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Forest Service

**Northeastern  
Research Station**

Resource Bulletin NE-163

# Forests of the Garden State

**Richard H. Widmann**



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## **Preface**

New Jersey's forests, a critical component of the State's natural resources, have been rich in history from colonial settlement to the present. In the Nation's most densely populated state, forests cover 45 percent of New Jersey's land mass and differ greatly in character from the coastal plain to the highlands region. These highly diverse forests provide globally significant biological communities, habitat for wildlife, forestry products, water quality, and opportunities for recreational. Although population growth and expansion into the rural environment have placed increased pressure on the State's forests, management professionals with the New Jersey Department of Environmental Protection's Forest Service continue to protect this valuable natural resource and provide sound stewardship to ensure that the broad range of benefits derived from these forests will be available to future generations.

## Forests of the Garden State

Long known as the Garden State, New Jersey also is noted for lots of people, congested roads, suburban sprawl, and industrial development, all which have changed the character of the State over the last half century. Despite this change, much of the Garden State is forested—more than one might think. Like a garden, a forest produces valuable products and related benefits that must be tended and protected. Looking after this important resource requires a knowledge of current forest conditions and trends. To obtain this information, the USDA Forest Service periodically inventories the Nation's forests. In 1998, in cooperation with the New Jersey Department of Environmental Protection, Division of Parks and Forestry, researchers with the Northeastern Research Station's Forest Inventory and Analysis (FIA) unit completed the fourth survey of New Jersey's forests. This report summarizes the findings of the most current and previous inventories (1956, 1972, and 1987), as well as major changes that have occurred in the State's forests.

## Historical Perspective

Settlers arriving in what is now New Jersey more than 300 years ago followed the waters inland and were confronted with dense forests. Along the coastal plain to the south, there were extensive forests of pines and thick stands of Atlantic white-cedar. The settlers also encountered huge hardwood forests along the Delaware River, and vast forested hills and mountains in the northern region. The Native Americans who lived here had barely disturbed these forests; but the settlers--Dutch, Swedes, and English--needed land for farms and towns as well as wood to build houses and for items ranging from implements and fuel to pine tar, pitch, and timber for ships. And a growing population demanded that increasing amounts of land be cleared for growing crops and for pasture. So forests fell in New Jersey. By 1860, many stands had been cut over many times—yet the cutting continued. Of course, some timber remained and new growth responded in cutover areas, but by the Civil War, lumber production peaked in the State as tree felling declined because of an ever dwindling supply. In northern New Jersey, residents began to use coal from Pennsylvania to heat their homes as firewood became



Forest Inventory and Analysis field crews receive permission from private landowners before taking tree measurements on their land.

more difficult to obtain. And in Philadelphia, builders obtained shingles from Maine to offset the scarcity of cedar. Fire that often followed timber cutting also slowed the natural recovery of New Jersey's forests.

Today, forests now cover much of the State due to the sharp decrease in wood harvests beginning around 1860 along with a corresponding decrease in the amount of acreage farmed. This recovery was aided by the rise of a conservation ethic that began in the late 1800's. Given a chance to grow under sound management, trees became reestablished naturally and relatively quickly in most regions of New Jersey. Efforts to control wildfires and low populations of white-tailed deer greatly facilitated this regeneration process.

Jersey's residents have changed in how they look at and value forests. Originally, forests were seen as barriers to progress and needed to be cleared for settlement to occur. Timber products, fuelwood, and wild game were the major benefits received from the forest. Although these remain important, today's forest is valued and appreciated for amenities that enhance the quality of life: watershed protection, opportunities for recreation, conservation of wildlife habitat, diverse landscapes, and scenic beauty.

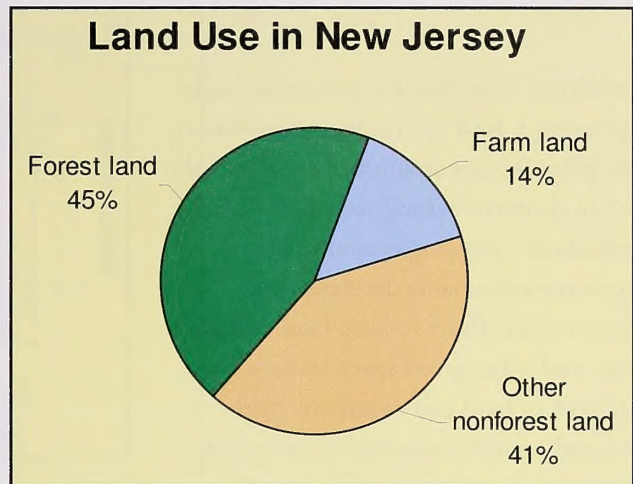
## About Forest Inventories

Widespread abuse of land in the Eastern United States led to the passage by Congress of conservation legislation

in the early part of the 20<sup>th</sup> century. Under this and subsequent Acts, the Forest Service's FIA units initiated ongoing forest surveys of all states to provide current data about the Nation's forest resources. FIA provides objective and scientifically credible information on key forest ecosystem processes, for example, the amount of forest land and whether it is increasing or decreasing in area, changes in species composition, and the rate at which trees are growing, dying, or being harvested. Such data are invaluable to numerous users because they:

- Help policymakers at both the federal and state level revise existing forest-management policies and formulate new ones, and enable land managers to better assess the effects of current and past management practices.
- Serve as a starting point for a variety of scientific investigations of processes by which forest ecosystems change over time.
- Keep the public informed as to the current health and sustainability of the Nation's forests.
- Address important resource issues such as urbanization, forest fragmentation, invasive pest species, wildfire risk, global climate change, and water quality.

FIA did not count every tree in inventorying New Jersey's forests. Instead, it used a scientifically designed sampling method. First, photointerpreters studied aerial photographs of the entire State. Then a grid of 17,000 points was overlaid on the photos. Each of the points was classified as to land use and, if forested, the size of the trees. For New Jersey, a sample of 433 plots was



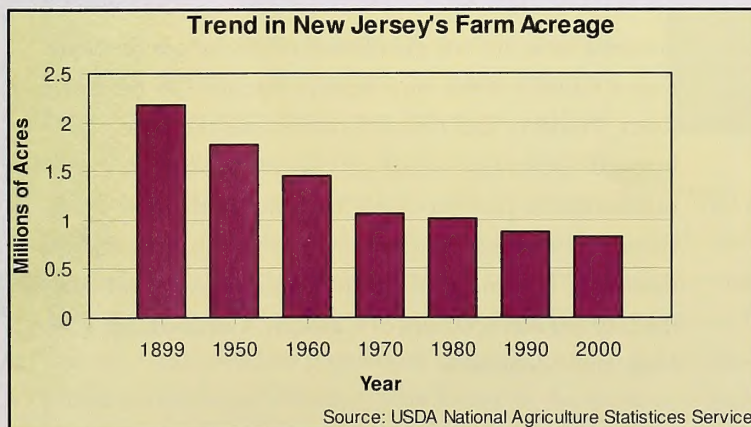
selected for measurement. Included were plots established during previous inventories. By remeasuring these plots, data were obtained on how individual trees grow. Some plots that had been established nearly 50 years ago were measured for the fourth time. Field crews collected information on a host of forest attributes, including the number, size, and species of trees. These data enabled FIA researchers to make reliable estimates of the current condition and overall health of New Jersey's forests, as well as the degree to which this vital resource is changing over time.

## Land Use and Forest Cover

### Extent of and Trends in Forest-Land Area

Forests cover 45 percent of New Jersey, or 2.1 million acres. This amount of forest cover is remarkable for a state that has seen tremendous population growth and economic development during the last decade. The State's forest land has remained relatively stable because

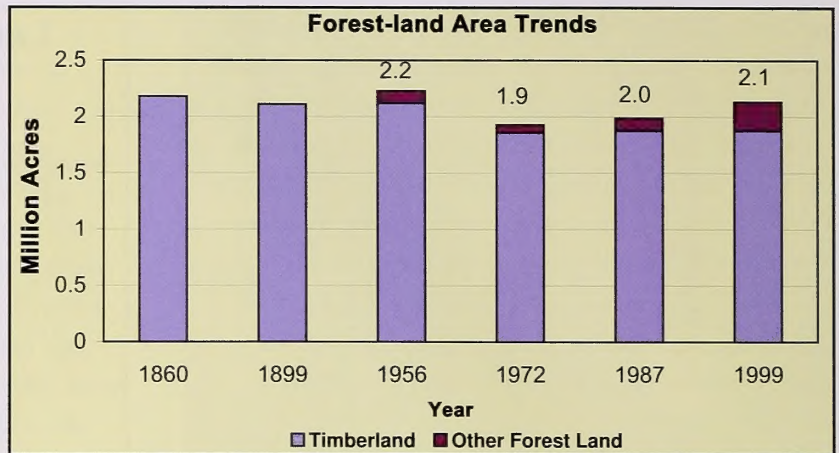
most of the population growth historically has been concentrated in areas adjacent to New York City, and because there has been a decrease in farm land. Land in farms is now less than half of what it was in 1956—a loss of more than a million acres. Although much of what formerly was farm land has been developed, a substantial portion has been left untended and has reverted to forest through natural regeneration. These new forests have negated losses in forest to development.



In addition, New Jersey is a national leader in protecting land by regulatory legislation. State planning has attempted to balance the need to conserve natural resources with the demands of a growing economy by promoting sustainable development. Conservation efforts to keep land in forests, farms, and other green space include both purchases of land and easements by the State and nongovernmental organizations. Conservation easements restrict future development while leaving the responsibility for management and ownership in private hands. By managing growth wisely, the adverse impacts of urban sprawl can be minimized in New Jersey. Still, despite these conservation efforts, a steady decline in forest-land area is likely throughout the State due to continued pressure placed on forests and farm land from development.

The 1999 FIA forest inventory revealed that forest land in New Jersey increased by 143,900 acres since the 1987 survey. This increase is attributed to the use of a more inclusive definition of forest land. Small forested areas in rights-of-way and in certain urban areas that previously were classified as nonforest were reclassified as forest. These areas are at least an acre in size, more than 120 feet wide, and stocked with trees. This change in inventory procedure was required because the value of all forest land is increasingly being recognized. Otherwise, there has been little change in the total forest land area in the State since the 1987 inventory. A separate survey by the National Resources Conservation Service showed a decrease in nonfederal rural forest land in New Jersey from 1987 to 1997.

Forest land is categorized by the Forest Service as timberland or “other” forest land. These categories aid in understanding the availability of forest resources and forest management planning. Although New Jersey is not considered a timber-producing state, 88 percent of its forest land (nearly 1.9 million acres) is classified as timberland that is potentially available for harvesting.



The amount of timberland has not changed appreciably during the last three decades even though New Jersey’s population increased by 15 percent (1.2 million) between 1970 and 2000.

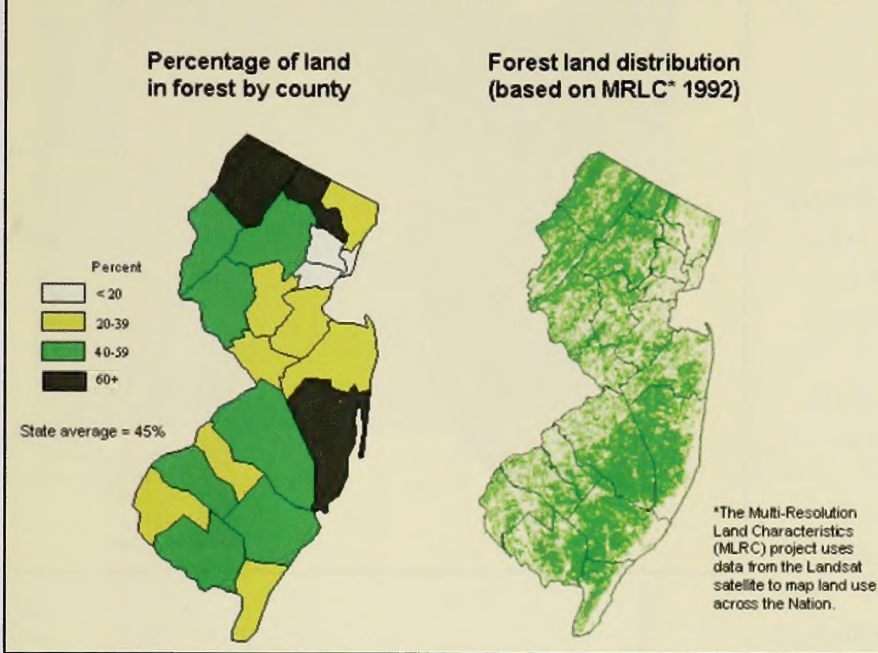
The other category of forest land includes reserved lands and unproductive forests. Harvesting for timber products on these lands is administratively restricted or economically impractical. Examples include parks, wildlife management areas, and wetlands where growing conditions are poor. Most of these forests are owned by public agencies. This category increased in area by nearly 150,000 acres (to 256,100) from 1956 to 1999. Nearly all of this increase is attributed to the reclassification of timberland to reserve status where timber harvesting is restricted.

### Distribution of Forest Land

Forested areas are not distributed evenly across the State. Sussex County is the most heavily forested (68 percent); Essex, Hudson, and Union Counties are the least forested. Generally, forests are concentrated in the northernmost portion of the State and in the Pine Barrens in Atlantic, Burlington, and Ocean, Counties in the south. Portions of the Pine Barrens also extend into the less forested counties of Camden, Cumberland, Cape May, and Gloucester.



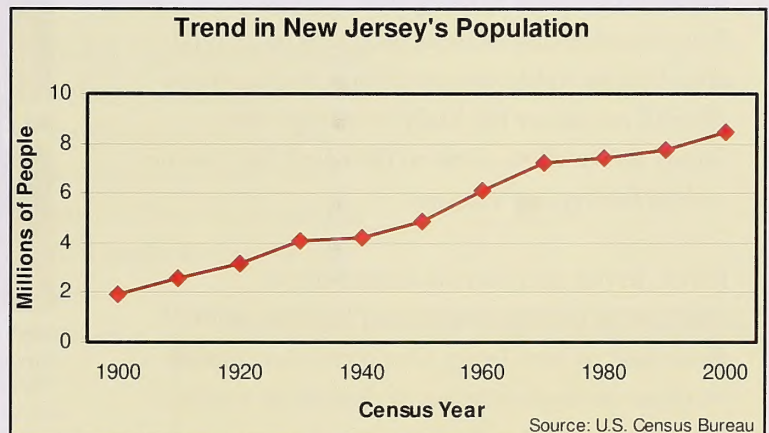
## County Maps of FIA Data and Remotely Sensed Data



## People and Forests

### Urban Forests

As the population of the Garden State continues to grow, the State's forests are becoming more urbanized. Urban forests are valued because they create more livable cities and towns, but frequently their value as habitat for wildlife and for ensuring biodiversity is impaired. The extent of urbanization can be depicted as a range of population densities. The urbanization map shows forest land by the population per square mile of the census block in which it occurs. The highest population densities are in those areas designated as urban by the U.S. Census Bureau. In addition to these designated urban areas, all forests in New Jersey are influenced by urbanization to some extent. In many instances, forests in areas with dense populations are on land that was initially rejected for development because the terrain was too wet, steep, or rocky. However, due to high prices for building lots and advanced building techniques, nearly all land is potentially suitable for development. Conservation efforts are focusing on identifying and preserving the most ecologically important of these urban forests. Areas with low population densities correspond to those with large public ownerships; Wharton State Forest in the south and Stokes and Worthington State Forests in the northwest portion of the State.

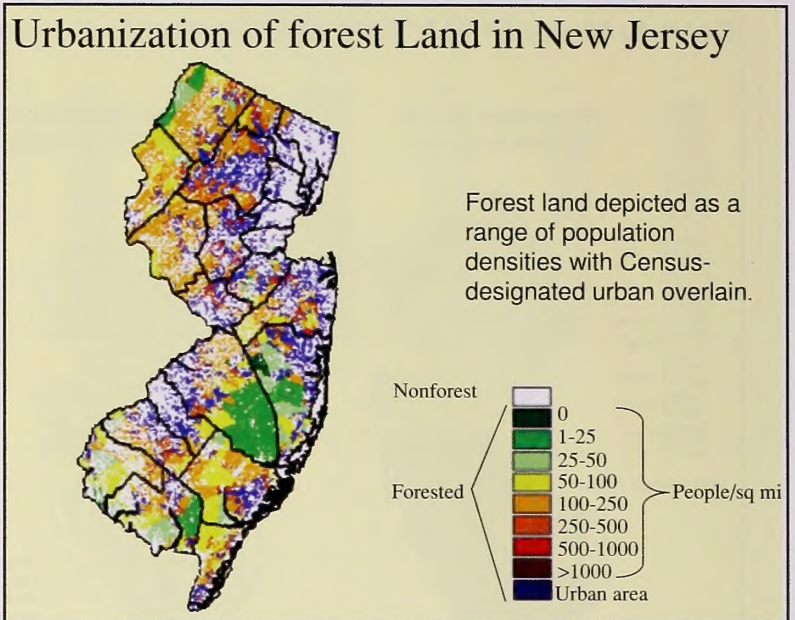


Major changes currently affecting New Jersey's forests are the result of people: it is people who decide where to clear land for houses and people who intentionally or unintentionally allow land to revert to forest. Absent people, nearly all of the State would be forested—but New Jersey's population is nearly 8.5 million and growing. How these people live on the land is a significant force in shaping the forest. New Jersey is the Nation's most densely populated state, yet it ranks ninth in the percentage of land area covered by forest.

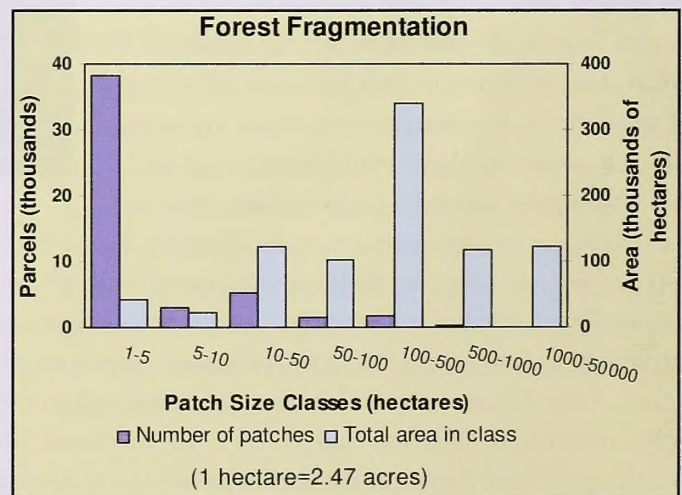
## Fragmentation is Degrading Forest Habitats

When a large portion of a forest is lost to new residential and urban development, the remaining forest land often is broken up into smaller tracts or noncontiguous patches. Known as forest fragmentation, this phenomenon is of growing concern to land managers and planners throughout the Northeastern United States. The fragmentation of forests, particularly by urban uses, degrades watersheds, reduces wildlife habitat, increases site disturbances, and favors invasion by exotic plant species. Many wildlife biologists believe that fragmentation is a contributing factor in the decline of some bird and wildlife species, though fragmentation favors species such as raccoons, squirrels, and white-tailed deer. These species are habitat generalists that have become acclimated to living near humans. Fragmentation also changes the character of rural areas because unlike owners of large tracts, owners of small parcels are less likely to manage their forests and/or allow access to their land for activities such as fishing and hunting.

Forest Service scientists are attempting to characterize the distribution and fragmentation of forest land in New Jersey. One way to accomplish this is to determine the size of these forest patches and their frequency. The State contains numerous patches that are 1 to 5 hectares (2.5 to 12.4 acres), but they represent only 5 percent of the total forest land. Three-quarters of New Jersey's forest land is in patches that exceed 100 hectares (247 acres). The largest patch, 5,726 hectares (14,149 acres), is in Warren County.



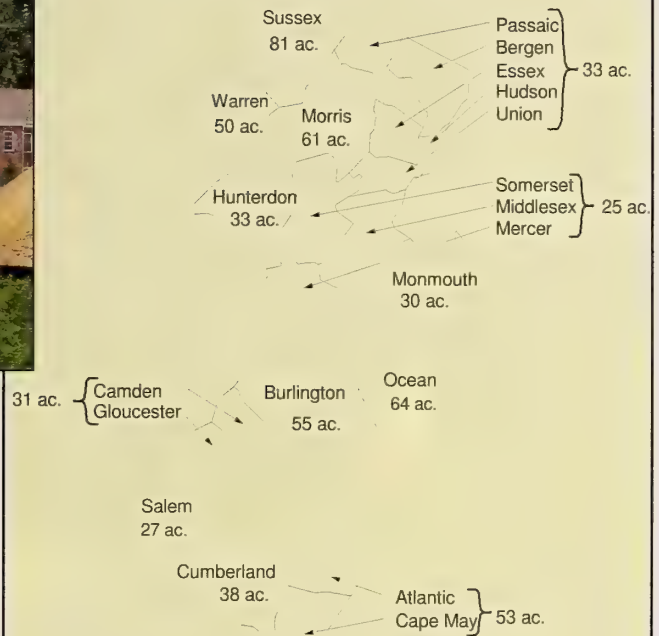
High deer populations change the amount and composition of forest regeneration. They eat suburban landscaping and cause high numbers of traffic accidents in many areas of New Jersey.





Development not only takes land out of forest but fragments the remaining forest habitat into small patches.

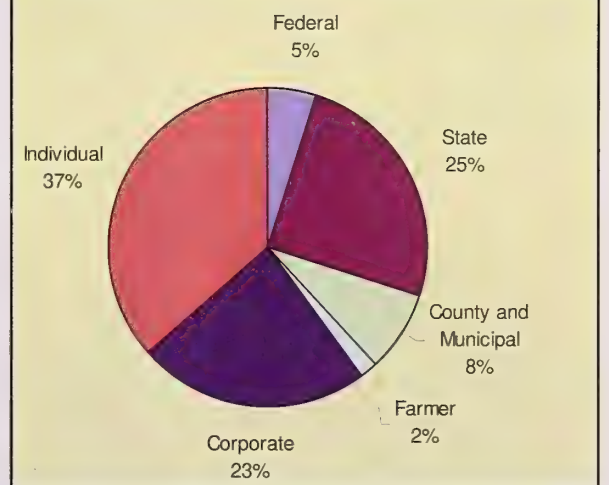
## Average Forest Patch Size



## Who Owns the Forest?

New Jersey has the highest percentage of forest land in public ownership of any state east of the Mississippi River. But unlike many western states, the Garden State has no National Forests and little forest land in federal ownerships. The State owns more than 500,000 acres of forest land—the largest ownership in New Jersey. However, this was not always the case. Because of public demand for recreation and clean water and a desire to keep parts of New Jersey undeveloped, State and local municipalities have been purchasing forest land and other open space. As a result, during the last half century, public ownership of forest land has more than doubled to 810,000 acres, increasing from 29 to 38 percent of forest land from 1987 to 1999. New Jersey is a leader in keeping land undeveloped for future generations to enjoy. Despite these increases in public ownership, the responsibility for managing the majority (62 percent) of New Jersey's forest land is in the hands of a large number of private owners. Recent estimates show that there are 89,000 forest-land owners in the State and their numbers are growing rapidly. They are represented by individuals, farmers, and corporations, including private land trusts. The reason for the rise in the numbers of forest-land owners is that large ownerships are being subdivided into smaller parcels to accommodate development. Owners have a wide range of reasons for owning land and diverse objectives in land management. Land trusts, whose holdings are increasing, work to keep land in forest by buying it outright or acquiring conservation easements that place restrictions on future use.

## Distribution of Forest Land Area by Ownership





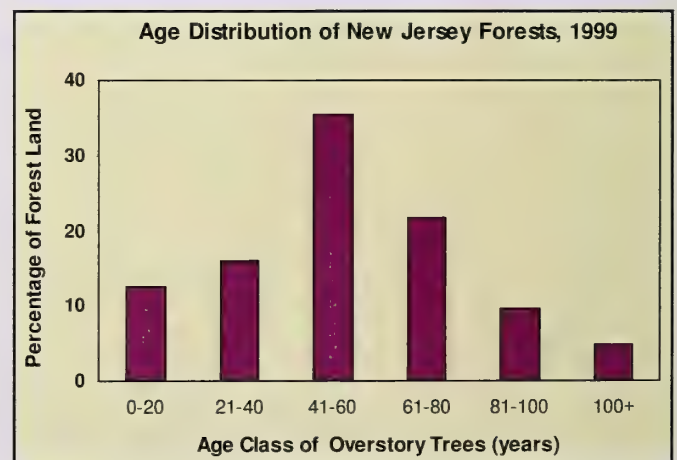
Public ownership of forest land provides recreational opportunities, protects water supplies, and preserves ecological values.

## Forest Structure and Composition Change Over Time

As forests mature, the species composition at a particular site undergoes what ecologists call forest succession. During this process, long-lived plants that can tolerate shaded conditions replace short-lived plants that need full sunlight to thrive. This continuous process is influenced by disturbances from natural as well as human sources. Examples of disturbance occurring in New Jersey's forests include drought, fires, outbreaks insect pests such as the gypsy moth caterpillars, land clearing followed by abandonment, and logging. The interaction of these and other factors working over time have shaped the State's diverse forest resource. An understanding of the changes taking place in New Jersey's forest is helpful in fully appreciating this valuable resource and in making wise decisions regarding its future.

## New Jersey's Forests Are Maturing

Many of the changes occurring in New Jersey's forests are associated with their age and maturation. Across the Northeastern States, forests are maturing as they recover from past land clearing and abuse. In the Garden State, many acres of forest land are abandoned farm lands that have naturally reverted to forest since the 1940's. Two-thirds of New Jersey's forests are younger than 60 years old. Because fewer acres of land are being allowed to revert, acreage in young stands will decrease. And once they mature, these stands will not be replaced. Maintaining forests that are well distributed across age classes enhances the biodiversity of the landscape and reduces the susceptibility to catastrophic damage.



## Trees Have Increased in Size and Number

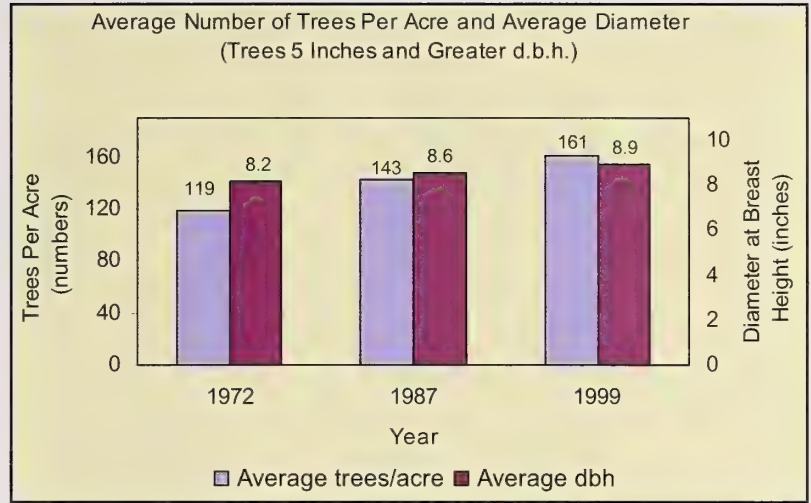
How well forests are populated with trees is determined by measures of tree size and number. Foresters measure a tree at its diameters at 4½ feet above the ground and refer to this as

diameter at breast height (d.b.h.). Of trees 5 inches and larger in diameter, the average d.b.h. has increased from 8.2 to 8.9 inches since 1972. During this period, the average number of trees at least 5 inches in diameter has increased from 119 to 161 per acre of timberland. Combined, these measures indicate that tree density has increased in New Jersey.

## Forest Composition

Changes in the numbers of trees have not been distributed evenly across diameter classes. Since 1972, the numbers of saplings has decreased while the numbers of trees in all diameter classes above 5 inches has increased. Combined, trees in the 2- and 4-inch diameter classes account for 70 percent of the trees at least 1 inch in d.b.h. Trees in the 6-, 8-, and 10-inch classes account for 24 percent; all trees 12 inches or larger account for 6 percent. The number of small trees declines as forests mature because the subsequent lack of sunlight reaching the forest floor inhibits the reproduction and growth of seedlings.

When describing a forest, people speak of the species of trees growing there, e.g., a pine, oak, or beech forest. Foresters use the term forest type to describe groups of species that are frequently found growing in association with one another. The 1999 inventory identified 36 forest types growing in the State.



Located primarily in the State's pinelands region and freshwater wetlands, Atlantic white-cedar swamps are essential storage areas for rainwater and water runoff. They help maintain productivity of wetland communities, provide essential habitat for wildlife and plant life, including threatened and endangered species, and add to the diversity and beauty of New Jersey's forest resource.



Courtesy of New Jersey Division of Parks and Forestry - New Jersey Forest Service

The New Jersey Forest Fire Service puts out most wildfires before they can threaten communities and structures. Forests in the Pine Barrens are adapted to disturbance from fires and recover with time.

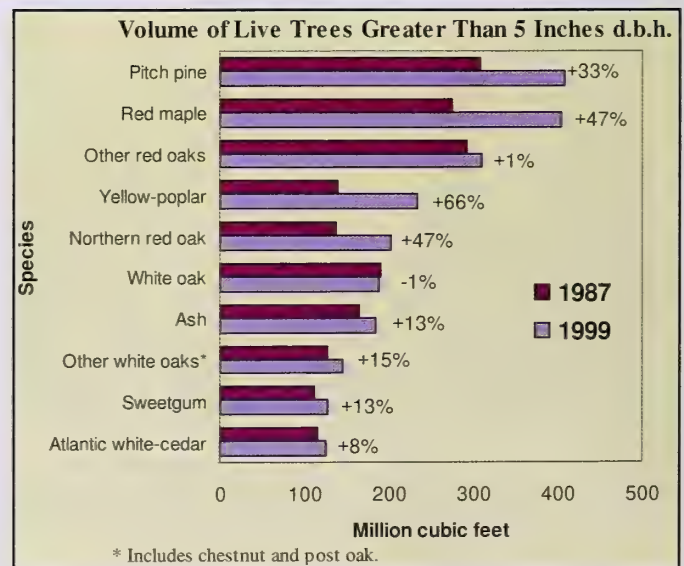
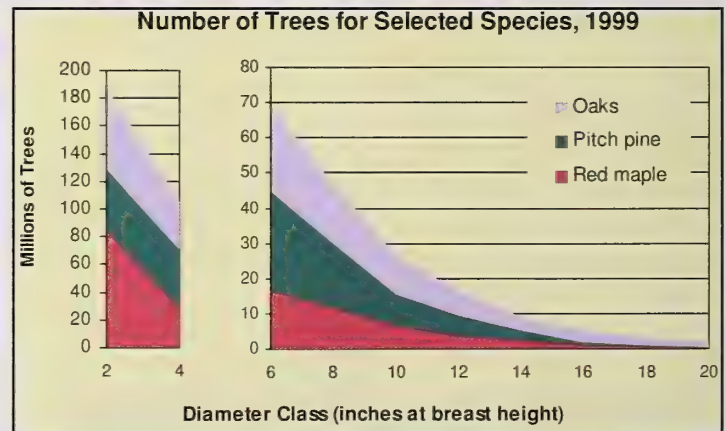
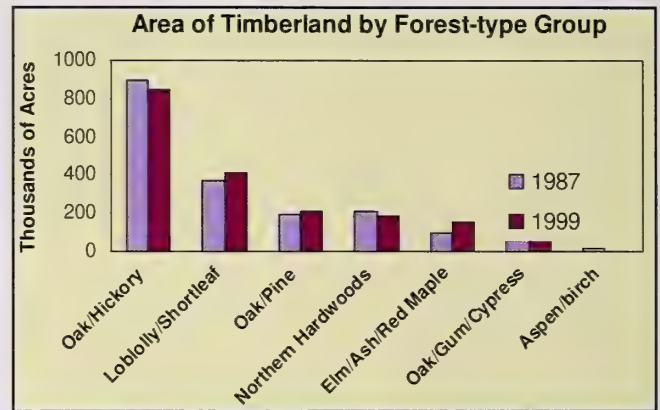
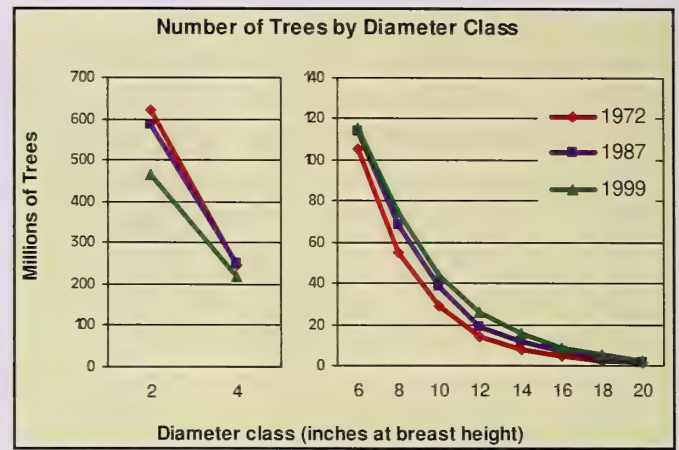


Pitch pine is the dominant tree in the pinelands of southern New Jersey.

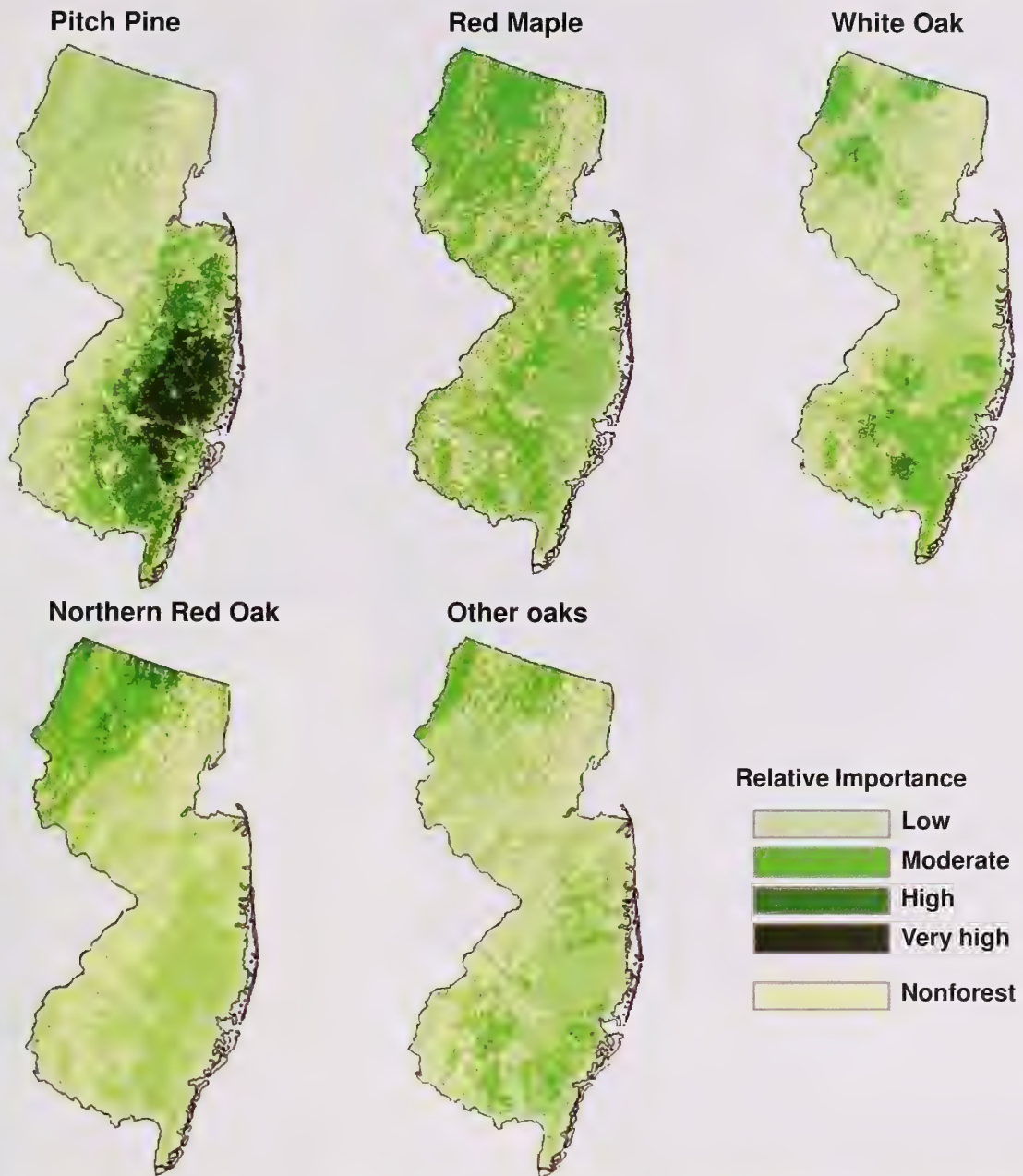
Similar forest types are combined into forest-type groups. Oak/hickory, the most common such group in the State, consists of well-known species such as white oak, northern red oak, hickory species, white ash, walnut, yellow-poplar, and red maple. The oak/hickory group covers two-thirds of New Jersey's forests. The pitch pine type, which is in the loblolly/shortleaf pine group, and the oak/pine group grow in the Pine Barrens in the southern part of the State. This area has a long history of wildfires, which promotes the growth of pine. Included in the oak/gum/cypress group are 32,000 acres of Atlantic white-cedar stands. Although covering too small an area to be captured by this inventory, some native red spruce grows in the extreme northwest portion of the State. These broad species groups, which have changed little in area since 1989, are another reflection of the diversity of New Jersey's forests.

The 1999 inventory also identified 77 species of trees, including many that are uncommon. Red maple, the most numerous species among trees less than 5 inches in diameter, is found to some extent in every forest-type group. Pitch pine is the most numerous species in the 6- to 10-inch diameter classes, while all oak species combined outnumber pitch pine and red maple trees in diameter classes above 12 inches.

The 10 most common species listed in the accompanying chart account for 79 percent of the total cubic-foot volume of trees in the State. Cubic-foot volume is a measure of the amount of wood in the bole of a tree between a 1-foot stump and a 4-inch top diameter. Pitch pine remained the leading species by volume, followed by red maple. However, red maple showed the largest increase in volume and likely will overtake pitch pine in terms of volume in the near future. Together, oak species represent 29 percent of the total volume of live trees at least 5 inches in d.b.h. Individual species are distributed by how well they are suited to particular site conditions. In addition to the factors mentioned, the numbers and types of animals present also affect species distribution. Deer, mice, and squirrels influence forest composition by browsing seedlings, consuming available seeds of preferred species, and storing seeds that later germinate. For example, deer prefer to browse oak rather than red maple and yellow-poplar seedlings.

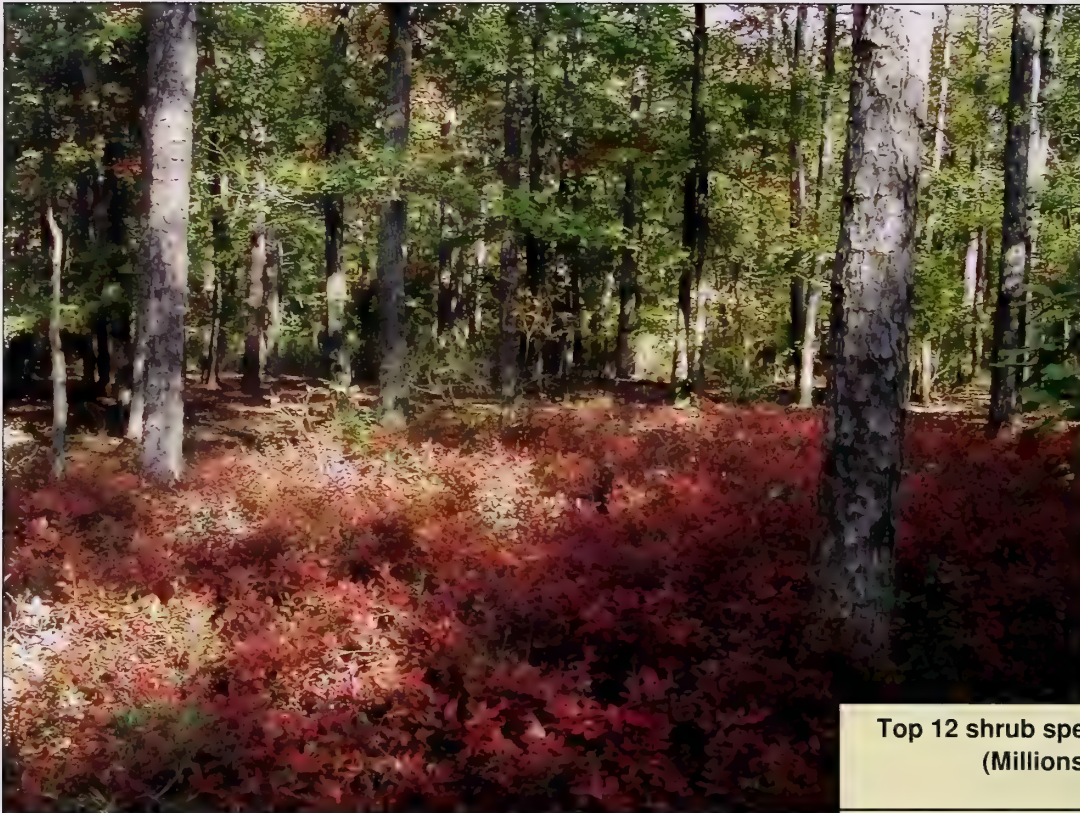


## Relative Importance of Five Common Tree Species Across New Jersey



### How were these maps created?

The inventory plots were used as known data. Then the values at unknown locations were predicted from information from those plots. For example, an unknown area near a group of plots with large amounts of pitch pine probably has high amounts of pitch pine as well. Using this principle, we made predictions at every location on the map. The values of relative importance are the percentage of a stand's stocking 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). Stand basal area is the total cross-sectional area of trees at breast height--usually calculated as square feet per acre.



Huckleberry and blueberry are the most abundant shrub in New Jersey's forests, turning a bright red in the fall.

Red maple grows abundantly throughout New Jersey except in the Pine Barrens, where wildfires have kept populations of this fire-susceptible species low and restricted its distribution to wet areas. In the dry, sandy soils of the Pine Barrens, pitch pine flourishes and is frequently found growing with blackjack and scarlet oak and a dense shrub layer of huckleberry and blueberry. As with many of the plants that grow here, pine and oak species are able to survive and reproduce after fires because of their thick bark and ability to sprout from stumps when the tree bole is killed. In addition, fire is the mechanism that causes the cones of pitch pine to open and release their seeds.

### Shrubs

Understory vegetation is an important component of forested habitats because it provides both food and cover for wildlife. Huckleberry and blueberry are the most common shrub species in New Jersey. Barberry, a

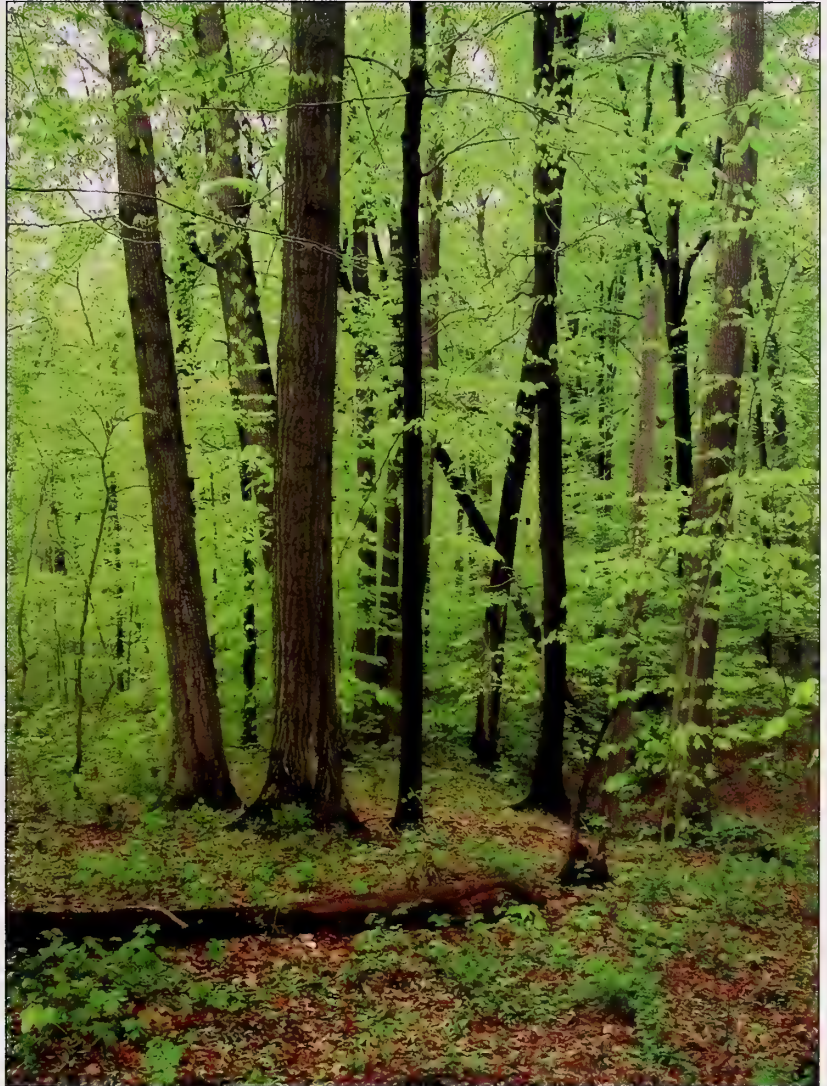
nonnative plant that invades natural plant communities, is the eleventh most common shrub growing in the State's forests. High deer populations contribute to the spread of barberry because it is browsed infrequently.

Top 12 shrub species in New Jersey (Millions of stems)	
Huckleberry	24,323
Blueberry	12,802
Sweet pepperbush	4,550
Sheep laurel	2,055
Rose	1,087
Briers/Brambles	930
Common spicebush	894
Mountain laurel	736
Maple-leaf viburnum	573
Maleberry/Staggerbush	506
Barberry	443
Fetterbush	277



## The Changing Face of New Jersey's Forest Habitat

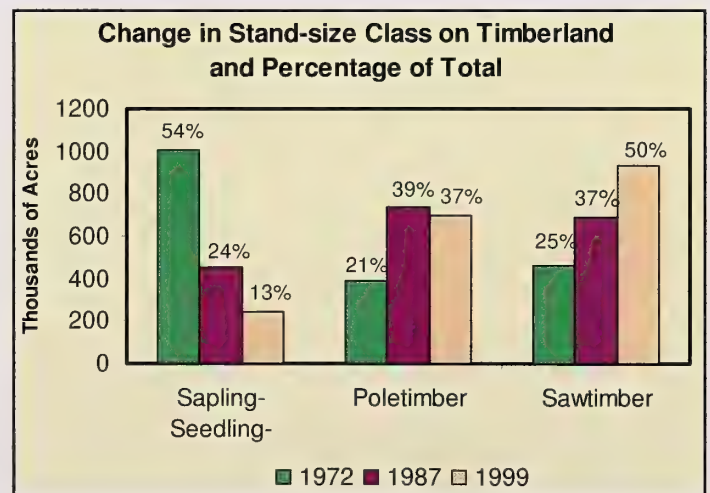
The types and number of wildlife species that inhabit a forest change as it matures. In the seedling-sapling stage that follows major disturbances such as clearcutting, fire, and land abandonment, many wildlife species use low-growing herbaceous and shrub vegetation. Species that prefer this type of habitat include the American goldfinch, cedar waxwing, song sparrow, and eastern cottontail. As larger trees become established and shade out much of the low-growing vegetation, species that depend on this early pioneer vegetation decline in number as others that use the boles of trees move into the area. This intermediate stage corresponds to the poletimber-size class. Many poletimber stands lack the low-growing vegetation of the regeneration stage and the tree boles lack the bark flaps, cavities, and other bole characteristics that develop as a stand matures. As a result, the number of species present is low between the dense thicket vegetation of the regeneration stage and the mature or sawtimber-size class, which is dominated by large trees. The number of species reaches a maximum in mature, overmature and all-age stands. Species that are more likely to inhabit mature stands include the black bear, porcupine, and pileated woodpecker.



New Jersey's forests are maturing. On half of the forest land, sawtimber-size trees are the dominate vegetation.

In New Jersey, the area in the regenerating or seedling-sapling stage has decreased because less farm land is being allowed to revert to forest. Conversely, the area in the mature or sawtimber-size trees has increased because low rates of harvesting have contributed to the continued growth and maturation of the forest. These changes have been accompanied by a remarkable recovery and return of many woodland species during the last century. Population increases have been noted for beaver, black bear, white-tailed deer, and wild turkeys.

Wildlife populations are dependent on the quality of the forest habitat. Habitat characteristics that increase as stands mature include the size of mast-producing trees and the number of standing dead and cull trees. Beech,



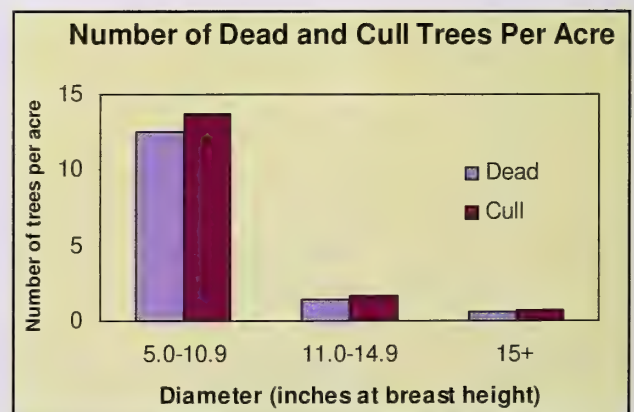


Land reverting to forest from abandon farm land offsets forest land lost to development. Only a small portion of New Jersey's forest land is covered with early successional seedling/sapling stands.

hickory, and the oaks are important mast-producing species. Hard mast such as nuts and hard seeds produced by overstory trees is an important forage resource for wildlife. Species that depend on acorns and other hard mast include the black bear, blue jay, chipmunk, gray fox, red-headed woodpecker, ruffed grouse, squirrel, striped skunk, white-tailed deer, and wild turkey. The amount of mast produced increases as trees become larger, so it can be assumed that mast production has increased in New Jersey with the increase in the number of large diameter beech, hickory, and oak. Since 1987, the number of oak and beech trees 11 inches and larger in diameter has increased by 26 and 23 percent, respectively.

Standing-dead and cull trees are important feeding and nesting sites for wildlife. These trees have a higher probability of being used by primary cavity nesters such as woodpeckers as their wood is more easily excavated. These and natural cavities caused by disease or injury are used as resting or nesting sites by various species of birds and small mammals. In New Jersey, 8 percent of all standing trees more than 5 inches in d.b.h. are dead. On average, there are 15 dead trees 5.0 inches or larger in diameter per acre of timberland. A third of the dead trees are species of oak.

Cull trees, which also are important to wildlife, exceed maximum allowances for defects for use as timber products. Yet some of the same characteristics that make these trees undesirable for timber products are beneficial to wildlife. Examples include cavities, broken tops, pockets of rot, and boles with numerous forks and limbs. On average, there are 16 cull trees per acre of timberland.



## Biomass

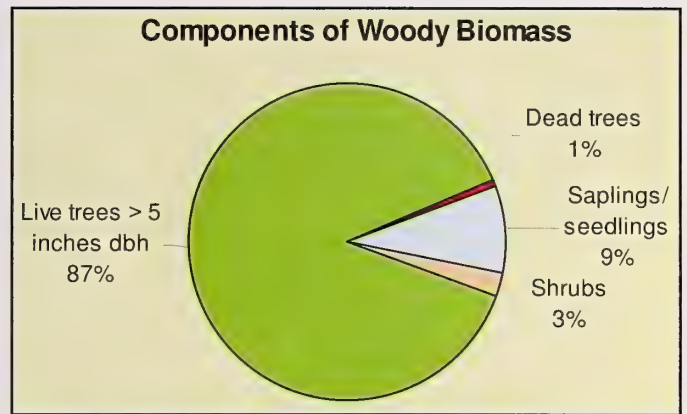
Trees play an important role in the world's carbon cycle. They act as a sink for carbon, removing it from the atmosphere in the form of carbon dioxide (a greenhouse gas) and storing it as cellulose. In this role, forests help mitigate the effect of burning fossil fuels and the resulting global climate change associated with increased levels of carbon dioxide in the atmosphere. In New Jersey, because of increases in tree volume, the State's forests contribute greatly to the sequestration of carbon.

Woody biomass, a measure of how much carbon is being stored on forest land, is the total weight of both live and dead trees, including branches, roots, and stumps, plus the weight of shrubs. The total dry weight of all biomass on New Jersey's timberland equals 135 million tons or 83 tons per acre. The largest portion of this amount (55 percent) is contained in the merchantable boles of commercially important trees. It is this component that can be converted to high-value wood products. Other portions of biomass are underutilized and can be considered as a potential source of fuel for commercial power generation. Because it is a renewable source of energy, biomass could help reduce the Nation's dependence on fossil fuels. In some regions of the country, the use of biomass to fuel commercial power generating plants has provided markets for low-grade trees and other waste wood.

## Sustainability and Use of New Jersey's Forests

Well-tended forests supply a continuous flow of products without impairing long-term productivity. Unlike coal and oil, forests are alive and renewable. One way to judge the sustainability of a forest is to look at the components of inventory change—growth, removals, and mortality.

During the last 50 years, the growth of New Jersey's forest resource has greatly outpaced losses due to the removal of trees by cutting and mortality. Removals include trees harvested on land that remains in forest, trees lost because the forest was developed for a nonforest use, and trees removed from the timber resource base because they grow on land where harvesting now is restricted. The most recent inventory revealed that since



1987, on an annual basis, the net growth of trees in New Jersey averaged 58 million cubic feet versus 36 million cubic feet in removals. This surplus translates to an annual net increase of 0.8 percent in the volume of wood on the State's timberland.

Nearly 70 percent of removals are attributed to the conversion of forests to nonforest uses; 27 percent is attributed to timberland reclassified to reserve status, and 5 percent to harvesting. Trees regenerate and thrive after harvesting so long as the land remains in forest. Forests classified as reserved continue to provide benefits other than timber products. Converting large amounts of forest to nonforest use threatens sustainability because such changes usually are permanent. As a result, future timber growth from these lands is lost, as are related benefits, for example, the recharge of groundwater aquifers. Loss of forest land to development is a growing concern in New Jersey as the adverse effects of clearing forests for development are cumulative over time. By contrast, forests recover from sustainable timber harvests. Because harvesting represents only 3 percent of the annual net growth, it has few impacts on the State's timber resource. New Jersey currently has few sawmills, so a large portion of the harvested trees is shipped to mills in Pennsylvania and New York. The lack of markets for raw wood products makes it more difficult for forest owners to generate profits from their land and increases the likelihood that these tracts will be converted to other nonforest uses.

In addition to insects and diseases, disturbances such as fire, wind, and competition among trees contribute to tree mortality. The volume of trees that die from causes



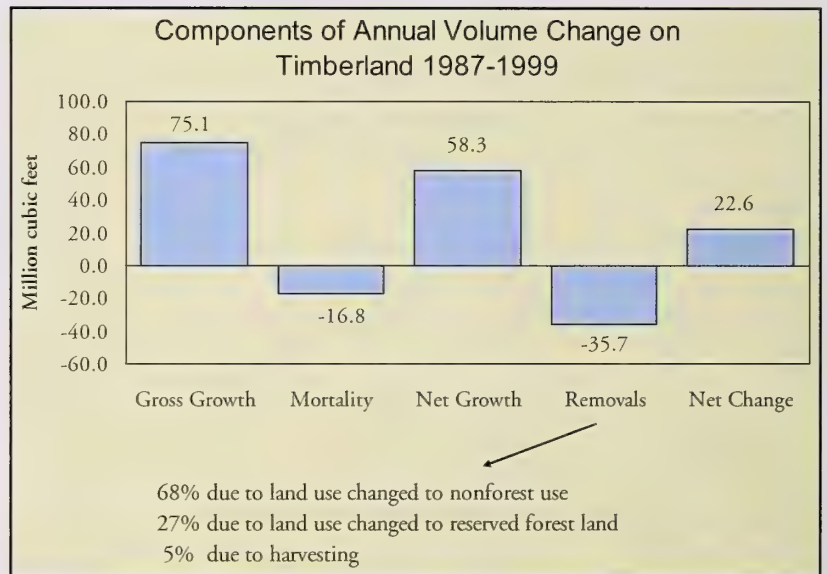
Courtesy of New Jersey Forest Fire Service

Despite the use of state-of-the-art equipment and technology, wildfires have burned thousands of acres of New Jersey's forests during drought years.

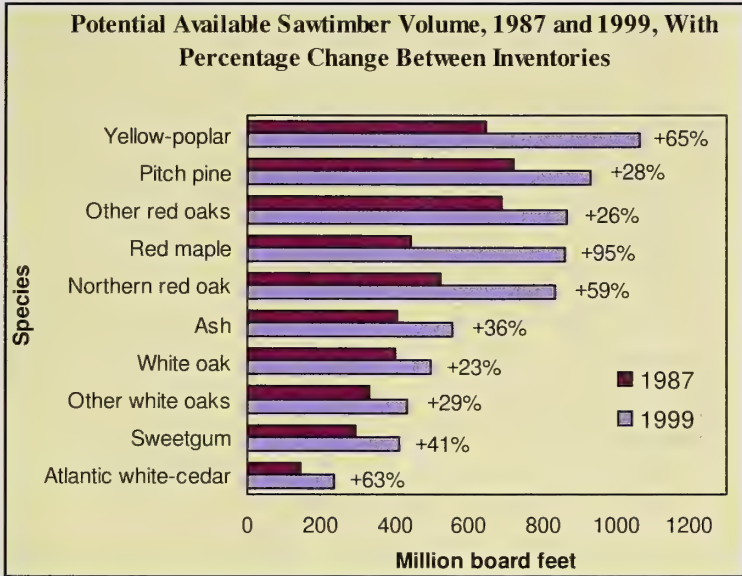
other than cutting is reported as mortality. In 1999 in New Jersey, average annual mortality was 16.8 million cubic feet or 0.6 percent of the inventory volume. This rate, similar to those in neighboring states, is considered normal. Generally, mortality rates were higher for trees less than 11 inches d.b.h. than for larger diameter trees; mortality rates were higher for softwood than for hardwood species. In many instances, the smaller trees that died were understory trees that were crowded out by larger trees. As trees become larger, fewer can grow on each acre of forest land.

### Potential Supply of Timber

New Jersey has untapped potential with respect to its timber resource. In 1999, the potential amount of sawtimber available for harvesting totaled 8.1 billion board feet, an increase of 44 percent since the 1987 inventory. This total is equivalent to the amount of wood in a half million houses. The large increase in volume was attributed primarily to the many poletimber-size trees that grew to sawtimber size. Hardwood species account for 83 percent of the total board-foot volume. Yellow-poplar and pitch pine were the leading species in sawtimber volume; the oak species accounted for a third of the volume.



	<b>Mortality Rates</b>		
	Trees 5 to less than 11 inches d.b.h.	Trees 11 inches and larger in	All trees 5 inches and larger in d.b.h.
Softwood species	80.00%	70.00%	0.80%
Hardwood species	100.00%	0.30%	0.50%
<b>All species</b>	<b>0.90%</b>	<b>0.40%</b>	<b>0.60%</b>



so unchecked populations can explode under the right conditions.

The loss of the American chestnut to the chestnut blight in the early 1900's and the demise of the American elm to the Dutch elm disease later in the century demonstrate the destructive nature of nonnative exotic species. Introduced diseases that are not as well known are the butternut canker, which is slowly eliminating butternut trees from the Nation's eastern forests, and dogwood anthracnose, which has greatly reduced the populations of dogwood trees in the forest understory. Since the late 1960's, periodic outbreaks of the gypsy moth caterpillar have defoliated thousands of acres of forest, resulting in large losses of tree growth and extensive tree mortality. White oak is particularly susceptible to gypsy moth.

## Forest Health

Forests are continually stressed by insects, diseases and other factors that reduce growth and increase tree mortality. How forests withstand them is a measure of their overall health. To a great extent, New Jersey's forests have overcome these stresses as trees have continued to increase in number, size, and volume. An increasing threat to forest health is the introduction of exotic insects, diseases, and plants from overseas. Introduced species typically have few natural enemies in this country,

The hemlock woolly adelgid (HWA) and the elongated hemlock scale, introduced to the United States from Asia, are causing widespread mortality of eastern hemlock trees. The HWA has been destroying hemlock stands in New Jersey for more than two decades. Many hemlocks grow in nearly pure stands in ravine forests in the northern part of the State. The loss of dense shade provided by these trees can alter the ecology of streams in



Above, courtesy of USDA APHIS, image 2652087 ([www.forestryimages.org](http://www.forestryimages.org))

The hemlock woolly adelgid, an introduced pest, is killing hemlock trees in northern New Jersey. Without the dense shade provided by hemlocks, streams warm in the sun and become unsuitable for trout.

ravines. Because the HWA and hemlock scale feed on the juices in the hemlock needles, chemical spraying to control these pests is ineffective. Currently, a predatory beetle that is a natural enemy of the HWA in Asia is being released in the State. Another destructive forest insect pest, the Asian longhorn beetle, was detected in Jersey City in 2002. Thought to have arrived in the United States in the wood of shipping pallets, the beetle feeds on a variety of hardwood trees, including maples and ash. Intense efforts are underway to prevent this species from establishing itself in the State. To date, the Asian longhorn beetle can be eliminated only by removing infested trees and destroying them by chipping or burning.

Air pollution and climate change are long-term threats to the health of a forest. Air pollutants such as ozone can distress foliage and acid deposition can alter the soil chemistry. A warming of the climate could result in a shift in the range of certain tree species that thrive in cool weather. Species such as sugar maple would migrate northward out of New Jersey, making growing conditions favorable to other species.

To assess long-term forest health, the Forest Service carefully measures selected indicators that can help scientists detect when trees are under stress and which species are most susceptible. These include crown dieback, ozone injury, lichen communities, and soil conditions. The accumulate data from these annual measurements should provide increasingly accurate assessments of the health of New Jersey's forests.

## **The Future of New Jersey's Forests**

In general, New Jersey's forests are healthy and resilient, and will continue to mature. Current trends indicate that the State's future forests will have larger trees, higher volumes per acre, and more old-growth characteristics. But these forests will be vastly different from the original forests that confronted the early settlers. As the Garden State's economy and population grow, the impact on the forest resource will only increase. Land cleared for development will remain in this condition permanently even as more land is cleared. Fragmentation of forests into ever smaller patches will continue, rural areas will

become more urbanized, and the introduction of unwanted invasive insect, disease, and exotic plant species will continue to threaten native species. Once established, many nonnative species become a permanent part of the ecosystem they inhabit. The adverse effects of these changes may not be immediately evident, and the overall impact may be difficult to assess because forests change slowly.

High deer populations are causing changes in species composition and hindering the ability of forests to reproduce. Natural processes within the forest are disrupted by interference by humans. For example, increased efforts to control wildfires as homes and new developments encroach on forests, breaking the natural fire cycle to which the State's pinelands are adapted. As a result, in the Pine Barrens, pine eventually could lose its dominance to hardwood species.

Threats to New Jersey's forest from beyond its borders include pollutants carried into the State by wind, and possible changes in climate. These and other factors will make it increasingly difficult to manage the Garden State's forests. As threats to forest health increase, the monitoring and tending of forest land will become more important. Attempts now underway to keep hemlock trees from disappearing and to control Asian longhorn beetles are examples of management activities that will become more common in the future.

Attention to the urban forest will increase our understanding of how trees benefit society. Programs designed to build, maintain, and enhance the urban forest likely will expand, as will community commitments to protect the State's urban-suburban forests. Regarding trees as a valued element of the urban infrastructure will result in a better managed resource that will improve the aesthetics and livability of New Jersey's cities and towns.

The area of forest in the State has peaked as the area of new forests from abandoned agricultural lands now is being outpaced by development. In reaction to this, forests in public ownership probably will continue to expand. Land trusts, nonprofit organizations, and public



**Before Thinning**

Thinning understory vegetation concentrates future growth on a few large trees and reduces the risk of destructive crown fires.

Photos courtesy of New Jersey Division of Parks and Forestry - New Jersey Forest Service



**After Thinning**

agencies and government entities are actively pursuing protection strategies. Conservation easements allow lands to remain in private ownership and protect critical habitats for wildlife while providing a continued mechanism for forest use. The pace of forest loss will be determined by the effectiveness of efforts to identify and

target for protection undeveloped land that is critical for providing benefits such as clean drinking water and recreational and aesthetic enjoyment. Should these and other programs be successful, New Jersey will become a leader in integrating people into a functioning ecosystem.



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Widmann, Richard H. 2005. **Forests of the Garden State**. Resour. Bull. NE-163. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station. 20 p.

A report on the fourth forest inventory of New Jersey conducted in 1998-99 by the Forest Inventory and Analysis unit of the Northeastern Research Station. Discusses the current condition and changes from previous inventories for forest area, timber volume, tree species, and growth and removals. Graphics depict data at the state level and by county where appropriate.

**Keywords:** New Jersey; forest inventory; volume; biomass; growth and removals

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