed here are not addressed in this summary report of Forests of Southern New England, but can be found in the interactive report, available at <https://doi.org/10.2737/NRS-RB-125-INT>.

- There are an estimated 5.2 million acres of forest land in Southern New England
 - * 3.0 million acres in Massachusetts
 - * 1.8 million acres in Connecticut
 - * 370,000 acres in Rhode Island
- The area of forest land has not changed substantially since the previous inventory in 2012.
- Tree cover in the urban area of the region is among the highest in the nation—62 percent in Connecticut, 57 percent in Massachusetts, and 51 percent in Rhode Island.
- Nearly two-thirds of the forest land is privately owned and of this land, the majority is owned by families and individuals.
- Seventy-six species of trees were tallied on FIA inventory plots.
- Red maple, eastern white pine, and eastern hemlock are the most common in terms of numbers of trees.
- Eastern white pine, red maple, northern red oak and are the most common in terms of volume of trees.
- The most common forest-type group is oak/hickory, representing an estimated 48.7 percent of the forest land across the region.
- Eighty-two percent of the forest land in the region is classified as large stands, i.e., stands are dominated by softwoods ≥ 9.0 inches d.b.h. or hardwoods ≥ 11.0 inches d.b.h.
- Eleven percent of the tree volume is in trees < 9 inches d.b.h., 51 percent is in trees that are between 9 and 17 inches d.b.h, and 38 percent is in trees that are ≥ 17 inches d.b.h.
- The annual growth of trees is estimated to be 274.7 million cubic feet with growth to removal ratios well above 1.0 for the most common species.
- Overall tree crown health was good.
- The forests continue to face threats from invasive insects, such as emerald ash borer and hemlock woolly adelgid, and invasive plants, in particular, oriental bittersweet, multiflora rose, and Japanese barberry.
- Forest regeneration is facing challenges due to maturing forests, relatively few stand replacing events, such as windstorms or substantial timber harvests, and deer browsing.
- The region's forests provide countless benefits to the people of the region. Carbon sequestration, air pollution removal, and runoff avoidance alone provide an estimated \$1.5 billion per year.
- The forests contain an estimated 635.0 million tons of carbon: 55 percent in soil organic carbon, 36 percent in live trees, and the rest in dead trees, understory plants, and leaf litter.

- There are an estimated 8.8 million cubic feet of sawtimber in the region's forests with the highest percentages being in eastern white pine, northern red oak, and red maple.
- The forests provide critical habitat for many plants and animals. The mature forests provide snags, or standing dead trees, that are important to many species, but there is a paucity of young forests that many species rely on for at least some of their needs.

What is This Report?

This is a summary of the results of an inventory of the forests of Southern New England, composed of Rhode Island, Connecticut, and Massachusetts. The inventory was conducted from 2013 to 2017 and is referred to as the 2017 inventory. The inventory was conducted by the USDA Forest Service, Forest Inventory and Analysis program. More detailed results are available in an interactive digital collection available at <https://doi.org/10.2737/NRS-RB-125>.

The results presented in the interactive report are divided into sections that focus on forest features, forest health, and socioeconomics (Fig. 1). Graphics, including interactive maps and charts, summarize data and illustrate trends that make it easier for readers to make comparisons between inventory periods, geographic locations, and ecological divisions. This document offers a summary of those results.

Table 1 provides references for previous forest resource inventory results for Rhode Island, Connecticut, and Massachusetts.

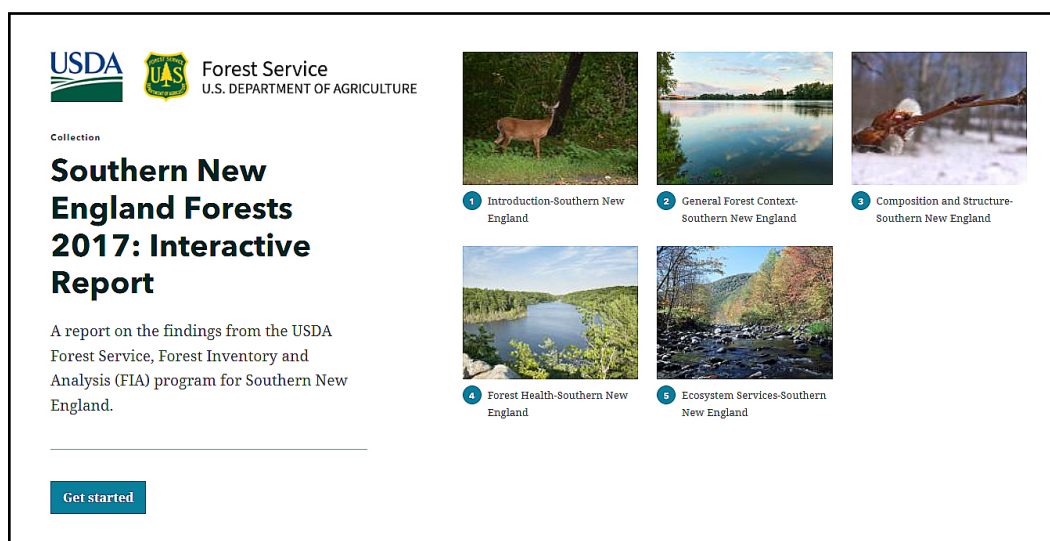


Figure 1.—The Forests of Southern New England, 2017: Interactive Report is a digital collection that focuses on different forest aspects.

Table 1.—Previously published comprehensive FIA reports for Southern New England states

Year	Connecticut	Massachusetts	Rhode Island
2012	Butler et al. 2015	Butler et al. 2015	Butler et al. 2015
2007	Butler et al. 2011	Butler et al. 2011	Butler et al. 2011
1998	Alerich 2000a	Alerich 2000b	Alerich 2000c
1985	Dickson and McAfee 1998a	Dickson and McAfee 1998b	Dickson and McAfee 1998c
1972	Dickson and Bowers 1976	Peters and Bowers 1977a	Peters and Bowers 1977b
1953	Griswold and Ferguson 1957	Ferguson and Howard 1956	Ferguson and McGuire 1957

What is FIA?

The Forest Inventory and Analysis program (FIA) was established by the U.S. Congress to “make and keep current a comprehensive inventory and analysis of the present and prospective conditions of and requirements of the forest and range lands of the United States” (Forest and Rangeland Renewable Resources Planning Act of 1974). For additional information on the FIA program, visit: www.nrs.fs.usda.gov/fia.

Forest Area

The most basic forest statistic is the total area of forest land. FIA defines forest land based on tree cover and how land is used. Estimates based on land use versus land cover, can be very different, especially in urban and suburban areas where trees are located on lands used predominantly for commercial or residential purpose.

FIA separates forest land into timberland, reserved, and unproductive categories. Ninety-six percent of the forest land is classified as timberland, meaning the land is available for and capable of producing commercial timber. The remaining forest land is either public lands that are legislatively reserved (3 percent) or classified as unproductive (<1 percent). These distributions have not changed substantially over the past few decades.

What we found

An estimated 59 percent of the region is covered by forest land. There are an estimated 5.2 million acres of forest land across the region (Fig. 2): 1.8 million acres in Connecticut, 3.0 million acres in Massachusetts, and 370,000 acres in Rhode Island. The forest land is concentrated in the more rural areas in the region, away from the major metropolitan areas and transportation corridors.

The area of forest land has remained fairly stable over the past few decades. Since 2012, Connecticut has seen a moderate, and statistically significant, increase (54,000 acres), while there were no significant changes detected for Massachusetts or Rhode Island.

What this means

Keeping forests as forests is the first step in forest conservation. Forest land has been the dominant land use across Southern New England for many decades, it still is, and will presumably continue to be so. Although the net change in forest land is small, there are some losses and gains as discussed in the next section. The distribution of forest land is not even across the region, and this will influence who directly and indirectly benefits from the forests.

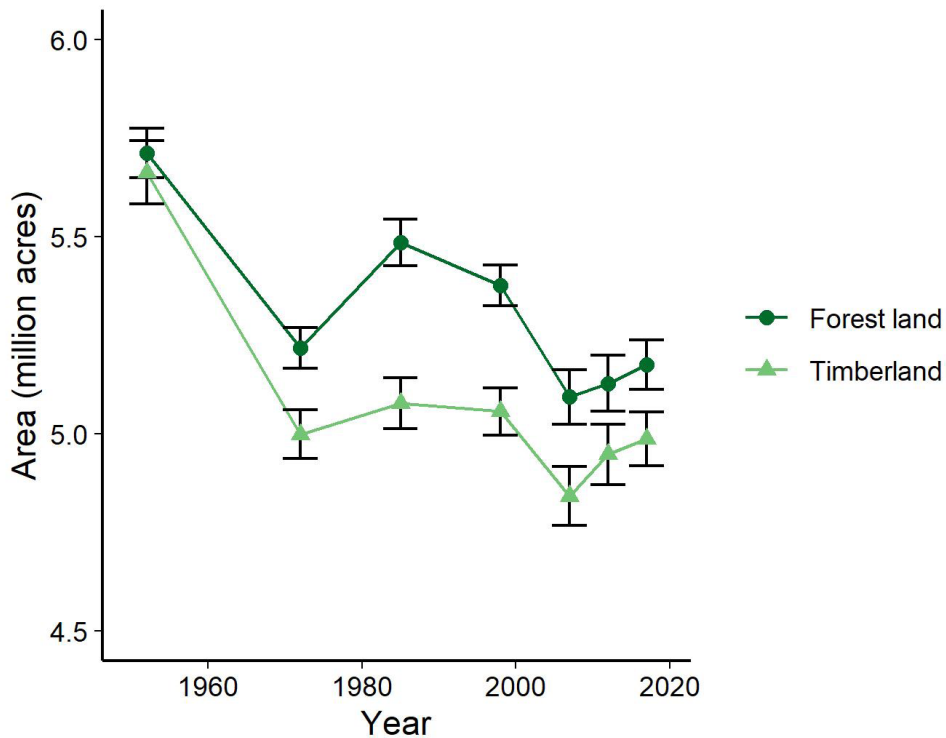


Figure 2.—Area of forest land and timberland in Southern New England from 1950 to 2017. Error bars represent a 68 percent confidence interval around the estimates.

Species Composition

Trees are the dominant features of forests. They can be described many ways, including in terms of composition, structure, growth, mortality, and removals. Forest composition is described here based on the species of trees encountered on FIA inventory plots, in terms of numbers of species and distribution of species in terms of numbers and volumes of trees. These last two metrics, numbers and volume, give somewhat different views of the forests in part due to the fact that numbers of trees include trees ≥ 1 inch diameter at breast height (d.b.h., measured at 4.5 feet above ground) and volumes include only trees ≥ 5 inches d.b.h.

What we found

Seventy-six species of trees were tallied on FIA inventory plots in Southern New England between 2011 and 2017 (for a complete list of species, see appendix). Fifty-eight species were found in Connecticut, 67 in Massachusetts, and 46 in Rhode Island. This is a slightly lower number than was encountered in the 2012 or 2007 inventories, where 83 and 86 species of trees were encountered, respectively.

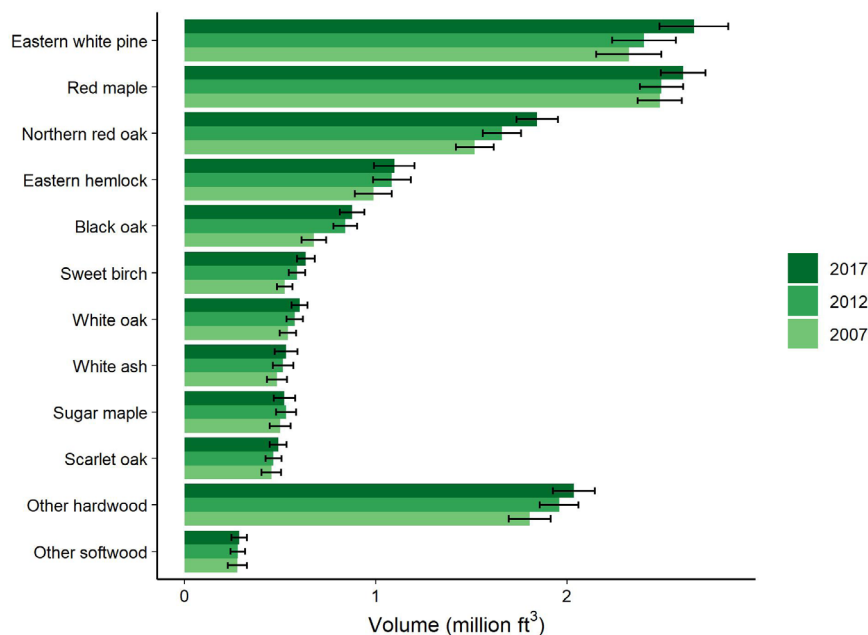


Figure 3.—Net volume of all live trees (≥ 5 inches d.b.h.) on forest land by species, Southern New England, 2007, 2012, and 2017. Error bars represent a 68 percent confidence interval around the estimate.

There are an estimated 2.5 billion trees in the forests of Southern New England. The most common species are red maple, eastern white pine, eastern hemlock, sweet birch, and American beech. Examining each state separately, red maple is still the most common species. Compared to the 2012 and 2007 inventories, the order of the most common species has not changed appreciably, but the total numbers of trees are down slightly from 2.6 billion in 2012 and 2007.

The trees across the region have a combined estimated volume of 14.2 billion cubic feet (Fig. 3). The order of the top species varies somewhat compared to those in terms of number of trees; eastern white pine, red maple, northern red oak, eastern hemlock, and black oak are the most voluminous species. Eastern white pine is the most voluminous in Massachusetts, but red maple is dominant in Connecticut and Rhode Island. Overall, the volume has been increasing for most species.

What this means

Changes in forest composition are inevitable as trees grow and die, but forest processes operate over long time horizons. As a result, the forest composition has remained relatively stable over the past decades. These trends are also the result of relatively few stand replacing events across the region, be they natural (e.g., hurricanes) or anthropogenic (e.g., timber harvesting).

The increase in tree volume with an accompanying decrease in numbers of stems is largely a result of the region's aging forests. The larger trees continue to put on wood and smaller trees are dying as they are outcompeted. Some of the decreases in numbers, such as for white ash and eastern hemlock, are also related to insects and diseases.

The forests of Southern New England are some of the most diverse across the United States and will likely continue to be so. In terms of numbers of trees, the forests are dominated by red maple and this species will continue to be dominant for the foreseeable future. In terms of volume, white pine is dominant, but red maple is a close second and these two are likely to continue to dominate.

It should be noted that the FIA system is designed to capture the major tree species, but rare species may be missed. This number only includes tree species that are growing in forests; the large number of horticultural species of trees planted in urban areas are not included.

Invasive Forest Insects

Invasive insect activity impacts the structure and composition of forest ecosystems. Monitoring the status of these organisms provides a measure of forest health and is crucial in assessing the current state and changing trends in Southern New England's forests. Over the past 5 years, defoliation from *Lymantria dispar*, forest tent caterpillar (*Malacosoma disstria*), and winter moth (*Operophtera brumata*) has varied across the region, while Asian longhorned beetle (*Anoplophora glabripennis*) detections decreased in Massachusetts.

Emerald Ash Borer

First detected in Southern New England in 2012, emerald ash borer (*Agrilus planipennis*; EAB) is now present in Connecticut, Massachusetts, and Rhode Island. As EAB is difficult to detect at low levels, natural spread was enhanced by human-mediated transportation of infested materials, such as firewood, therefore, spread of EAB has outpaced detection, with population establishment averaging 3 to 8 years prior to identification (Hermes and McCullough 2014). All three species of ash (white, green, and black ash) found in Southern New England are hosts of EAB. While mortality due to EAB varies by infestation level, a mortality to growth ratio above 0.6 is indicative of an acute forest health issue (Conkling et al. 2005).

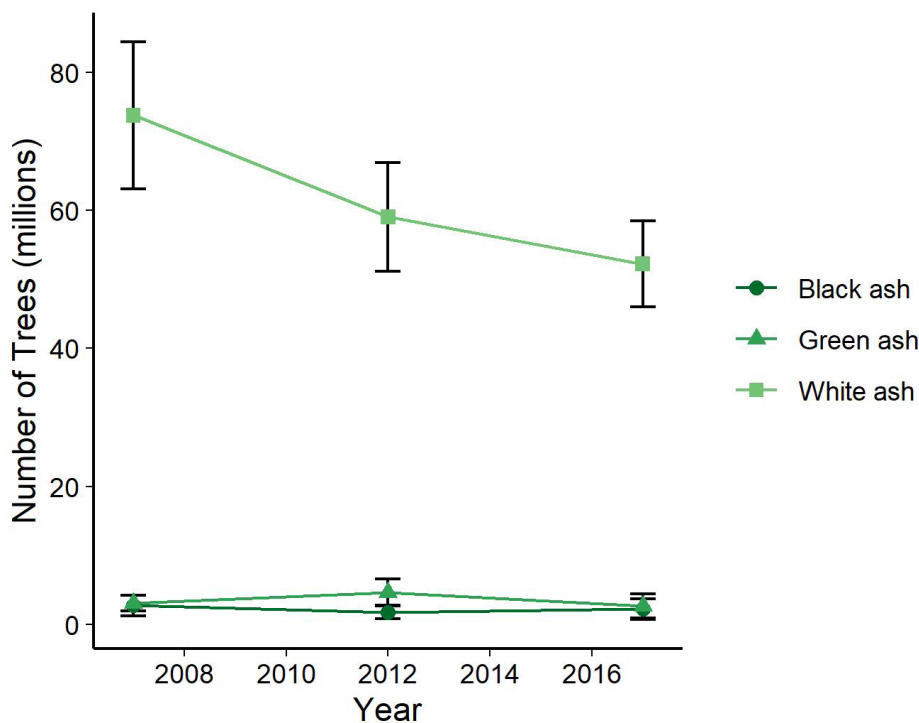


Figure 4.—Number of ash trees on forest land, Southern New England, 2007, 2012, and 2017. Error bars represent a 68 percent confidence interval around the estimate.

There are an estimated 57 million ash trees (≥ 1.0 inch d.b.h.) on forest land in Southern New England, a significant decrease from the 80 million trees in 2007 (Fig. 4). Average annual mortality of ash on forest land totals 8 million cubic feet, or 7 percent of total mortality. Between 2012 and 2017, the mortality-to-gross growth ratio for ash increased from 0.6 to 0.8; this is likely an indicator of mortality due to EAB activity. Mortality of ash is expected to increase further as EAB persists. The loss of ash in forested ecosystems will affect species composition and alter community dynamics. Continued monitoring will help to identify the long-term impacts of EAB in forested settings.

Hemlock Woolly Adelgid

Eastern hemlock is not a major component of most of the forests across Southern New England, but it is important in many areas and provides important functions in these areas (Fig. 5). It is highly valued as a timber species, for wildlife habitat, and for the unique niche it fills in riparian areas. Hemlock woolly adelgid (*Adelges tsugae*; HWA), native to eastern Asia, was first discovered in southern Connecticut around 1989 and has since spread across most of Southern New England (Ward et al. 2004). In areas where populations have established, they often reach high densities, causing widespread hemlock defoliation and mortality (McClure et al. 2001, Orwig et al. 2002).

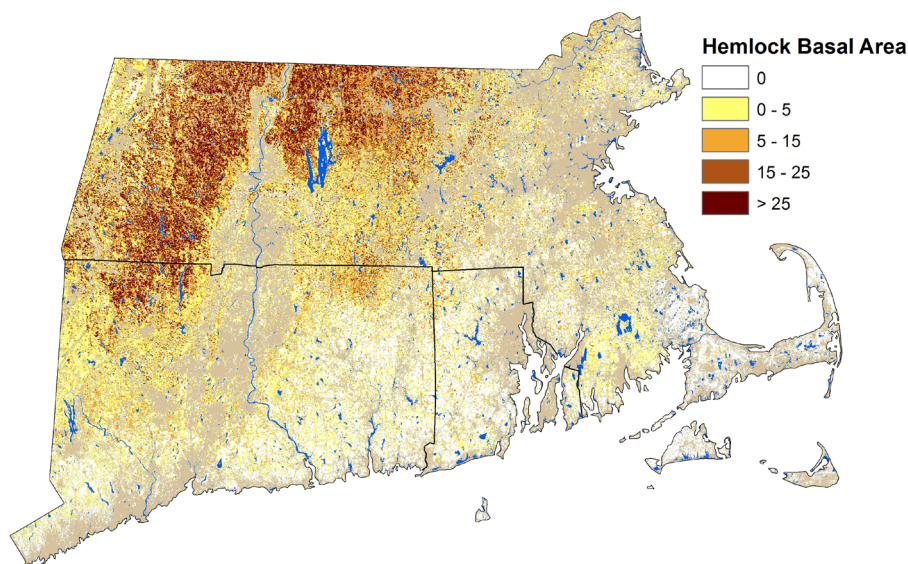


Figure 5.— Basal area of hemlock on forest land, Southern New England, 2017. Basal area is the cross-sectional area of trees at 4.5 feet and is reported here in terms of square feet per acre.

Southern Pine Beetle

Southern pine beetle (*Dendroctonus frontalis*; SPB), a destructive bark beetle native to the southeastern United States, was confirmed in Southern New England in 2015 following over a decade-long outbreak in the Pinelands of New Jersey (Clarke and Nowak 2009, Dodds et al. 2018). Pitch pine is a favored host of SPB. While there is much to learn about susceptibility and the potential for reproductive success in northeastern pine species, red pine and Scotch pine have been attacked in Connecticut (Dodds et al. 2018, Hain et al. 2011). Additionally, eastern white pine, eastern hemlock, red spruce, and Norway spruce are occasional hosts (Clarke and Nowak 2009, Dodds et al. 2018).

Pitch pine, with 28 million trees (≥ 1.0 inches d.b.h.), makes up 5 percent of susceptible host species. Eastern white pine (55 percent), eastern hemlock (36 percent), red spruce (3 percent), and red pine/Scotch pine/Norway spruce (less than 1 percent combined) account for an additional 553 million susceptible trees. Species preferred by SPB occur on 12 percent of the region's forest land, or 612,000 acres. Of these stands, 88 percent are high density stands, where the basal area of host trees is greater than 80 square feet per acre (Fig. 6). Stand density is considered to be a critical factor in determining risk and expansion rate of SPB (Clarke and Nowak 2009).

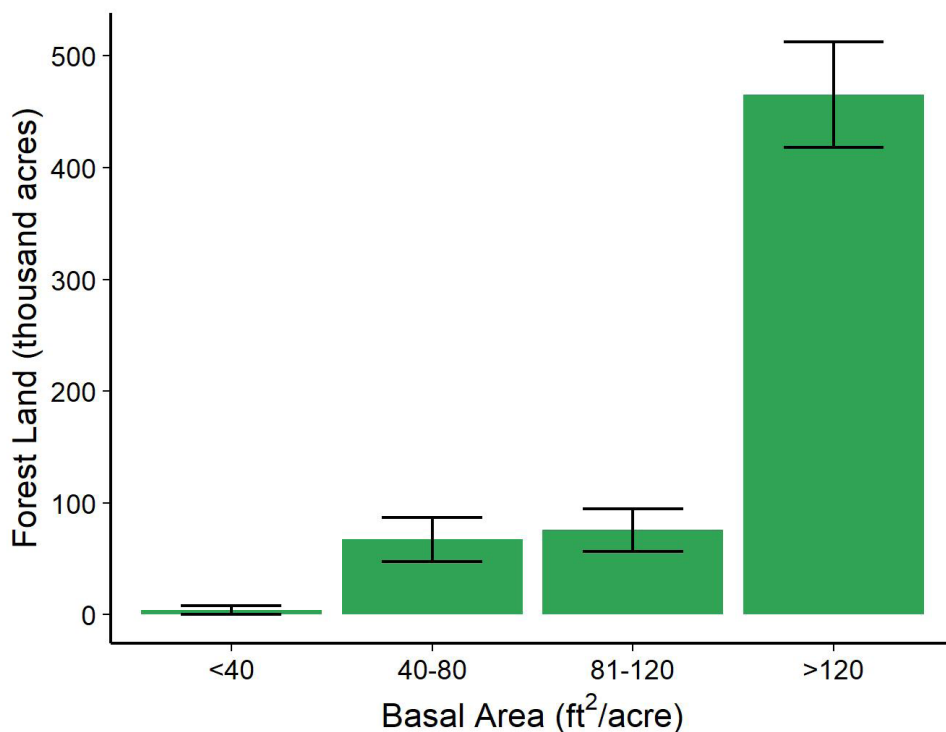


Figure 6.—Area of forest land by basal area for pitch pine, red pine, eastern white pine, eastern hemlock, scotch pine, red spruce forest types, Southern New England, 2017. Error bars represent a 68 percent confidence interval around the estimate.

Ecosystem Services

The forests and trees of Southern New England provide multiple benefits—also called ecosystem services—to people living in the region and beyond. Ecosystem services are defined as “...the aspects of ecosystems utilized (actively or passively) to produce human well-being” (Fisher et al. 2009). These include material benefits, such as timber and nontimber forest products, as well as non-material benefits, such as recreation and other cultural services. Regulating services (sometimes called critical ecological functions) produce well-being by regulating the energy and matter flows that constitute the human environment—things such as climate and hydrology that contribute to high quality drinking water supplies, among many other benefits.

We used i-Tree Landscape (i-Tree Team 2018), a component of the i-Tree suite of tools, to estimate the provision of three regulating services: carbon sequestration, air pollution removal, and runoff avoidance on Southern New England forests. This is far from a comprehensive treatment of ecosystem services; other metrics relevant to other services and benefits may be found in the interactive report section “Ecosystem Services” (<https://doi.org/10.2737/NRS-RB-125-INT>).

What we found

These three services produced benefits worth an estimated \$1.5 billion per year from the forests and trees of the region (Fig. 7): \$887 million from Massachusetts’s forests and trees, \$566 million from Connecticut’s forests and trees, and \$124 million from Rhode Island’s forests and trees. When accounting for forest area, this equates to an estimated \$284 per year per acre. Of the total, \$570 million per year, or 39 percent, is from carbon sequestration services. Another \$334 million per year (23 percent) is attributable to avoided storm water runoff.

The final \$573 million per year, or 39 percent, consists of benefits associated with the removal of 158 million kg of air pollutants. In terms of mass, the pollutant that was most removed by forests is ozone. In total, 113 million kg of ozone were removed—72 percent of the total quantity of pollutants removed. The removal of pollutants by forests improves human well-being primarily through reducing the annual number of disease cases and health incidents. In 2017 there were an estimated 88,632 fewer health incidents as a result of forests’ removal of pollutants. Eighty-one percent of these avoided incidents were acute respiratory symptoms and asthmatic episodes. In addition to disease cases, pollution removal services resulted in 14,491 fewer instances of lost school and workdays and 63 fewer mortalities.

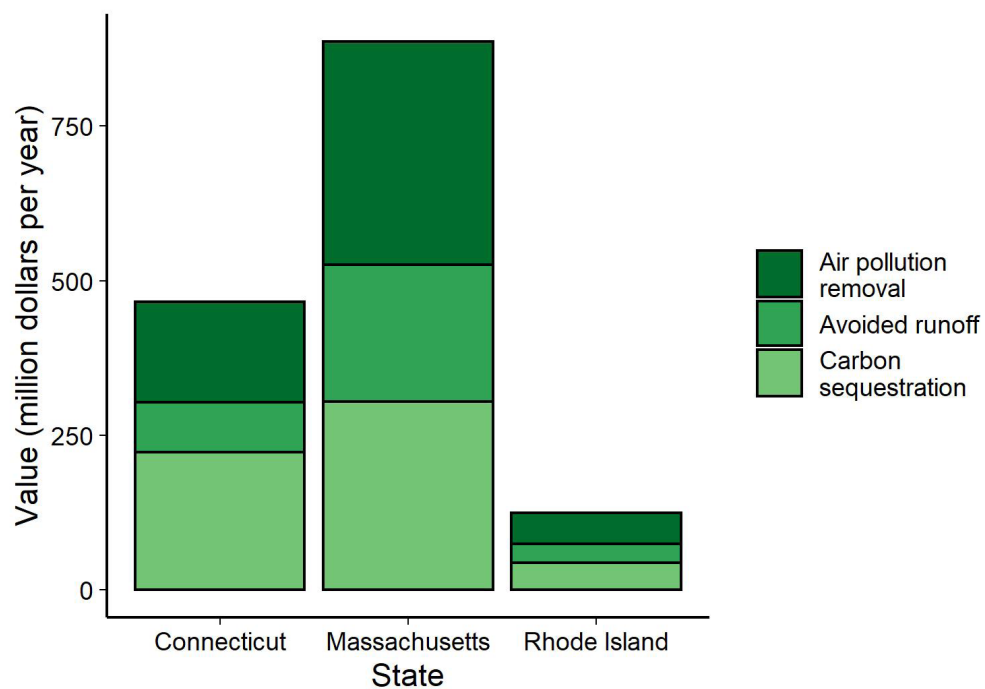


Figure 7.—Total annual value of three ecosystem services provided by forests and trees of Southern New England, 2017.

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Appendix

List of tree species, greater than or equal to 5 inches d.b.h found on FIA inventory plots, in Connecticut, Massachusetts, and Rhode Island, 2017

Common name	Genus	Species	Connecticut	Massachusetts	Rhode Island
Balsam Fir	<i>Abies</i>	<i>balsamea</i>	X	X	X
Boxelder	<i>Acer</i>	<i>negundo</i>		X	X
Striped Maple	<i>Acer</i>	<i>pensylvanicum</i>	X	X	
Norway Maple	<i>Acer</i>	<i>platanoides</i>	X	X	X
Red Maple	<i>Acer</i>	<i>rubrum</i>	X	X	X
Silver Maple	<i>Acer</i>	<i>saccharinum</i>	X	X	X
Sugar Maple	<i>Acer</i>	<i>saccharum</i>	X	X	X
Mountain Maple	<i>Acer</i>	<i>spicatum</i>		X	
Ailanthus	<i>Ailanthus</i>	<i>altissima</i>	X	X	
Mimosa, Silk tree	<i>Albizia</i>	<i>julibrissin</i>		X	
Serviceberry Spp.	<i>Amelanchier</i>	<i>spp.</i>	X	X	
Yellow Birch	<i>Betula</i>	<i>alleghaniensis</i>	X	X	X
Sweet Birch	<i>Betula</i>	<i>lenta</i>	X	X	X
Paper Birch	<i>Betula</i>	<i>papyrifera</i>	X	X	X
Gray Birch	<i>Betula</i>	<i>populifolia</i>	X	X	X
American Hornbeam, Musclewood	<i>Carpinus</i>	<i>caroliniana</i>	X	X	X
Mockernut Hickory	<i>Carya</i>	<i>alba</i>	X	X	X
Bitternut Hickory	<i>Carya</i>	<i>cordiformis</i>	X	X	
Pignut Hickory	<i>Carya</i>	<i>glabra</i>	X	X	X
Shagbark Hickory	<i>Carya</i>	<i>ovata</i>	X	X	X
American Chestnut	<i>Castanea</i>	<i>dentata</i>	X	X	X
Northern Catalpa	<i>Catalpa</i>	<i>speciosa</i>		X	
Hackberry	<i>Celtis</i>	<i>occidentalis</i>			X
Atlantic White-Cedar	<i>Chamaecyparis</i>	<i>thyoides</i>		X	X
Flowering Dogwood	<i>Cornus</i>	<i>florida</i>	X	X	
Hawthorn Spp.	<i>Crataegus</i>	<i>spp.</i>	X		
American Beech	<i>Fagus</i>	<i>grandifolia</i>	X	X	X
White Ash	<i>Fraxinus</i>	<i>americana</i>	X	X	X
Black Ash	<i>Fraxinus</i>	<i>nigra</i>	X	X	X
Green Ash	<i>Fraxinus</i>	<i>pennsylvanica</i>	X	X	X
American Holly	<i>Ilex</i>	<i>opaca</i>		X	X
Butternut	<i>Juglans</i>	<i>cinerea</i>		X	
Black Walnut	<i>Juglans</i>	<i>nigra</i>		X	
Eastern Redcedar	<i>Juniperus</i>	<i>virginiana</i>	X	X	X
Tamarack (Native)	<i>Larix</i>	<i>laricina</i>	X	X	
Yellow-Poplar	<i>Liriodendron</i>	<i>tulipifera</i>	X		X
Apple Spp.	<i>Malus</i>	<i>spp.</i>	X	X	X
Blackgum	<i>Nyssa</i>	<i>sylvatica</i>	X	X	X
Eastern Hophornbeam	<i>Ostrya</i>	<i>virginiana</i>	X	X	X

Appendix continued on next page

Appendix (continued).

Common name	Genus	Species	Connecticut	Massachusetts	Rhode Island
Norway Spruce	<i>Picea</i>	<i>abies</i>	X	X	
Red Spruce	<i>Picea</i>	<i>rubens</i>	X	X	
Red Pine	<i>Pinus</i>	<i>resinosa</i>	X	X	
Pitch Pine	<i>Pinus</i>	<i>rigida</i>	X	X	X
Eastern White Pine	<i>Pinus</i>	<i>strobus</i>	X	X	X
Scotch Pine	<i>Pinus</i>	<i>sylvestris</i>	X		X
American Sycamore	<i>Platanus</i>	<i>occidentalis</i>	X		
Eastern Cottonwood	<i>Populus</i>	<i>deltoides</i>	X	X	
Bigtooth Aspen	<i>Populus</i>	<i>grandidentata</i>	X	X	X
Quaking Aspen	<i>Populus</i>	<i>tremuloides</i>	X	X	X
Sweet Cherry, Domesticated	<i>Prunus</i>	<i>avium</i>	X		
Pin Cherry	<i>Prunus</i>	<i>pensylvanica</i>		X	
Black Cherry	<i>Prunus</i>	<i>serotina</i>	X	X	X
Cherry And Plum Spp.	<i>Prunus</i>	<i>spp.</i>			X
Chokecherry	<i>Prunus</i>	<i>virginiana</i>	X	X	
White Oak	<i>Quercus</i>	<i>alba</i>	X	X	X
Swamp White Oak	<i>Quercus</i>	<i>bicolor</i>	X	X	X
Scarlet Oak	<i>Quercus</i>	<i>coccinea</i>	X	X	X
Scrub Oak	<i>Quercus</i>	<i>ilicifolia</i>	X	X	
Bur Oak	<i>Quercus</i>	<i>macrocarpa</i>		X	
Swamp Chestnut Oak	<i>Quercus</i>	<i>michauxii</i>		X	
Pin Oak	<i>Quercus</i>	<i>palustris</i>		X	
Chestnut Oak	<i>Quercus</i>	<i>prinus</i>	X	X	X
Northern Red Oak	<i>Quercus</i>	<i>rubra</i>	X	X	X
Post Oak	<i>Quercus</i>	<i>stellata</i>		X	
Black Oak	<i>Quercus</i>	<i>velutina</i>	X	X	X
Black Locust	<i>Robinia</i>	<i>pseudoacacia</i>	X	X	X
White Willow	<i>Salix</i>	<i>alba</i>	X		
Black Willow	<i>Salix</i>	<i>nigra</i>		X	
Willow Spp.	<i>Salix</i>	<i>spp.</i>	X		X
Sassafras	<i>Sassafras</i>	<i>albidum</i>	X	X	X
American Mountain-Ash	<i>Sorbus</i>	<i>americana</i>		X	
American Basswood	<i>Tilia</i>	<i>americana</i>	X	X	
Other Or Unknown Live Tree	<i>Tree</i>	<i>unknown</i>		X	
Eastern Hemlock	<i>Tsuga</i>	<i>canadensis</i>	X	X	X
American Elm	<i>Ulmus</i>	<i>americana</i>	X	X	X
Slippery Elm	<i>Ulmus</i>	<i>rubra</i>	X	X	

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