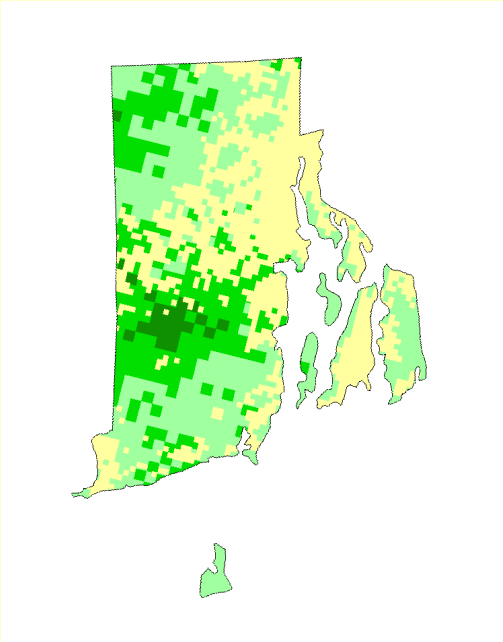
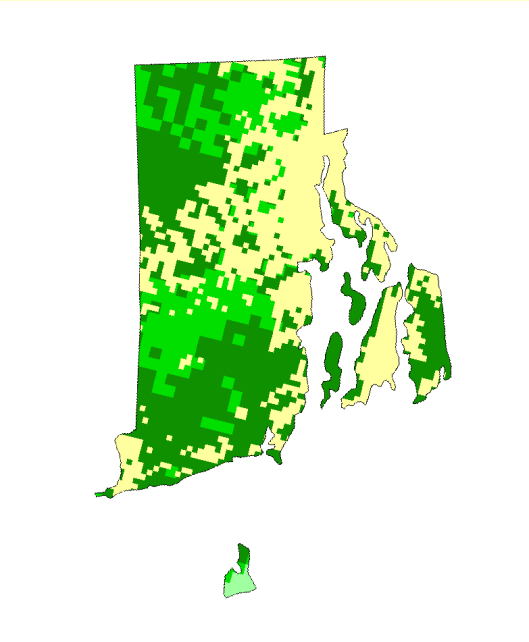
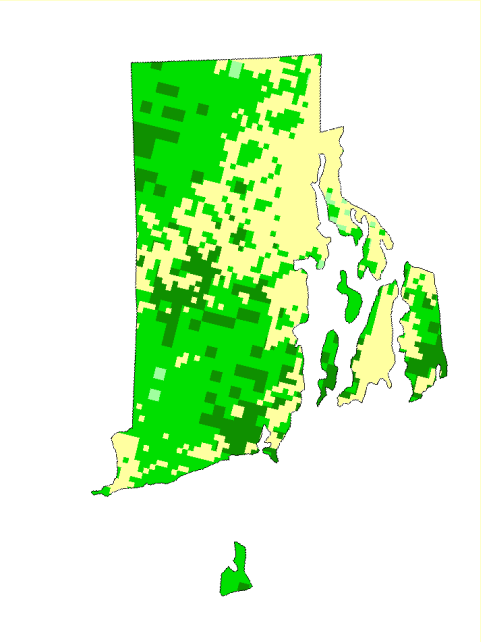
Figure 8. Relative importance of five common tree species across Rhode Island.



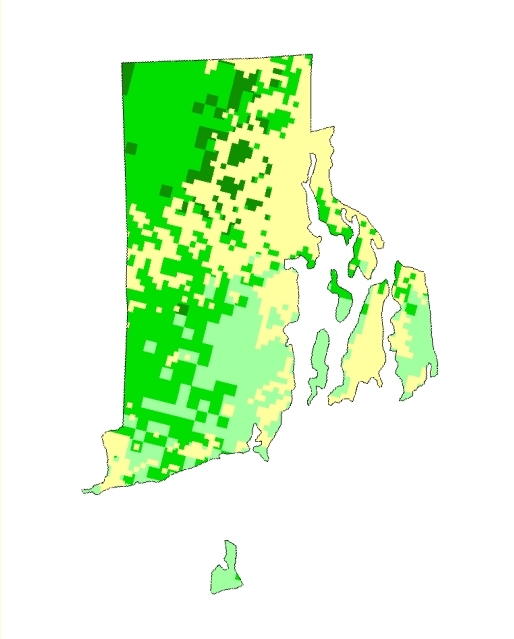
Eastern White Pine



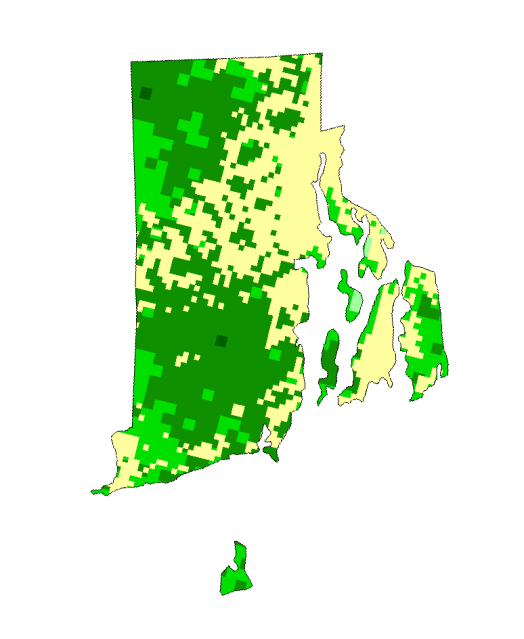
Red Maple



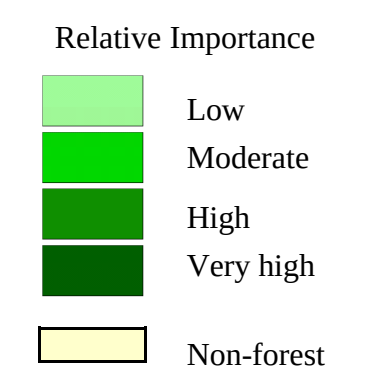
White Oak



Northern red oak



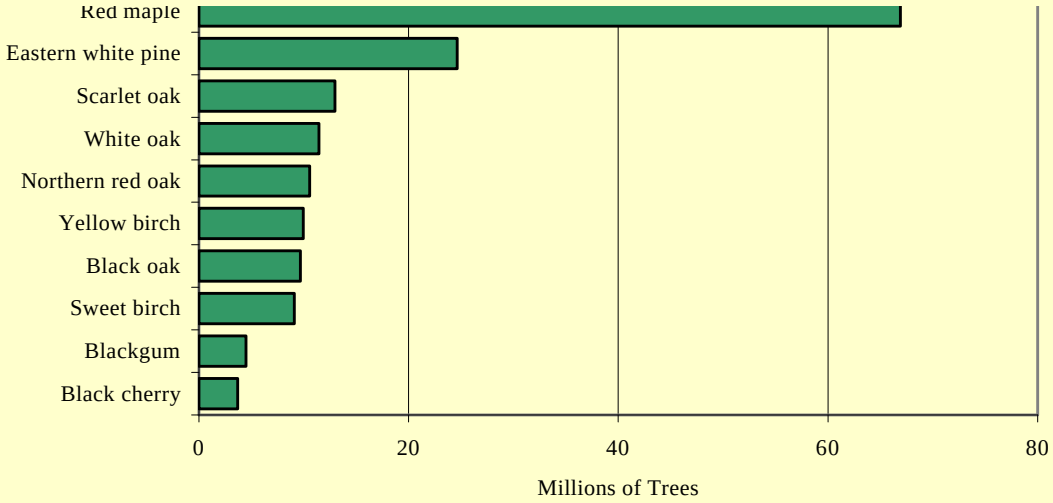
Other oaks



How were these maps created?

The 103 forested plots that were inventoried were used as known data. We predicted values at unknown locations using information found at these known locations. For example, an unknown area near a group of plots with large amounts of red maple probably has high amounts of red maple as well. Using this principle, we made predictions at every location on the map. The values are actually relative importance, or the percentage of a *stand's* basal area that is composed of that species. The categories used are low (less than 5 percent of a stand's basal area), moderate (5-19 percent), high (20-49 percent), and very high (50 percent or greater).

Figure 9. Number of trees, 5 in or greater diameter at breast height, of the ten most common tree species in Rhode Island.



FOREST COMPOSTION (CONTINUED)

Northern red oak

Since northern red oak and eastern white pine are commonly found growing together in Rhode Island, their distributions are similar (Fig. 8). Northern red oak is a major component of the oak/hickory forest type that dominates the state and is also an associate of the expanding maple/birch forest type.

Northern red oak is highly prized by the furniture and other forest product industries for its rich grain and durability. The best stands of northern red oak are found in northwestern Rhode Island on moist soils. After 25 to 50 years, northern red oaks start to produce acorns, that along with the acorns of other oaks, are an important food source for many wildlife species. Though these trees can live beneath other trees, they need full sunlight to thrive and reach maturity. In addition to reproducing by acorns, oaks commonly reproduce through stump sprouting where the trees have been cut or otherwise damaged.

White oak

Some of the oldest and largest trees in Rhode Island are white oaks. These trees can be found as relics in the forest indicating an abandoned pasture or homestead and are common in the woodlots of the larger estates. White oak also is found as part of the current forest throughout most of the state. There is a decreasing number of white oaks in the smaller size classes and usually, this species forms only a minor component of Rhode Island forests.

White oak grows well throughout Rhode Island, especially on moist, well drained sites. These trees also are valuable for the high quality wood and as a food source. In the past, white oaks have been particularly affected by the gypsy moths that have sporadically reached epidemic levels.

Other oaks

Scarlet oak, black oak, and chestnut oak are also found throughout much of Rhode Island. Other oak species, such as swamp white oak, are present in Rhode Island, but seldom encountered.

As with most oaks, these other oaks need a lot of light to establish and reach maturity. The exception is scarlet oak, which is somewhat more shade tolerant than other oaks. Scarlet oak, along with white oak, is one of the most common trees on Rhode Island's upland, well drained soils. Black oak tends to grow on moister sites. The abundance of these oaks has remained relatively stable.

Forest Structure

Forest structure refers to the physical attributes of a forest, such as the size and spacing of the trees. Structure is significant because it influences many of the characteristics that are important to people, plants, and wildlife. A forest of widely spaced trees of similar size appears and functions very differently than a forest of small trees that are packed tightly together, even if the species present are similar.

Aging forests

One factor greatly affecting both the structure and composition of Rhode Island forests is that the forests are getting older. As a result of low harvesting levels and few disturbances, the average forest age class increased from 40 to 60 years between 1998 and the previous forest inventory. Now more than half of the forest is in the 60-year age class.

The tendency for the forests to be concentrated in a single age class limits forest diversity. Younger forests, which represented a significant portion of the compositional diversity across the landscape are disappearing. This lack of diversity increases the forests susceptibility to catastrophic damage and limits wildlife diversity.

Forest volume

In the absence of disturbances, wood will continue to accumulate in forests. The volume of wood in Rhode Island forests has increased by 11 percent since 1985 and 45 percent since 1972. Currently there are nearly 500 million cubic feet of wood in the forest that are now or will be suitable for commercial uses. Barring any large-scale disturbances, the volume of wood will continue to increase until the forests become "overmature" and the volume stabilizes.

The total resource

Another approach to measuring the amount of wood in the forests is to include the trunks, roots, branches, and leaves of all trees and other woody plants—biomass. The total weight of forest biomass is useful in considering a forest's ability to store carbon to potentially offset fossil fuel emissions and help mitigate global climate change. In 1998, Rhode Island forests contained almost 25 million dry tons of trees and shrubs and the forests have the potential to produce much more.

Black birch
Betula lenta

Figure 10. Age distribution of Rhode Island forests

Sassafras
Sassafras albidum

Forest Health

A healthy forest is not necessarily one without stresses. Rhode Island forests have been and continue to be challenged by an array of diseases, insect pests, and other factors, but the ability of the forests to overcome these challenges has been well demonstrated. That is not to say that the forest has not been altered over time. Except for the influence of humans, it has been the invasive agents (non-native insects and diseases) that have had the most widespread impacts on the forest resource of the state.

After its introduction into the United States in 1869, the gypsy moth arrived in Rhode Island in 1901 and is now well established. Periodic outbreaks have caused thousands of acres of defoliation leading to large losses of growth and extensive tree mortality. White oaks seem particularly vulnerable to mortality. But abundant high quality trees continue to grow here. As one tree dies or becomes less vigorous, other trees take advantage of new opportunities. The extensive oak mortality of the early 1980s is at least partially responsible for observed increases in eastern white pine.

During the past two decades, outbreaks of gypsy moths have been less frequent and less widespread. In 2001, about 8,000 acres were defoliated by gypsy moths in Rhode Island. But before the caterpillars could mature, they were almost entirely wiped out by an infection from a fungus, *Entomophaga maimaiga*, that has become established within much of the gypsy moth's range. A disease complex that includes a virus and the aforementioned fungus appears to be providing an effective, if not complete, measure of control. With these pathogens in place, the gypsy moth may have a future more akin to a native insect than a conquering invader.

The same cannot be said for the chestnut blight. This disease effectively eliminated the American chestnut in Rhode Island and the nation in the early 1900s. Prior to the blight, American chestnut was a dominant species in the state and was highly prized for construction and furniture making. Its growth was rapid, its wood durable, and its nuts were an important food source for people and wildlife. In recent years, there has been progress developing a variety of American chestnut that is resistant to the blight.

More recently, the hemlock woolly adelgid is causing widespread mortality to Rhode Island's eastern hemlock trees. Initially identified in 1924 as an insect native to Asia, the adelgid was discovered in southern Rhode Island in 1985 and within 10 years established itself throughout the state. Chemical spraying is an effective treatment, but is not practical in forests that contain extensive areas of hemlocks. There is currently promising research on a biological control agent, but extensive mortality has taken place and more hemlocks will be lost before a solution can take effect.

Gypsy moth

Hemlock woolly adelgid egg masses

Methods for Monitoring Forest Health

The USDA's Forest Health Monitoring (FHM) program was established to monitor the long-term status and trends in the health of forest ecosystems. It is a national program implemented with the cooperation of individual states. Rhode Island has participated in the program since it began in 1990. Measurements have been taken annually and include a wide set of indicators that reflect forest conditions. Three of these measures are tree damage, crown dieback, and crown transparency.

Between 1998 and 2001, measurements were made on eight FHM plots in Rhode Island and adjacent portions of Connecticut and Massachusetts. These adjacent plots were included because the forest conditions were similar to those found in Rhode Island and the increased number of plots allowed for a greater accuracy in interpreting the results.

Dutch elm disease, butternut canker, dogwood anthracnose, beech bark disease, red pine scale, other pathogens, and a host of insect pests are common in the forest, but the forest continues to survive and thrive. However, stress is cumulative. Times of stress from environmental conditions, such as drought, tend to exacerbate the effects of insects and pathogens resulting in measurable damages.

Insects, disease, fire, wind, ice, and other destructive agents have all contributed to tree mortality in Rhode Island. But generally, the primary species of Rhode Island's forests are healthy with the exception of eastern hemlock. Some methods for assessing forest health include tree damage, crown dieback, and crown transparency (see box at the top of this page).

Tree damage

Tree damage is one of the simpler indicators of forest health. Causes of tree damage in Rhode Island include wind, insects, diseases, and other plants such as vines.

More than 80 percent of forest trees in Rhode Island show no signs of damage. The species that showed the greatest damage were red maple and white ash. Sixty percent of the damage observed was due to decay with most other damage being either broken tops or vines.

Crown dieback

Crown dieback occurs in the upper and outer portions of a tree and represents recent branch mortality, which begins at the tip of a branch and proceeds toward the trunk. Low dieback ratings are considered to be an indicator of good health because the tree has been able to support foliage and growth in the outer portions of its crown. Very few trees measured in Rhode Island had significant crown dieback. Dieback ratings were low on 84 percent of the trees, moderate on 15 percent, and high on 1 percent.

Crown transparency

Transparency measures the amount of light that passes through a tree's crown. A low transparency rating means that light was seen through less than 30 percent of the crown and indicates a healthy tree. Transparency ratings were low on 92 percent of all trees in the state.

An eastern white pine killed by an unidentified agent