New Jersey's Forests 2008

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Abstract

The first full annual inventory of New Jersey's forests reports more than 2.0 million acres of forest land and 83 tree species. Forest land is dominated by oak/hickory forest types in the north and pitch pine forest types in the south. The volume of growing stock on timberland has been rising since 1956 and currently totals 3.4 billion cubic feet. The average annual net growth of growing stock from 1999 to 2008 averages 94.6 million cubic feet per year. This report includes additional information on forest attributes, land use change, carbon, timber products, and forest health. The included DVD provides information on error estimates, quality assurance of data collection, tables, and raw data.

Acknowledgments

The authors would like to thank the many individuals who contributed to both the inventory and analysis of New Jersey's forest resources. Primary field crew and QA staff over the 2004-2008 inventory cycle included Joseph Kernan, Stephen Potter, Richard Starr, Jr., Michael Whitehill, and Thomas Willard. Data management personnel included Carol Alerich, Charles Barnett, James Blehm, Gary Brand, Dale Gormanson, Mark Hatfield, Bob Ilgenfritz, Greg Liknes, Lisa Mahal, Richard McCullough, Kevin Nimerfro, Barbara O'Connell, Jay Solomakos, and Jeffrey Wazenegger. Report reviewers included Rich Widmann and Jon Klischies (New Jersey Forest Service).

Cover: Batsto River. Photo by Richard Widmann, U.S. Forest Service

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Foreword

It is with great satisfaction that we present to you New Jersey's statewide forest inventory report. This report is a cooperative effort led by the Forest Inventory and Analysis program of the Forest Service, U.S. Department of Agriculture, and the New Jersey State Forestry Services, New Jersey Department of Environmental Protection, summarizing conditions and trends in New Jersey's forest resources.

Maintaining open space is a value supported by the majority of New Jersey residents. Despite New Jersey's dense population and small size, the state is 42 percent forested. As New Jersey's population has risen, the amount of forest land in the State has remained fairly constant since the 1970s. The reversion of farmland to forest plays a role in maintaining forest land. In addition, the State's dedication to conservation efforts have expanded public land holdings and promoted the stewardship of private lands.

The continued conservation of forested land in our state is not without its challenges. However, while New Jersey's forests are aging and increasing in volume, regeneration of younger trees has been in decline, leaving our forests vulnerable to rapid, widespread changes due to succession. These changes could have impacts on water quality, wildlife habitat, recreation opportunities, and overall quality of life in the state. Threats from insects and diseases, parcelization, invasive species, wildfire, urban sprawl, and associated land conversion present additional challenges to stakeholders.

Moving forward, New Jersey land managers must be flexible and adapt to changing land use and conditions. With the majority of our State's forested lands in private ownership, government and private entities will have to meet these challenges together. It is our hope that New Jersey's Forests 2008 will provide valuable information to land managers. We invite the readers of this report to reach out to other interested stakeholders in order to engage in thought provoking discussion about our forest resources.

Lynn E. Fleming
State Forester
New Jersey State Forestry Services
Division of Parks and Forestry
Department of Environmental Protection

Contents

Highlights

On the Plus Side

Despite a growing population, statewide estimates of forest area have remained consistent since 1971 and currently account for 42 percent of total land area.

At 55 tons per acre, New Jersey timberland contains a large amount of aboveground biomass.

New Jersey's forests support a wide diversity of tree and vascular plant species.

Carbon stocks in New Jersey are relatively high and will continue to increase as young stands mature.

Forest growth continues to increase and exceeds volume losses due to harvest, land-use change, and mortality.

The quality and quantity of sawtimber resources on timberland have been steadily increasing across New Jersey.

Wildlife habitat provided by standing dead trees is relatively high; most of these snags are Atlantic white-cedar.

Areas of Concern

Forest land continues to show a pattern of forest loss in favor of developed land uses that are likely to become permanent.

Mortality is on the rise, particularly within large-diameter stands and among ash, yellow birch, and cottonwood and aspen species groups.

While continuous forest land is located in some areas of New Jersey, forest fragmentation is high in heavily residential and urban areas.

Largely attributable to hemlock woolly adelgid, mortality of hemlock has reached its highest rate since 1987.

Invasive plant species, including Ailanthus, Japanese honeysuckle, and multiflora rose, are widely distributed across New Jersey.

Issues to Watch

The average size of private forest parcels is small and is accompanied by indications that many private holdings will be changing ownership in the near future.

Though emerald ash borer has not been identified in New Jersey, ash mortality has more than tripled since 1987, indicating the potential presence of this insect or minimally, that it will perpetuate an underlying forest health problem if introduced.

A dominant component of New Jersey's forest resource, a high density of pitch pine in the southern half of the state increases risk of and potential damage caused by an outbreak of southern pine beetle.

Though growing-stock volume continues to rise, the majority of forest stands are maturing and will eventually experience density and age-related issues.

Atlantic white-cedar. Photo by Susan Crocker, U.S. Forest Service.


Mixed hardwood and conifer stand. Photo by Susan Crocker, U.S. Forest Service.

Background

Wallkill River National Wildlife Refuge. Photo by Kevin Holcomb, U.S. Fish and Wildlife Service.

An Overview of Forest Inventory

What is a tree?

Trees are perennial woody plants with central stems and distinct crowns. The Forest Inventory and Analysis (FIA) program, of the Forest Service, U.S. Department of Agriculture, defines a tree as any perennial woody plant species that can attain a height of 15 feet at maturity. Deciding which species should be classified as shrubs and which should be classified as trees is a dilemma. A complete list of the tree species measured in this inventory can be found in Appendix A in "New Jersey's Forests 2008: Statistics, Methods, and Quality Assurance", on the DVD in the inside back cover pocket of this bulletin.

What is a forest?

FIA defines forest land as land at least 10 percent stocked by trees of any size or formerly having had such tree cover and not currently developed for nonforest uses. The area with trees must be at least 1 acre in size, and roadside, streamside, and shelterbelt strips of trees must be at least 120 feet wide to qualify as forest land. Trees in narrow windbreaks, urban boulevards, orchards, and other 'nonforest' situations are very valuable too, but they are not described in this report.

What is the difference between timberland, reserved forest land, and other forest land?

From an FIA perspective, there are three types of forest land: timberland, reserved forest land, and other forest land. In New Jersey, about 93 percent of forest land is timberland, 6 percent is reserved forest land, and 1 percent is other forest land.

- Timberland is unreserved forest land that meets the minimum productivity requirement of 20 cubic feet per acre per year at its peak.

- Reserved forest land is land withdrawn from timber utilization through legislation or administrative regulation.

- Other forest land is commonly found on low-lying sites with poor soils where the forest is incapable of producing 20 cubic feet per acre per year at its peak.

In New Jersey's periodic inventories (1999 and prior), only trees occurring on timberland plots were measured. Therefore, we cannot report volume of trees on forest land for those inventories. The new annual inventory system, which in New Jersey began with the 2004-2008 inventory (hereafter referred to as the 2008 inventory), facilitates the estimation and reporting of volume on all forest land, not just timberland. As these annual plots are remeasured in the coming years, we will also be able to report growth, removals, and mortality on all forest land. Trend reporting in this publication is necessarily limited to timberland except for the area of forest land on which individual tree measurements are not required.

Where are New Jersey's forests and how many trees are in New Jersey?

Forest distribution, composition, and structure are affected by ecological factors, including geology, soil type, and climate. These characteristics help define the five physiographic regions of New Jersey: Ridge and Valley, Highlands, Piedmont, Inner Coastal Plain, and Outer Coastal Plain (Collins and Anderson 1994) (Fig 1). The unique features of each region influence the presence and type of forest therein. Exposed bedrock and thin, rocky soil characterize the Ridge and Valley section, where chestnut oak and pitch pine-scrub oak types dominate the landscape (Collins and Anderson 1994). Mesic soils in the broad ridges of the Highlands and rolling hills of the Piedmont give way to red oak-white oak-hickory, hemlock-mixed hardwood and maple-beech-birch forests. Soils of the Inner Coastal Plain have higher clay content and are thus more fertile than the dry, sandy, acidic soils of the Outer Coastal Plain (Collins and Anderson 1994). White oak, chestnut oak, scarlet oak, and American holly are dominant species

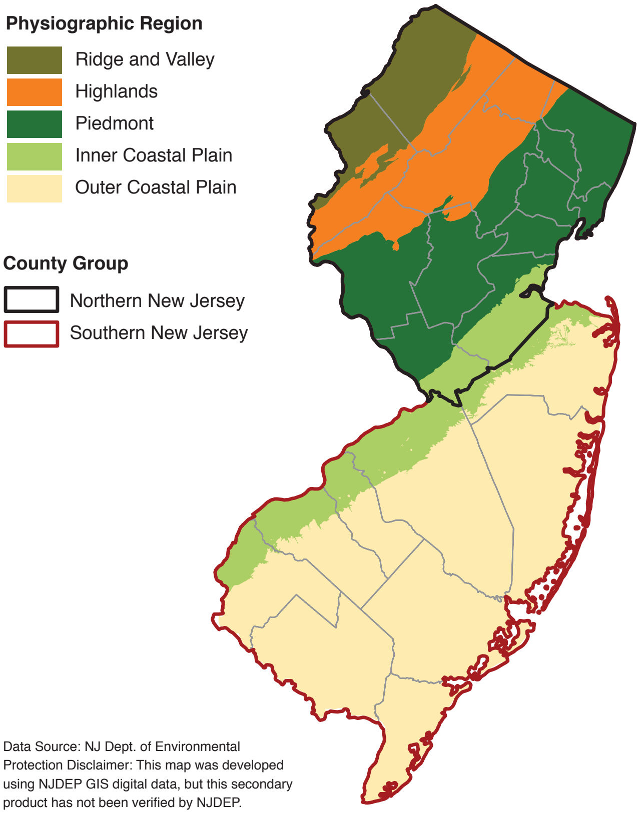


Figure 1.—Physiographic regions of New Jersey and county group by region.

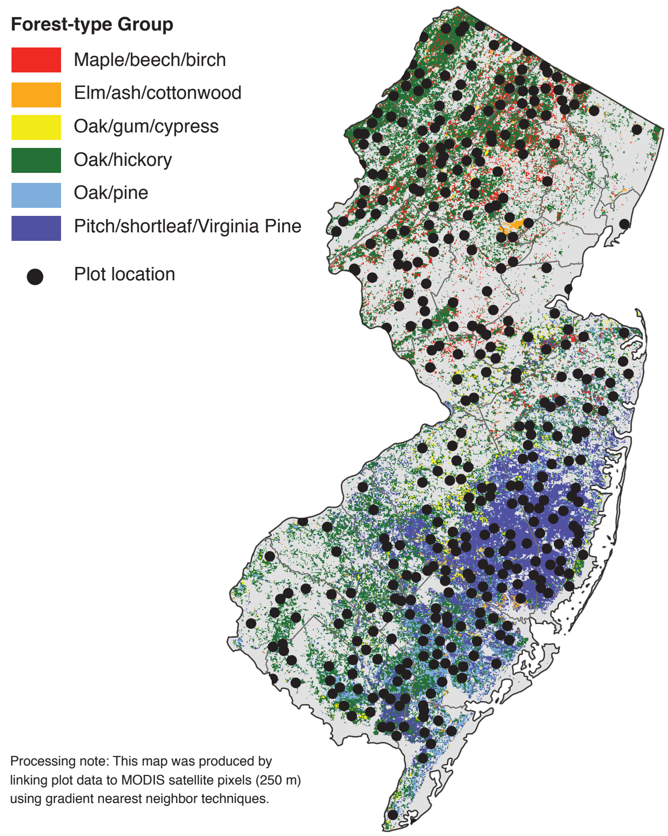


Figure 2.—Distribution of forested FIA plot locations and forest land by forest-type group, New Jersey, 2008. Plot locations are approximate.

within the Inner Coastal Plain. The Pine Barrens, which covers most of the Outer Coastal Plain, is a region that is highly influenced by fire and as a result, pitch pine and blackjack oak thrive (Collins and Anderson 1994).

Forest land area is concentrated in the southeastern and northwestern portions of the State (Fig. 2). Forest types in these two regions vary greatly; while oak-hickory forest types are more prevalent in northern New Jersey, pitch pine forests dominate southern New Jersey. New Jersey's forest land contains approximately 989 million trees that are at least 1 inch in diameter at breast height (d.b.h., 4.5 feet above the ground). We do not know the exact number of trees because the estimate is based on a sample of the total population. Trees were measured on 373 forest plots (Fig. 2). For information on sampling errors, see "New Jersey's Forests 2008: Statistics, Methods, and Quality Assurance" on the DVD at the back of this bulletin.

How do we estimate a tree's volume?

Forest inventories typically express volume in cubic feet, but the reader may be more familiar with cords (a stack of wood 8 feet long, 4 feet wide and 4 feet high). A cord of wood contains approximately 79 cubic feet of solid wood and 49 cubic feet of bark and air. Volume can be precisely determined by immersing a tree in a pool of water and measuring the amount of water displaced. Less precise, but much cheaper and easier to do with living trees, is a method adopted by the Northern Research Station. In this method, several hundred trees were cut and detailed diameter measurements were taken along their lengths to accurately determine their volumes (Hahn 1984). Statistical tools were used to model this data by species group. Using these models, we can produce individual tree volume estimates based on species, diameter, and tree site index.

This method was also used to calculate sawtimber volumes. FIA reports sawtimber volumes in International 1/4-inch board foot scale as well as Doyle rule. To convert to the Scribner board foot scale see Smith (1991).

How much does a tree weigh?

Building on previous work, the U.S. Forest Service's Forest Products Laboratory developed estimates of specific gravity for a number of tree species (U.S. For. Serv. 1999). These specific gravities were applied to estimates of tree volume to determine merchantable tree biomass (the weight of the bole). To estimate live biomass, we have to add in the stump (Raile 1982), limbs, and bark (Hahn 1984). We do not currently report the live biomass of roots or foliage. Forest inventories report biomass as green or oven-dry weight. Green weight is the weight of a freshly cut tree; oven-dry weight is the weight of a tree with zero percent moisture content. On average, 1 ton of oven-dry biomass is equal to 1.9 tons of green biomass.

How do we estimate all the forest carbon pools?

FIA does not directly measure the carbon in standing trees; it estimates forest carbon pools by assuming that half the biomass in standing live/dead trees consists of carbon. Additional carbon pools (e.g., soil, understory vegetation, belowground biomass) are modeled based on stand/site characteristics (e.g., stand age and forest type).

How do we compare data from different inventories?

Data from new inventories is often compared with data from earlier inventories to determine trends in forest resources. For comparisons to be valid, the procedures used in the two inventories must be similar. As a result of ongoing efforts to improve the efficiency and reliability of the inventory, several changes in procedures and definitions have occurred since the 1999 inventory of New Jersey. While these changes will have little effect on statewide estimates of forest area, timber volume, and tree biomass, they may have significant effects on plot classification variables such as forest type and stand-size class. Some of these changes make it inappropriate to directly compare 2008 data tables with those published for the 1999 or earlier inventories. Note that references to the 1956, 1971, 1987, and 1999 periodic inventories each refer to that single year of inventory, but references to the '2008' annual inventory refer to the 5-year period, 2004-2008.

Recently, significant changes were made to the methods for estimating tree-level volume and biomass (dry weight) for northeastern states, and the calculation of change components (net growth, removals, and mortality) was modified for national consistency. Regression models were developed for tree height and percent cull to reduce random variability across datasets.

The Component Ratio Method (CRM) was implemented as a means to obtain biomass estimates for the live, aboveground portion of trees; belowground coarse roots; standing deadwood; and down woody debris (Heath et al. 2009). Additionally, the "midpoint method," introduced some differences in methodology for determining growth, removals, and mortality to a specified sample of trees (Westfall et al. 2009). This approach involves calculating tree size attributes at the midpoint of the inventory cycle (2.5 years for a 5-year cycle) to obtain a better estimate for ingrowth, mortality, and removals. Although the overall net change component is equivalent under the previous and new evaluations, estimates for individual components will be different.

A word of caution on suitability and availability

FIA does not attempt to identify which lands are suitable or available for timber harvesting, particularly since such suitability and availability is subject to changing laws, economic/market constraints, physical conditions, adjacency to human populations, and ownership objectives. The classification of land as timberland does not necessarily mean it is suitable or available for timber production. Forest inventory data alone are inadequate for determining the area of forest land available for timber production. Additional factors, like those provided above, need to be considered when estimating the timber base, and these factors may change with time.

How do we produce maps?

A geographic information system (GIS) and various geospatial datasets were used to produce the maps in this report. Unless otherwise indicated, forest resource data are from FIA and base map layers, e.g., state and county boundaries, were obtained from the National Atlas of the United States (USDI 2011). Depicted FIA plot locations are approximate. Additional FIA data is available at: http://fia.fs.fed.us/tools-data/. Sources of other geospatial datasets are cited within individual figures. All New Jersey maps are portrayed in the State Plane Coordinate System, North American Datum of 1983.

Yellow-poplar. Photo by Susan Crocker, U.S. Forest Service.

Forest Features

Brendan T. Byrne State Forest. Photo by Susan Crocker, U.S. Forest Service.

Forest Area

Background

Estimates of forest area provide information on current status and trends in forest ecosystems. Fluctuations in area estimates may indicate changing land use and/or forest health conditions. Monitoring changes in the forest land base provides information essential for management and decisionmaking.

What we found

An inventory of New Jersey's forest resources in 1956 showed that 2.2 million acres, or 46 percent of the State was forested. Following a significant decrease reported in the 1971 inventory, the amount of forest land has since hovered around its current estimate of 2.0 million acres, or 42 percent of total land area (Fig. 3). While forest land occurs throughout most of New Jersey, it is heavily concentrated in the northwest and southeast portions of the State (Fig. 4). An examination of change in forest area by county indicates that two-thirds of counties have experienced gains in forest area since 1987 (Fig. 5). Most counties experiencing losses in forest area are located in the metropolitan areas surrounding New York City and Philadelphia. Forest land consists mainly of sawtimber stands (61 percent); 29 percent of forest land is made up of poletimber stands, 9 percent contain sapling-seedling stands and 1 percent is nonstocked. Additionally, the age of forest stands is increasing, averaging between 41-60 years in 1999 and 61-80 years in 2008 (Fig. 6).

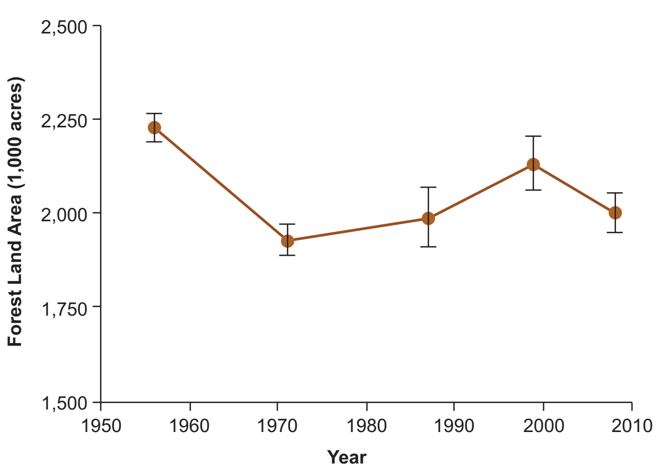


Figure 3.—Area of forest land by inventory year, New Jersey (error bars represent a 68-percent confidence interval).

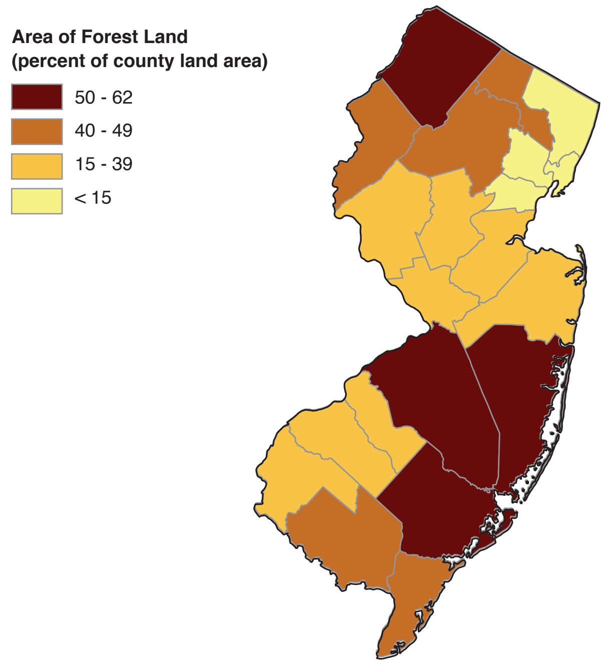


Figure 4.—Area of forest land as a percentage of county land area, New Jersey, 2008.

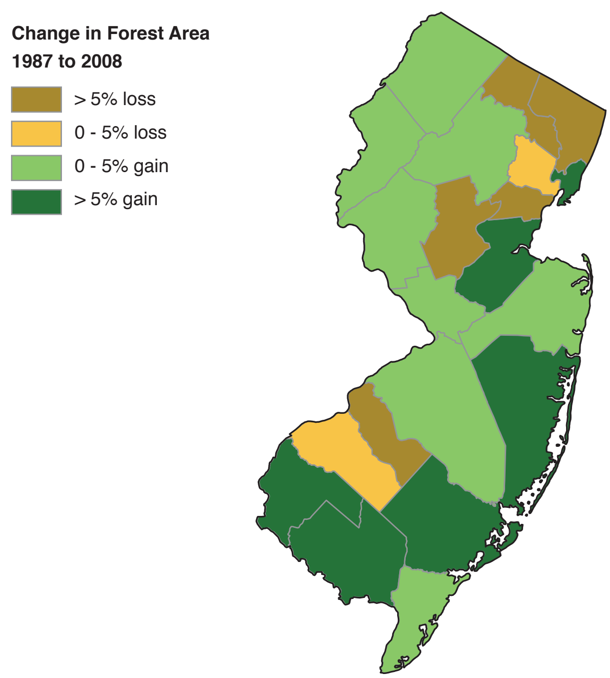


Figure 5.—Change in the area of forest land by county, New Jersey, 1987-2008.

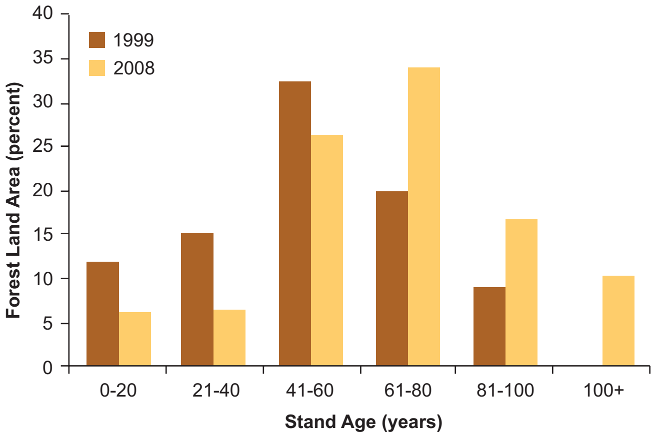


Figure 6.—Area of forest land (percent) by stand-age class, New Jersey, 1999 and 2008.

What this means

Despite its dense population and small size, New Jersey is heavily forested. While the population of New Jersey has risen, the area of forest land has remained fairly constant since the 1970s. This is due in part to the reversion of farmland to forest land and conservation efforts that have created numerous state forests and state parks, such as the Pinelands National Reserve (Collins and Anderson 1994). The distribution of changes in forest area shows that, in general, urban areas are becoming more urban and forested areas are becoming more forested. Sampling errors increase with increasing scale, therefore, care should be given when monitoring area changes at the sub-state level.

Forest Biomass

Background

Biomass is a measure of the aboveground weight of live trees that is allocated among tree components (e.g., boles, stumps, tops, and limbs). Measurements of biomass provide estimates of the quantity and distribution of forest resources, and the availability of these resources for different uses (e.g., carbon sequestration, biofuels, or wildlife habitat).

What we found

The amount of live-tree and sapling biomass on New Jersey timberland has been growing since 1987 (Fig. 7). Currently, biomass is an estimated 101.5 million dry tons, equivalent to 55 tons per acre of timberland. While the distribution of biomass across the State is similar to that of forest area, the greatest amounts of forest biomass are in the Highlands region (Fig. 8). Statewide, 69 percent

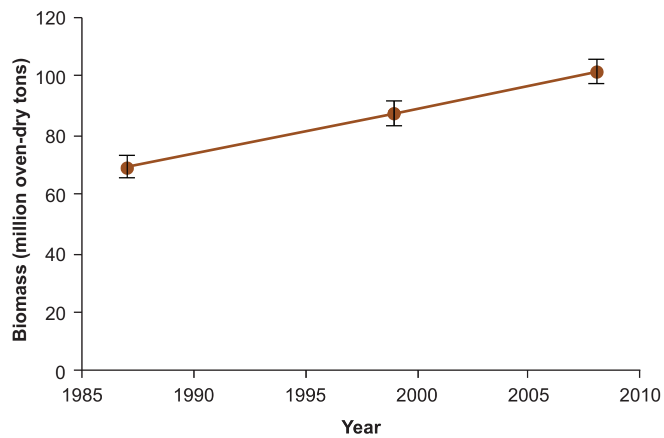


Figure 7.—Live-tree and sapling biomass on timberland by inventory year, New Jersey (error bars represent a 68-percent confidence interval).

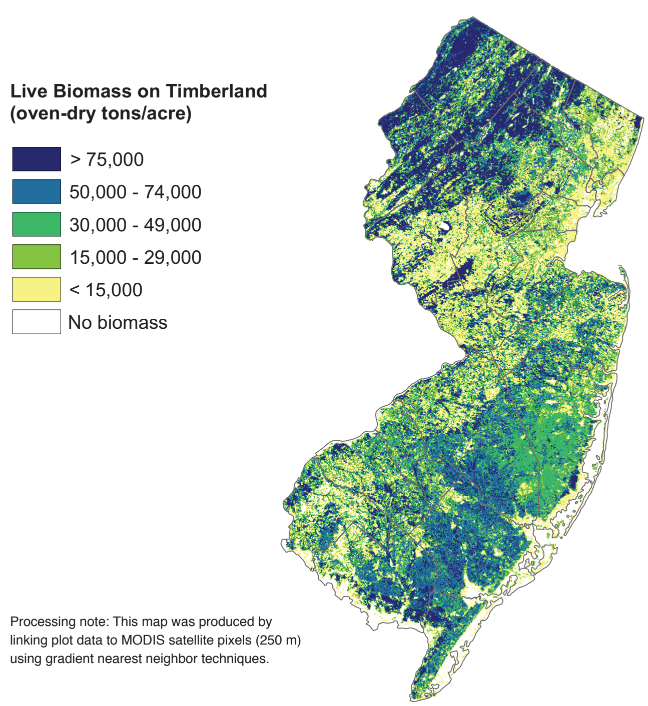


Figure 8.—Distribution of live-tree and sapling biomass on timberland, New Jersey, 2008.

of total biomass is contained in the boles of growing-stock trees; 20 percent is in growing-stock stumps, tops and limbs; 6 percent is in saplings; and 5 percent is in nongrowing-stock trees (Fig. 9).

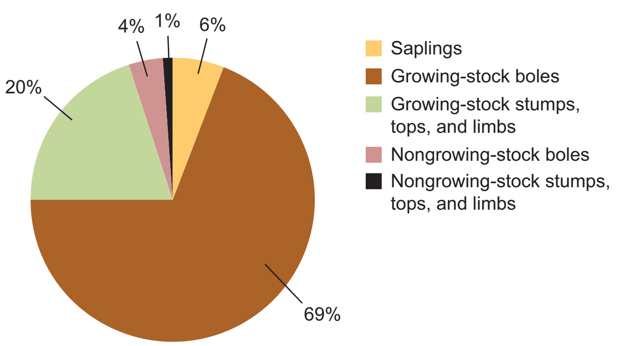


Figure 9.—Forest biomass on timberland by tree component, New Jersey, 2008.

What this means

Statewide efforts to maintain forest area has supported the increase of forest biomass across New Jersey. As the majority of forest biomass is found in the boles of growing-stock trees, the management of forests is closely tied to the dynamics of carbon storage and future wood availability. Given the increasing demand to manage biomass components for bioenergy and carbon, monitoring forest biomass will become more critical.

Species Composition

Background

Forest composition is constantly evolving. Influenced by the presence or absence of disturbances such as timber management, recreation, wildfire, prescribed burning, extreme weather, and invasive species, the current state of species composition is a reflection of historical and environmental trends within a forest. As a result, the speicies composition in a forest is an indicator of forest health, growth, succession, and the need for stand improvement, i.e., management. Knowledge of the distribution of species within a stand allows for the measurement and prediction of change.

What we found

New Jersey's forest land contains 989 million trees (greater than 1 inch in d.b.h.) representing 83 different tree species (common and scientific names of trees found in New Jersey's forests are detailed on the accompanying DVD on the inside back cover of this bulletin). Pitch pine and red maple are by far the most abundant species by number and volume, together making up 34 and 29 percent, respectively (Figs. 10, 11). Oaks are dominant throughout the State. Fifteen species of oaks were recorded on forest land; these species account for 16 percent of all species by number and 27 percent of total live-tree volume. Species

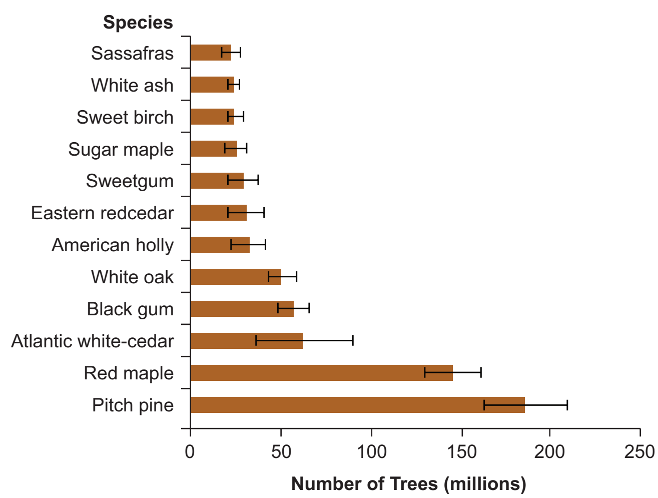


Figure 10.—Top 12 species on forest land by number of live trees, New Jersey, 2008 (error bars represent a 68-percent confidence interval).

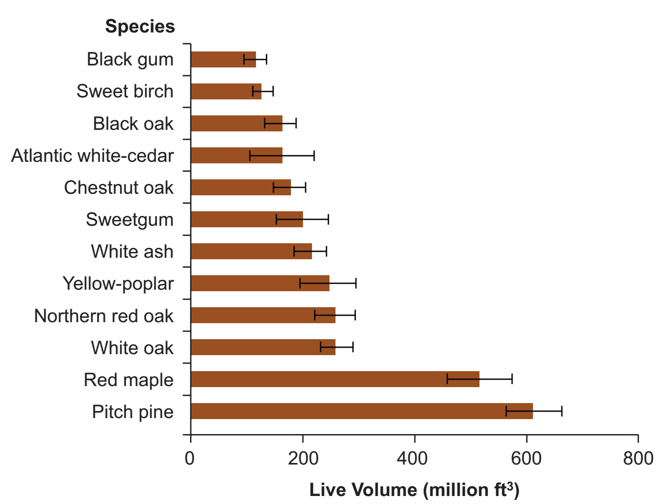
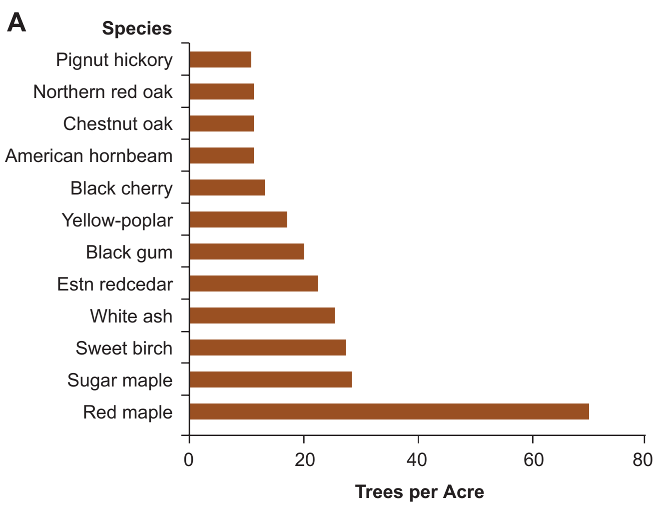


Figure 11.—Top 12 species on forest land by volume of live trees, New Jersey, 2008 (error bars represent a 68-percent confidence interval).

composition varies across the State, primarily between northern and southern New Jersey (Figs. 12A and B). While red maple, sugar maple, sweet birch, and white ash are the most numerous species in northern New Jersey, pitch pine, red maple, Atlantic white-cedar and white oak are the most prevalent species in southern New Jersey.



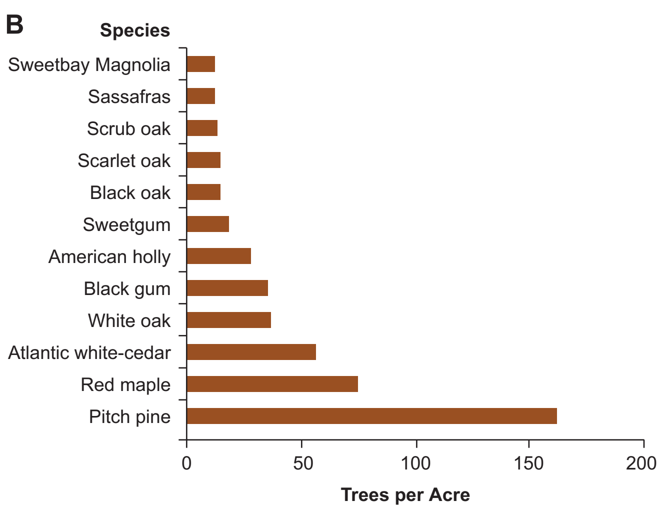


Figure 12.—Top 12 species on forest land in terms of trees per acre for (A) northern New Jersey and (B) southern New Jersey, 2008.

What this means

New Jersey's geologic past has sculpted a rich landscape that is home to a diverse array of tree species. A mixture of upland hardwoods populates the more mesic sites of northern New Jersey. In contrast, the sandy soils of southern New Jersey allow acid- and fire-tolerant species, such as pitch pine, American holly, and scrub oak to flourish. New Jersey is also uniquely situated at the crossroads of many species ranges, allowing typically northern or southern trees to meet and intermingle.

Forest Density

Background

The density of a forest indicates the current phase of stand development and has implications for diameter growth, tree mortality, and yield. Density is typically measured in terms of number of trees or basal area per unit area. Stocking, a relative measure of density, represents the degree of tree occupancy required to fully utilize the growth potential of the land.

What we found

Since 1971, the density of New Jersey's forests has increased. However, the current estimate of 447 trees per acre of timberland represents a decrease in the number of growing-stock trees since 1987 (Fig. 13). In contrast, the average acre of timberland contains more growing-stock volume; total growing-stock volume is an estimated 1,870 cubic feet per acre (Fig. 14). Most of New Jersey timberland is fully (44 percent) or moderately

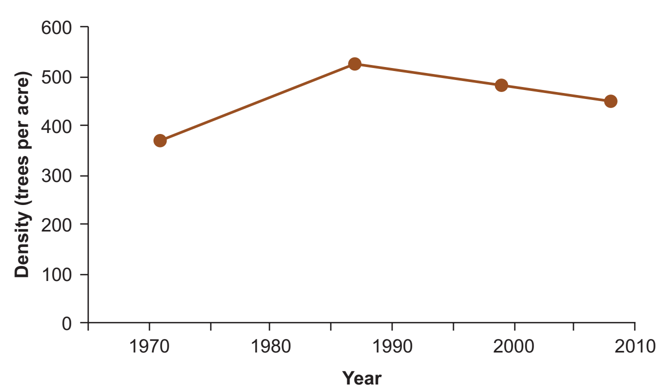


Figure 13.—Density of growing-stock trees on timberland by inventory year, New Jersey.

(39 percent) stocked (Fig. 15). Overstocked stands, which represent 4 percent of timberland, contain too many trees to support adequate tree growth and development. Poorly stocked stands that do not contain enough trees to fully utilize a site represent 12 percent of timberland.

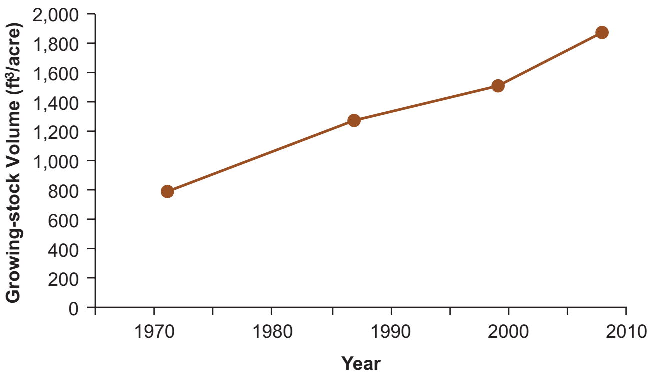


Figure 14.—Growing-stock volume per acre on timberland by inventory year, New Jersey.

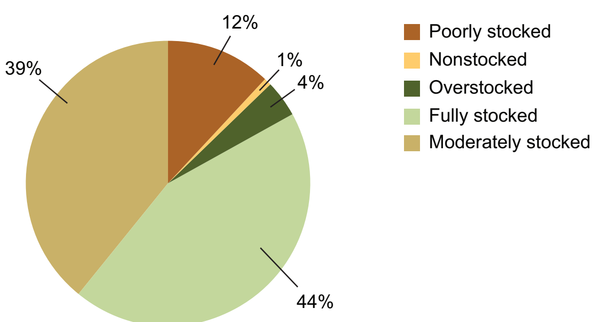


Figure 15.—Area of timberland by stocking class, New Jersey, 2008.

What this means

Decreasing numbers of trees and increasing volume are indicative of a maturing forest resource. In the absence of natural or human disturbance, this trend can be expected to continue until stands reach a state of senescence. Current stocking levels indicate adequate growing conditions, but also show a preponderance of fully stocked stands. As trees grow and put on additional volume, these stands will be expected to face an increased amount of stand stagnation issues, including density-induced mortality.

Carbon stocks

Background

Collectively, forest ecosystems represent the largest terrestrial carbon sink on earth. The accumulation of carbon in forests through sequestration helps to mitigate emissions of carbon dioxide to the atmosphere from sources such as forest fires and burning of fossil fuels. FIA does not directly measure forest carbon stocks. Instead, a combination of empirically derived carbon estimates (e.g., standing live trees) and models (e.g., carbon in soil organic matter based on stand age and forest type) are used to estimate New Jersey's forest carbon stocks. Estimation procedures are detailed by Smith et al. (2006).

What we found

New Jersey's forests currently contain almost 149 million tons of carbon. Live trees and saplings represent the largest forest ecosystem carbon stock in the State at more than 65 million tons, followed by soil organic matter (SOM) at 61 million tons (Fig. 16). Within the live-tree and sapling pool, merchantable boles contain the bulk of the carbon (~ 40 million tons) followed by roots (~ 11 million tons) and tops and limbs (~ 9 million tons). Most of New Jersey's forest carbon stocks are found in relatively young stands aged 41-80 years (Fig. 17). Early in stand development, most forest ecosystem carbon is in the SOM and

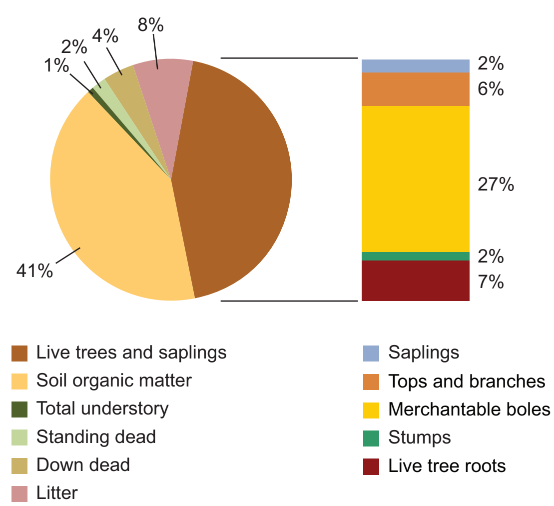


Figure 16.—Estimated carbon stocks on forest land by forest ecosystem component, New Jersey, 2008.

belowground tree components. As forest stands mature, the ratio of above- to belowground carbon shifts and by age 61-80 years the aboveground components represent the bulk of ecosystem carbon. This trend continues well into stand development as carbon accumulates in live and dead aboveground components. A look at carbon by forest-type group on a per-unit-area basis found that 9 of the 13 groups have 70-95 tons of carbon per acre (Fig. 18). Despite the similarity in per-acre estimates, the distribution of forest carbon stocks by forest type is quite variable. In the elm/ash/cottonwood group, for example, 58 percent (~ 50 tons) of the forest carbon is in the SOM, whereas in the oak/hickory group, only 31 percent is in the SOM.

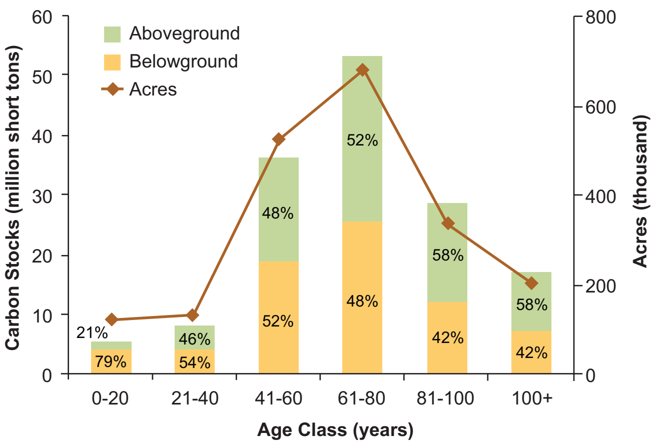


Figure 17.—Estimated above- and belowground carbon stocks on forest land by stand-age class, New Jersey, 2008.

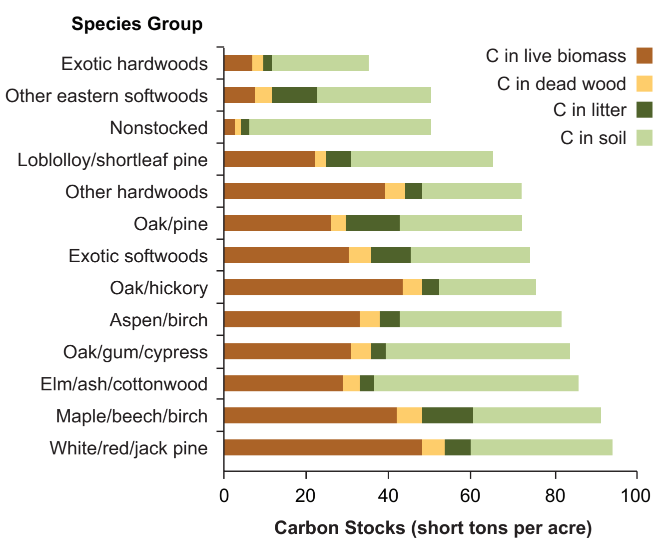


Figure 18.—Estimated carbon stocks per acre on forest land by forest-type group and carbon pool, New Jersey, 2008.

What this means

Carbon stocks in New Jersey's forests have increased substantially over the last several decades. The majority of forest carbon in the State is found in relatively young stands dominated by moderately long-lived species. This suggests that New Jersey's forest carbon will continue to increase as stands mature and accumulate carbon in above- and belowground components. Given the age class structure and species composition of forests in New Jersey, there are many opportunities to increase forest carbon stocks. Managing for carbon in combination with other land management objectives will require careful planning and creative silviculture beyond simply managing to maximize growth and yield.

Forest Ownership

Background

It is the owners of forest land who ultimately control its fate and decide if and how it will be managed. By understanding forest owners, the forestry and conservation communities can better help owners meet their needs, and in so doing, help conserve the region's forests for future generations. FIA conducts the National Woodland Owner Survey (NWOS) to better understand who owns the forests, why they own it, and how they use it (Butler 2008). Because NWOS is a separate and supplementary survey from traditional FIA plot measurement, estimates derived from the two surveys may not be exactly the same. Some data for New Jersey are combined with selected data for surrounding states (see Data Sources) because of the small sample size in the State.

What we found

Most of New Jersey's forests are privately owned (Fig. 19). Of these private acres, 62 percent are owned by families, individuals, and other unincorporated groups, collectively referred to as family forest owners. An estimated 120,000 family forest owners in New Jersey hold 805,000 forested

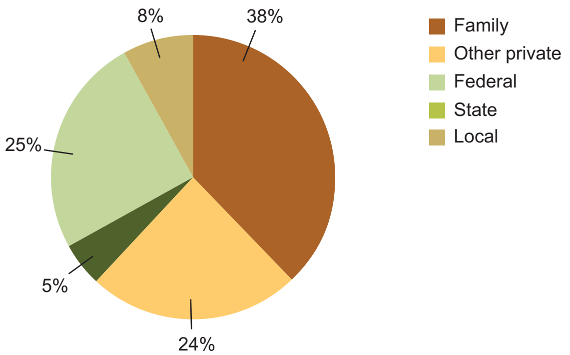


Figure 19.—Distribution of forest land by public and private ownership, New Jersey, 2006.

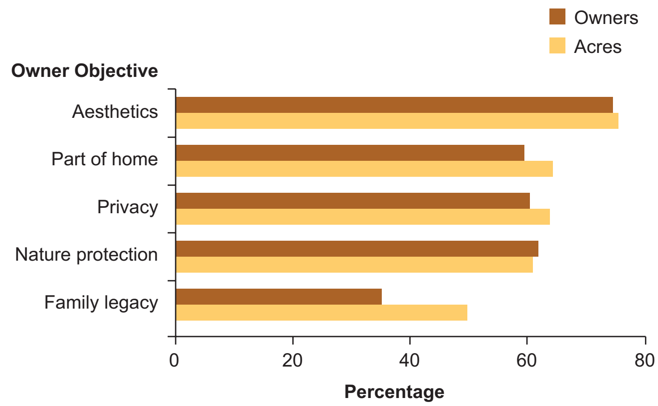


Figure 21.—Primary ownership objectives of family forest owners, New Jersey, 2006.

acres across the State. Seventy-three percent of these owners have between 1 and 9 acres of forest land (Fig. 20); the average holding size is 12 acres. The primary reasons for owning forest land are related to aesthetics, the forest land being part of a home site, privacy, and nature protection (Fig. 21). Although timber production is not a major ownership objective, 42 percent of the family forest land is owned by people who have commercially harvested trees. Twelve percent of the land is owned by people who have a written management plan, and 27 percent of the land is owned by people who have received management advice.

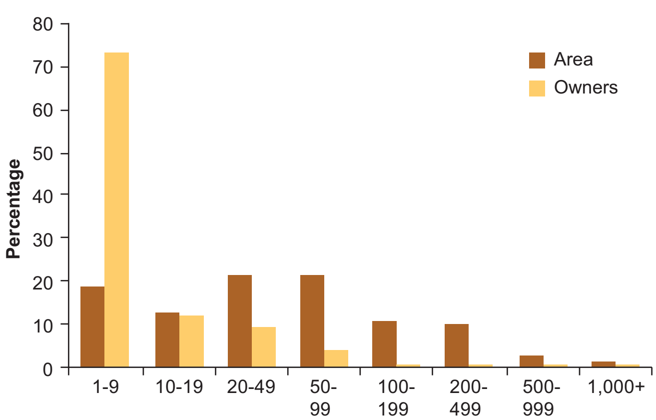


Figure 20.—Size of family forest holdings, New Jersey, 2006.

What this means

Much of family owned forest land is likely to change hands soon; 14 percent of family forest acres are owned by someone who plans to pass the land onto heirs or sell it in the near future. Family legacy is a major ownership objective and it is also a major concern. What can be done to help the forest owners and the land? It is clear that timber production is not on the forefront of forest owners' minds, but it is also clear that many owners are not averse to harvesting. It is important to provide programs that meet the owners' needs.

Land-use Change

Background

Forests provide habitat for forest-dwelling species, protect drinking water, serve as buffers for estuarine species against sedimentation and nutrient enrichment, and offer economic and other benefits for humans (Sprague et al. 2006). The rising demand for residential development places increased pressure on forest ecosystems (Claggett et al. 2004). Urban development is occurring at a rapid pace. Nowak et al. (2005) predicted that the area of urban land in the United States would nearly triple from 2000 to 2050.

New Jersey has the highest population density and the highest percentage of urban land of any state in the United States. This is due in part to its proximity to New York and Philadelphia, two of the largest cities in the nation. Although New Jersey's population growth has slowed in recent years, urban growth and sprawl continue to be a major threat to the State's remaining forest land.

FIA characterizes land area using several broad land-use categories, including forest, agriculture, and developed land. The conversion of forest land to other uses is referred to as gross forest loss, and the conversion of nonforest land to forest is known as gross forest gain. The magnitude of the difference between gross loss and gain is defined as net forest change. By comparing the land uses on current inventory plots with the land uses recorded for the same plots during the previous inventory, we can characterize forest land-use change dynamics. Understanding land-use change dynamics helps land managers make informed policy decisions. Furthermore, forest change estimates are vital to scientists studying the carbon cycle and its relationship to climate change. Analysis of land-use change is based on FIA's remeasurement of 367 forest and nonforest plots. These plots were initially measured in 1999 and were remeasured in 2008.

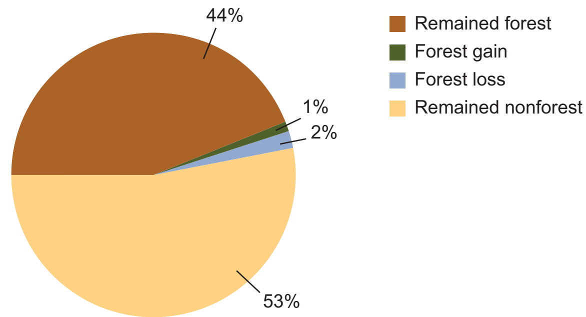


Figure 22.—Proportion of plots that remained forest, remained nonforest, or showed a loss/gain in forest land, New Jersey, 1999 to 2008.

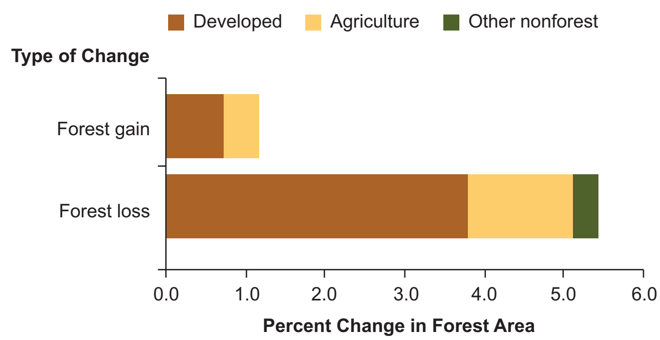


Figure 23.—Gross percent forest loss and forest gain by land-use category, New Jersey, 1999 to 2008.

What we found

More than half of the land area in New Jersey is nonforest; the majority of nonforest land is characterized by developed land uses. Between 1999 and 2008, land use across the State has largely remained the same; 44 percent of plots remained forested, 53 percent stayed nonforest, and 3 percent of plots experienced a change from either forest to nonforest or nonforest to forest (Fig. 22).

Overall, changes in land use resulted in a 5 percent loss of forest land, which was partially offset by a gain of 1 percent, for a net forest loss of 4 percent (Fig. 23). Most of the forest gain in New Jersey is from developed land. The plots that converted from a nonforest to forest land use generally appear to be in urban areas where a portion of cleared or mowed land converted to forest. The remaining plots that reverted to forest were in agricultural or other nondeveloped land uses where significant forest regrowth had occurred. It is unknown if this regrowth will persist, i.e., if the land owners will allow the normal course of vegetation succession to occur. The vast amount of forest area that was lost was converted to developed land uses. Generally speaking, this new development is unlikely to revert back to forest at a later date because most of it is due to urban expansion.

FIA data can be used to characterize forest land that has been lost to other land uses to determine if it differs from the characteristics of forest land in all of New Jersey. The forests of New Jersey are dominated by stands in the large-diameter size class; this class is also the most prevalent among the forested plots that were converted to nonforest land. There was, however, a greater proportion of small-diameter stands that were converted to nonforest uses (29 percent) than in the overall population (13 percent), suggesting that smaller-size-class stands were more apt to experience forest loss.

The distribution of remeasured plots across New Jersey highlights where forest land has been lost and gained (Fig. 24). Half of the forest loss plots appear to be concentrated around in the suburban area surrounding New York City. The average housing density (U.S. Census Bur. 2002) surrounding forest loss plots is 506 houses/km^2 which is more than three times the average housing density found in New Jersey as a whole (164 houses/km^2). The population density surrounding forest loss plots was twice that of New Jersey's overall population density, which total 832 and 416 people/km^2, respectively. Data suggests that forest loss in New Jersey is occurring in the more highly developed areas of the State.

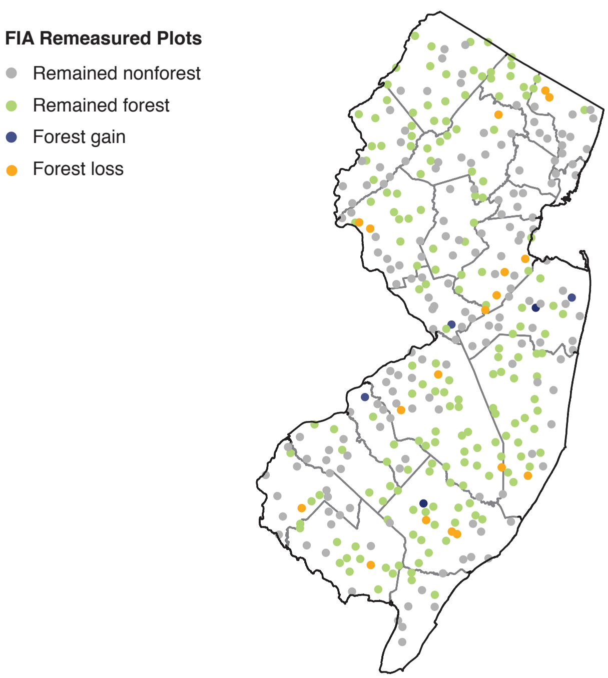


Figure 24.—Distribution of remeasurement inventory plots showing forest gains and losses, New Jersey 1999-2008 (plot locations are approximate).

What this means

Forest land in New Jersey is being lost to development as the State continues to become more urbanized. These forest losses are likely to be permanent and the magnitude of conversion has not been completely offset by gains in forest land, resulting in a net loss of forest acreage. Forest loss in New Jersey generally occurs near urban areas and in the more populated, developed areas of the State. This correlation between increasing housing and population densities and forest loss, coupled with an expected increase in urbanization over the coming decades, points to the need for careful management of the remaining forest resource.

Forest Growth

Background

A forest stand's capacity for growth, i.e., for trees to increase in volume, is an indication of the overall condition of the stand and more specifically of tree vigor, forest health, and successional stage. Forest growth is measured as average annual net growth, where net growth is equivalent to gross growth minus mortality. Average annual net growth represents an average for the annual change in volume between the two most recent inventories, 1999 and 2008 for this report.

What we found

Annual growth of growing-stock trees on New Jersey timberland has been on the rise since 1971 and currently averages 94.6 million cubic feet per year (Fig. 25). While three-quarters of total growth was in hardwoods, pitch pine had the highest growth rate of any individual species, followed by red maple, yellow-poplar, and northern red oak (Fig. 26). Average annual growing-stock growth as a percent of total growing-stock volume on timberland shows that all species groups are below 4 percent (Fig. 27). The largest increase in total volume per year occurred within the yellow-poplar and other red oaks groups. Growth was lowest within the eastern hemlock and ash species groups.

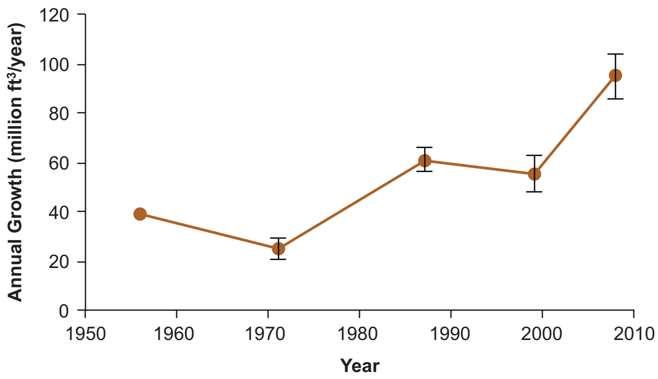


Figure 25.—Average annual net growth of growing stock on timberland by inventory year, New Jersey (error bars represent a 68-percent confidence interval).

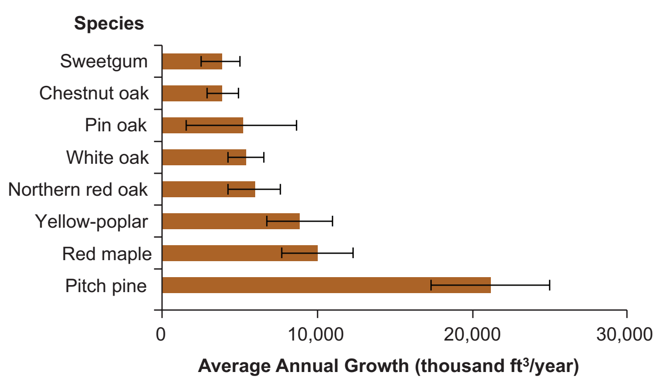


Figure 26.—Average annual net growth of growing stock on timberland for the top 8 species, New Jersey, 1999 to 2008 (error bars represent a 68-percent confidence interval).

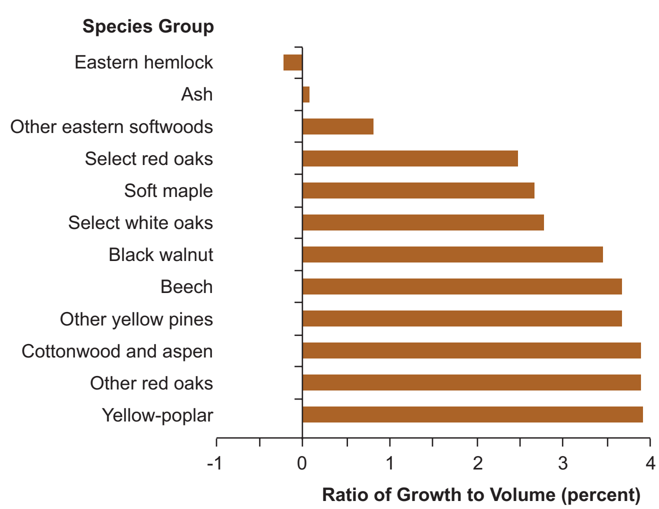


Figure 27.—Average annual net volume growth expressed as a percent of total growing-stock volume on timberland for selected species groups, New Jersey, 2008.

What this means

In recent decades, net growth of New Jersey's forests has continued to increase and forests are currently growing at their fastest rates since 1971. Many of the economically desirable tree species, such as northern red oak and white oak, continue to accrue tremendous growth each year. These species also show high growth relative to their total volumes. In contrast, ash and hemlock experienced low growth relative to total volume. Given the disparities in species growth rates, trends should continue to be monitored in the future.

Tree Mortality

Background

Forest health, vigor, and the rate of accretion and depletion are all influenced by tree mortality. Mortality can be caused by insects, disease, adverse weather, succession, competition, fire, old age, or human or animal activity; it is often the result of a combination of these factors. Tree volume lost as a result of land clearing or harvesting is not included in mortality estimates. Growing-stock mortality estimates represent the average cubic-foot volume of sound wood in growing-stock trees that died each year as an average for the years between inventories, 1998 and 2008.

What we found

Following a decline in the mortality rate of growing stock between 1956 and 1987, mortality has slowly begun to rise over the past few decades (Fig. 28). Average annual mortality of growing stock on timberland is currently an estimated 23.4 million cubic feet per year, or 0.7 percent of total growing-stock volume. Eighty-seven percent of mortality occurred within large-diameter stands. Ash, specifically white ash, has the highest rate of mortality, followed by other red oaks and soft maple (Fig. 29). Another metric indicative of mortality is

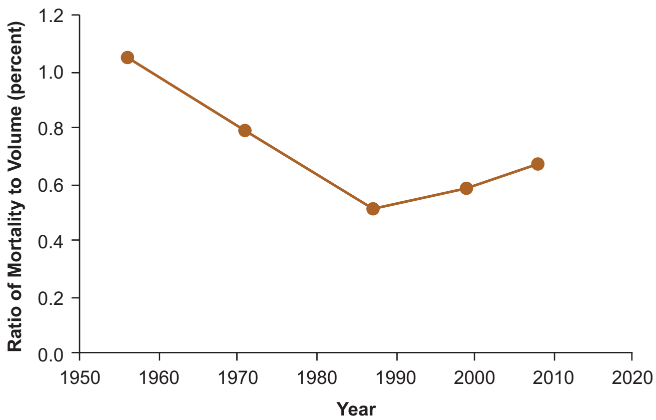


Figure 28.—Average annual mortality of growing stock as a percentage of total growing-stock volume on timberland by inventory year, New Jersey.

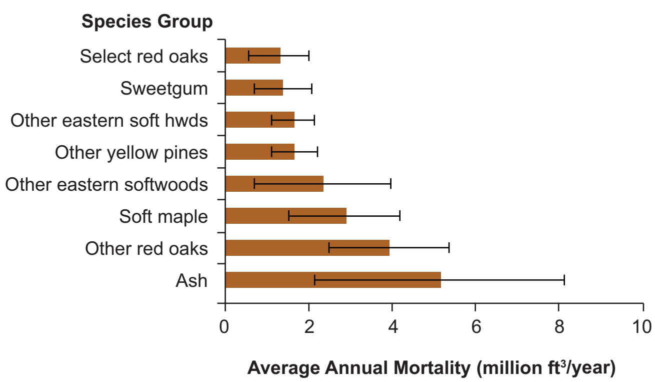


Figure 29.—Average annual mortality of growing stock on timberland for the top eight species groups, New Jersey, 2008 (error bars represent a 68-percent confidence interval).

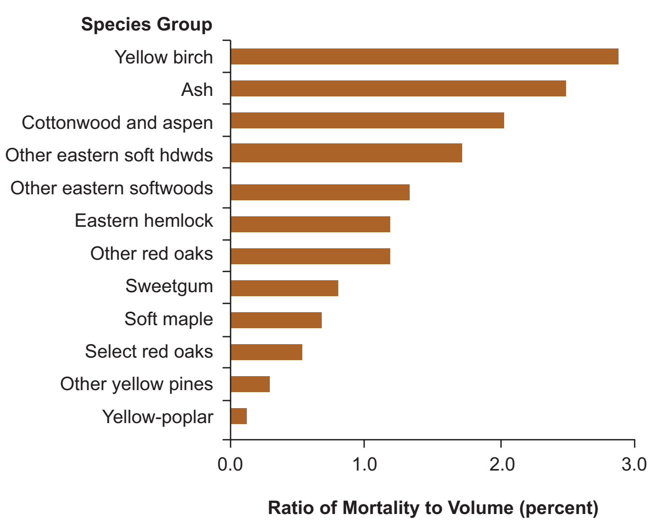


Figure 30.—Average annual mortality of growing stock as a percentage of total growing-stock volume on timberland by inventory year for selected species groups, New Jersey, 2008.

total growing-stock volume mortality on timberland as a percent of total statewide growing-stock volume on timberland. Yellow birch, ash, and cottonwood and aspen had mortality ratios greater than 2 percent (Fig. 30). All other species groups had mortality ratios below 2 percent.

What this means

Mortality is a natural process in forest stands as they develop and change over time. While the mortality rates for most species were low, the relatively high mortality rates of yellow birch, ash, and cottonwood and aspen indicate a yearly loss greater than 2 percent of statewide volume. Tree mortality is a crucial component of overall forest health and should continue to be monitored in the future.

Tree Removals

Background

One tool that can be used to analyze forest sustainability is to assess change in tree volume as a result of removals. Removals include harvested trees and trees lost due to a change in the definition of land use, i.e., timberland reverting to a nonforest use or timberland reverting to reserved land. Changes in the quantity of growing stock removed helps to identify trends in land-use change and forest management. Because removals are usually recorded on a limited number of plots, the estimates for removals show greater variance than those for growth, mortality, or area. Like forest growth, the rate at which trees are removed represents the annual average of removals that occurred between 1998 and 2008.

What we found

After a dip in the 1980s, growing-stock removal rates are now roughly equal to 1956 estimates (Fig. 31). Growing stock is currently removed from timberland at an average of 28.8 million cubic feet per year; of this, 29 percent of removals occurred as a result of a change in land use. The ratio of all annual removals to total growing-stock volume is 0.8 percent. The largest percent of removals occurred in the other red oaks, yellow-poplar, and soft maple species groups, where removals exceeded 4 million cubic feet per year (Fig. 32). Average annual growing-stock removals as a percent of total volume showed that black walnut at 4.2 percent had the highest removal rate relative to volume, followed by yellow-poplar at 2.1 percent and other red oaks at 1.7 percent (Fig. 33).

Figure 31.—Average annual removals of growing stock as a percentage of total growing-stock volume on timberland by inventory year, New Jersey.

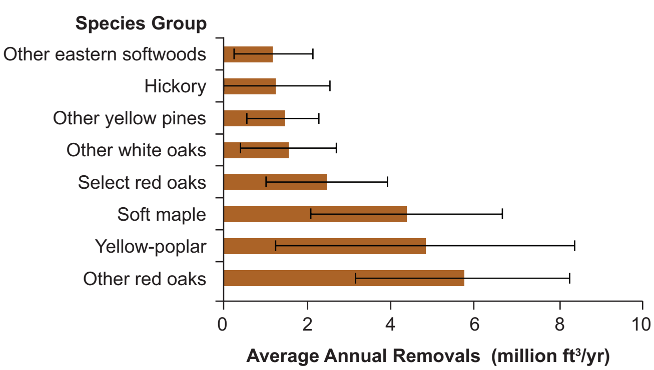


Figure 32.—Average annual removals of growing stock on timberland for the top eight species groups, New Jersey, 2008 (error bars represent a 68-percent confidence interval).

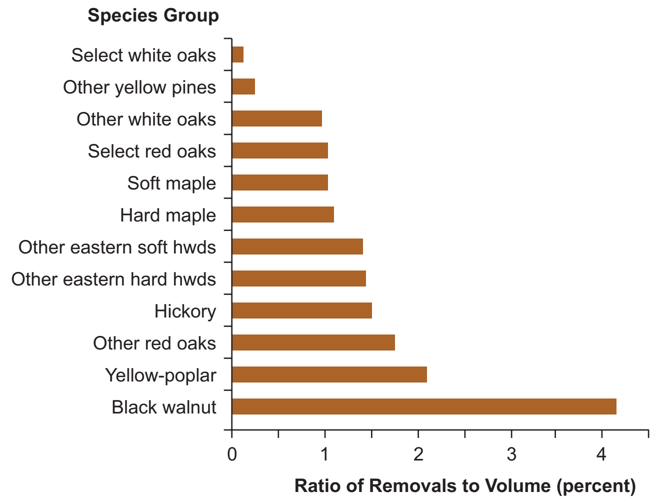


Figure 33.—Average annual removals of growing stock as a percentage of total growing-stock volume on timberland by inventory year for selected species groups, New Jersey, 2008.

What this means

Removals rates are indicative of both harvest and land-use change. The average annual rate of removals for all species groups combined (0.7 percent) is equivalent to that of mortality (0.7 percent). Net growth averages 2.4 percent for all species groups, which far exceeds that of removals and mortality. From a statewide perspective, it appears as though removals are in balance with forest growth and mortality, such that total volumes continue to increase. However, this may not be the case at smaller scales (e.g., county) or for specific species. In these cases, removals rates should be monitored and evaluated on a case-by-case basis.

Shortleaf pine. Photo by Susan Crocker, U.S. Forest Service.

Forest Indicators

Swamp at Wallkill River National Wildlife Refuge. Photo by U.S. Fish and Wildlife Service.

Down Woody Materials

Background

Down woody materials, including fallen trees and branches, fill a critical ecological niche in New Jersey's forests. They provide valuable wildlife habitat in the form of coarse woody debris and contribute to forest fire hazards via surface woody fuels.

What we found

The fuel loadings and subsequent fire hazards of dead and down woody material in New Jersey's forests are relatively low, especially when compared with the nearby states of Maryland and New York (Fig. 34). The size distribution of coarse woody debris (diameter larger than 3 inches) is dominated (88 percent) by pieces less than 8 inches in diameter (Fig. 35A). Moderately decayed coarse woody pieces (decay classes 2 and 3) constituted 70 percent of the decay class distribution (Fig. 35B). The carbon stocks of coarse woody debris appear to increase with increasing standing live-tree basal area on New Jersey's forest land to a peak of nearly 0.8 tons/acre of carbon in fully stocked stands (Fig. 36). The ground cover provided by coarse woody debris generally increases as standing live-tree basal area increases to a high of over 450 square feet/acre (approximately 1 percent coverage of 1 acre) in fully stocked stands (Fig. 37).

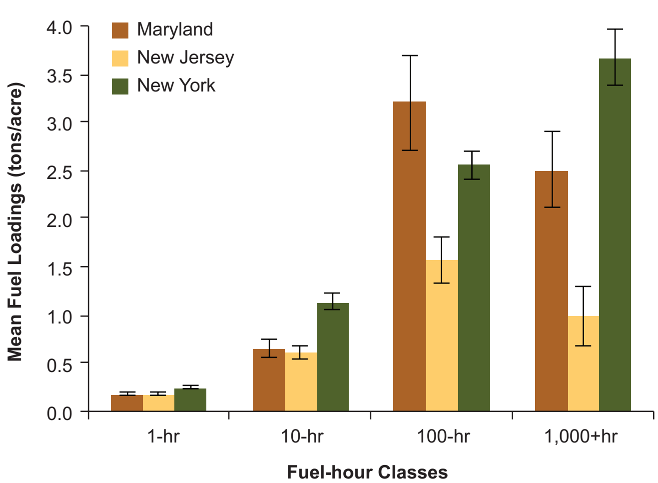


Figure 34.—Mean fuel loadings on forest land by fuel-hour class, Maryland, New Jersey, and New York, 2008 (error bars represent a 68-percent confidence interval).

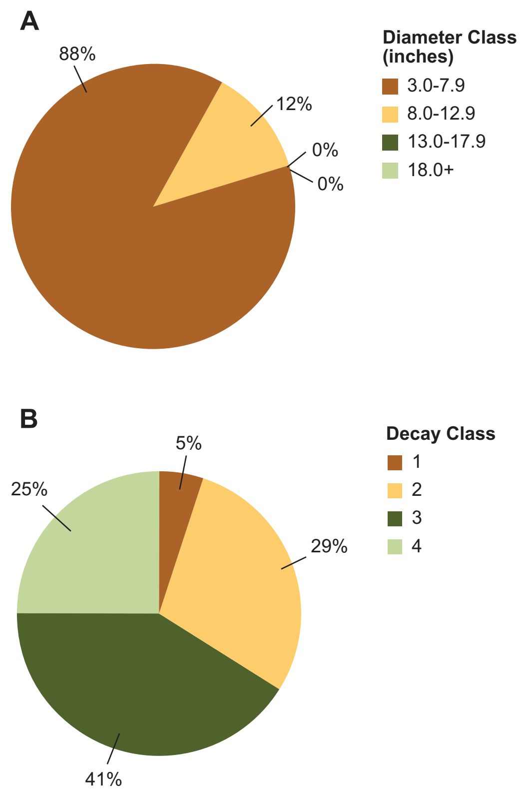


Figure 35.—Mean distribution of coarse woody debris by (A) transect diameter (inches); and (B) decay class (1 = least decayed, 5 = most decayed) on forest land, New Jersey, 2008.

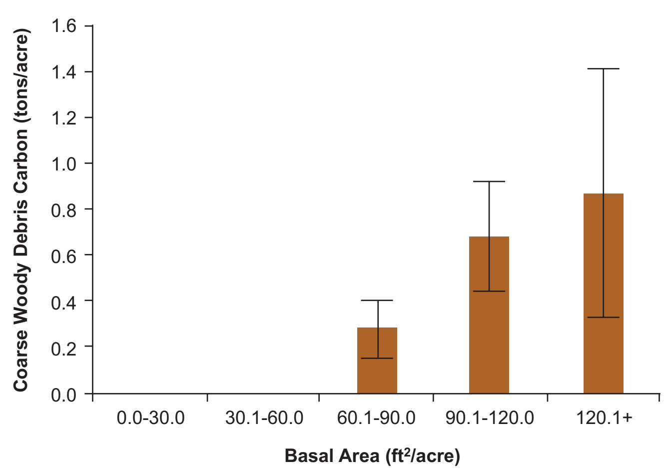


Figure 36.—Mean coarse woody debris carbon stocks on forest land by stand live-tree basal area, New Jersey, 2008 (error bars represent a 68-percent confidence interval).

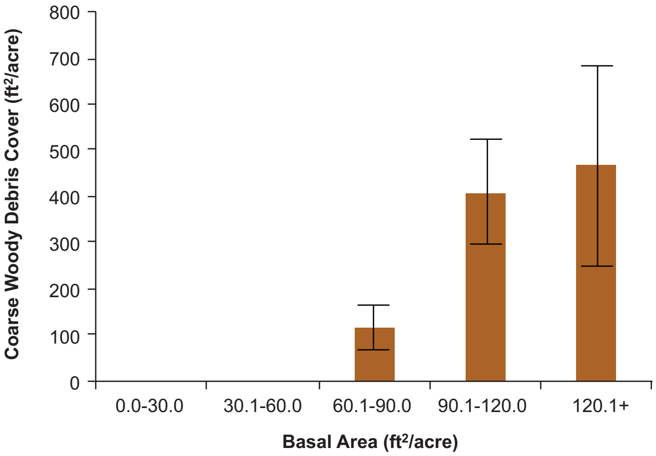


Figure 37.—Mean coarse woody debris ground cover on forest land by stand live-tree basal area, New Jersey, 2008 (error bars represent a 68-percent confidence interval).

What this means

The fuel loadings of down woody material can be considered a forest health hazard in times of drought or in isolated stands with excessive tree mortality. The ecosystem services (e.g., habitat for fauna or shade for tree regeneration) provided by down woody materials exceeds any negative forest health aspects. Coarse woody debris across New Jersey consists mostly of small pieces that are moderately decayed, and thus it constitutes a small, albeit important carbon stock. Compared to nearby states, the population of down woody materials in New Jersey's forests appears stable.

Forest Soils

Background

Rich soils are the foundation of productive forest land and they are also one of the major carbon banks. Soils develop in response to several factors; climate, local vegetation, topography, parent material, and time. These factors can be used to identify soil regions that were related to particular native forests. Today, the forest soil inventory illustrates the unique niches that different forests now occupy to maximize their competitive advantage. By identifying the soil properties associated with various forest types, the data collected by FIA provides critical baseline information to document changes in forest health resulting from natural or human influences.

The soil holds as much carbon as the aboveground vegetation. Therefore, it is another significant pool in the carbon cycle. The study of soil carbon is in its infancy. We need more measurements quantifying the soil carbon pool across different land types and we need more information on soil carbon flux over time. Annual inventories of FIA soil plots will provide this type of information. Due to a small sample size in pine forest-type groups, the results presented here are based upon observations at three oak/hickory plots in New Jersey, and 38 plots in Delaware, New York, and Pennsylvania that were sampled between 2001 and 2005. These neighboring states were sampled to identify stands found in the same forest-type group and in the same ecological province.

What we found

Variation exists between New Jersey and its neighbors, even this relatively narrow sample within one forest-type group (oak/hickory). The forest floor thickness in New Jersey is hard to distinguish from its neighbors, but the forest floor thickness in Pennsylvania's oak/hickory forest appears to be less (Fig. 38). Curiously, these similarities in total forest floor accumulation do not yield similar carbon stocks; the oak/hickory forests in Delaware are storing more than their neighbors (Fig. 39). The same is true when evaluating mineral soil carbon stocks (Fig. 40). Surface soils store more carbon than deeper

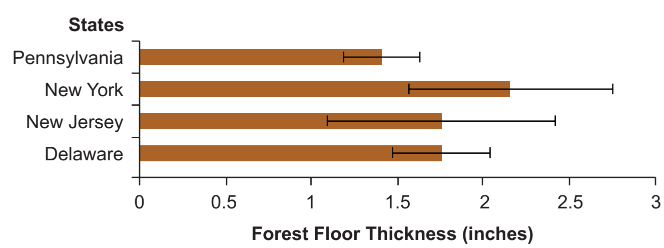


Figure 38.—Forest floor thickness by state, Pennsylvania, New York, New Jersey, and Delaware, 2001-2005 (error bars represent a 68-percent confidence interval).

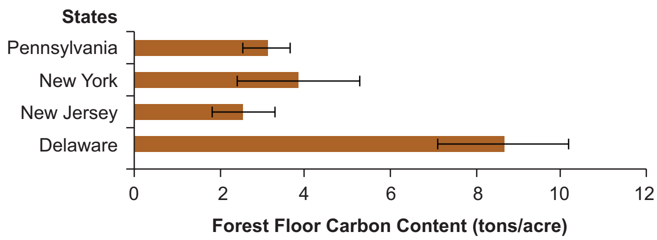


Figure 39.—Forest floor carbon by state, Pennsylvania, New York, New Jersey, and Delaware, 2001-2005 (error bars represent a 68-percent confidence interval).

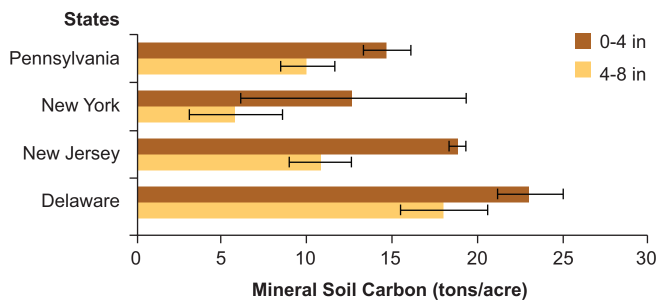


Figure 40.—Mineral soil carbon for the 0 to 4 in (0 to 10 cm) layer and 4 to 8 in (10 to 20 cm) layer by state, Pennsylvania, New York, New Jersey, and Delaware, 2001-2005 (error bars represent a 68-percent confidence interval).

soils, and Delaware's forests store the most carbon of these four states. However, the data suggest New Jersey's forests could be storing more mineral soil carbon than Pennsylvania and New York in similar landscapes.

Soil quality in New Jersey appears to present more challenges to forest growth than soils found in neighboring states. This can be considered from at least two related perspectives. First, the forests in New Jersey are found on soils with lower cation exchange capacities (mineral nutrients) than any of its neighbors (Fig. 41). Additionally, the aluminum:calcium (Al:Ca) ratio of mineral soil underlying New Jersey's forests was generally greater than 2.0; by contrast, forest soil in similar landscapes of Pennsylvania and New York were frequently less than 2.0 (Fig. 42).

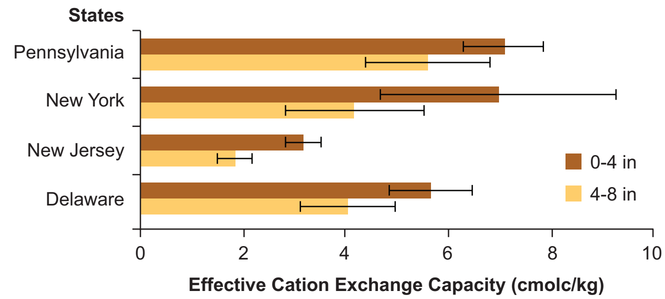


Figure 41.—Effective cation exchange capacity for the 0 to 4 in (0 to 10 cm) layer and 4 to 8 in (10 to 20 cm) layer by state, Pennsylvania, New York, New Jersey, and Delaware, 2001-2005 (error bars represent a 68-percent confidence interval).

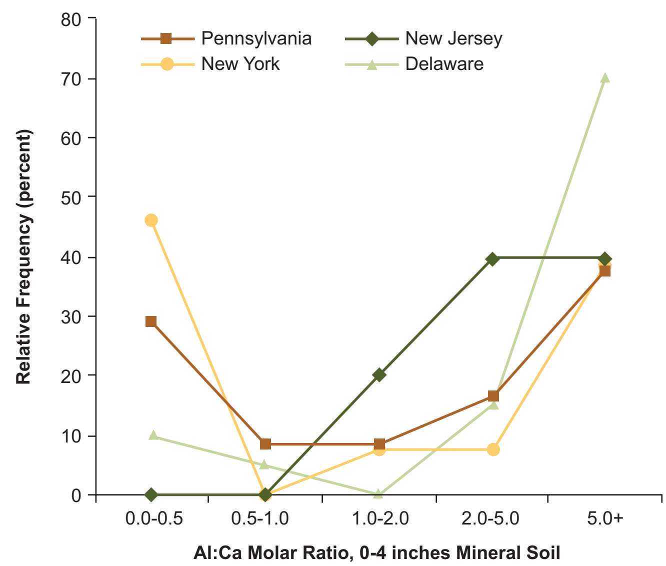


Figure 42.—Aluminum to calcium molar ratio for the 0 to 4 in (0 to 10 cm) layer by state, Pennsylvania, New York, New Jersey, and Delaware, 2001-2005.

What this means

The forest floor develops from the slow accumulation of organic matter. Soil organic matter, the primary component of which is carbon, has a number of important functions, including increasing water holding capacity, retaining some nutrients by cation exchange (e.g., Ca^{2+}, Mg^{2+}, K+), releasing other nutrients as it decays (e.g., N, P, and S), and capturing potential toxic agents (e.g., Hg) (McBride 1994). Carbon is also inventoried to track the sequestration of certain greenhouse gases. Thicker forest floors generally contribute to greater carbon storage. Direct measurements of carbon and the functions it provide are essential in better understanding the carbon cycle.

The relatively low amount of forest floor carbon storage in New Jersey's forest (particularly when compared with similar forests and landscapes in Delaware) suggest there are opportunities to increase carbon sequestration.

Atmospheric deposition of nitrogen and sulfur alters the soil by leaching essential minerals (Driscoll et al. 2001). Historically, the problem of acid deposition was particularly severe in the upper Ohio River basin (National Atmospheric Deposition Program 2011), but while the emissions that lead to acid deposition have declined, the effects persist (Driscoll et al. 2001). Effective cation exchange capacity (ECEC) is calculated as the sum of five key mineral elements: sodium, potassium, calcium, magnesium, and aluminum. High ECEC values are associated with higher fertility. The molar ratio of Al to Ca is a useful indicator of stress in forest ecosystems, particularly that caused by acid deposition (Cronan and Grigal 1995), and high Al:Ca ratios (greater than 2.0) indicate an increased likelihood of negative impacts on tree growth. Additionally, deposition of nitrogen increases litter decay rates (Kuperman 1999) with the potential to negatively affect the forest through nitrogen saturation (Aber 1992).

Forest Patterns

Background

The fragmentation of forest land is a major ecological issue worldwide. Fragmentation is the process by which contiguous tracts of forest land are broken down into smaller, more isolated patches surrounded by nonforest land uses, such as agriculture or urban development. Fragmentation results in a loss of interior forest conditions and an increase in edge habitat. This has many negative effects on the remaining vegetation and interior-dwelling wildlife species, e.g., loss of native species and increased populations of invasive species. Generally speaking, large patches of forest are more desirable because they contain continuous habitat, while patches that are too small consist entirely of edge habitat.

What we found

The National Land Cover Database (NLCD) 2006 (Xian et al. 2009) raster dataset was reclassified to create a six-class land-cover map of New Jersey (Fig. 43). The 'forest' category was further processed to make a map of average forest patch size by county (Fig. 44). The geographic center, or centroid, of each patch was used to determine the county to which the patch belonged. This prevents the administrative county boundary from artificially truncating the patch and underestimating the results.

Average patch size by county ranged from 8 to 150 acres. Generally speaking, larger patches are found in the northwest part of the State, and the smallest patches are found near developed areas. Patches across the State were also aggregated by size; 49 percent of forest land in New Jersey is found in patches 1,000 acres or larger (Fig. 45).

Environmental differences at forest edges due to urban development, agriculture, or barren land uses, also referred to as edge effects, can penetrate a forest patch

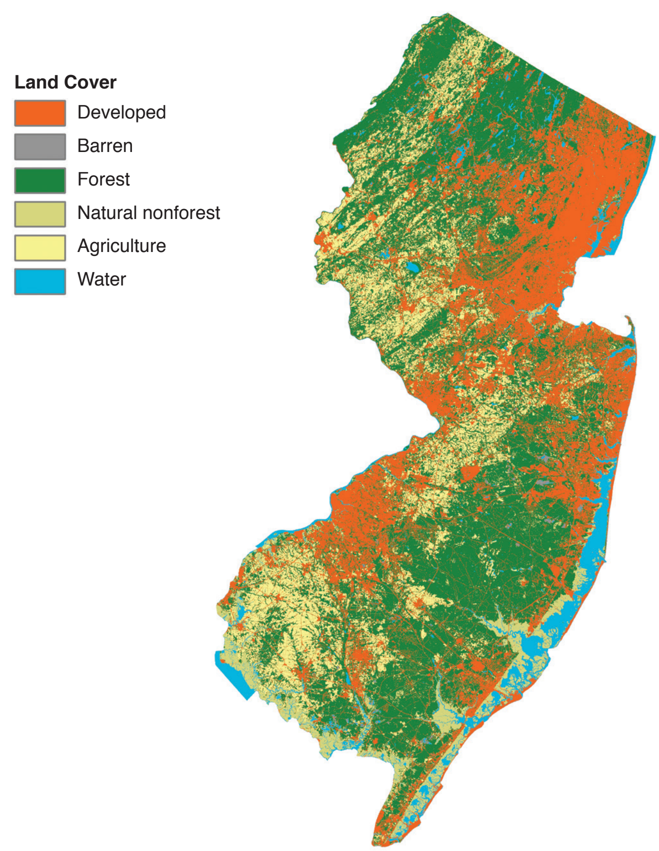


Figure 43.—New Jersey land cover derived from NLCD 2006.

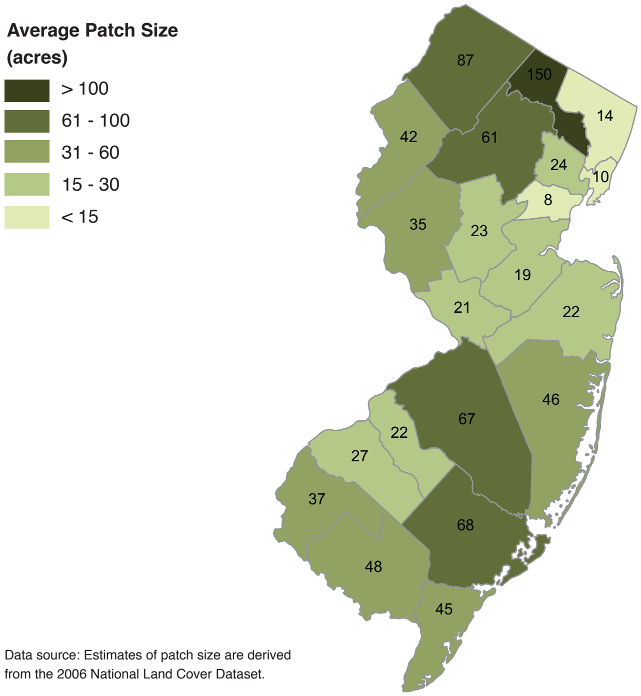


Figure 44.—Average forest patch size (derived from NLCD) by county, New Jersey, 2006.

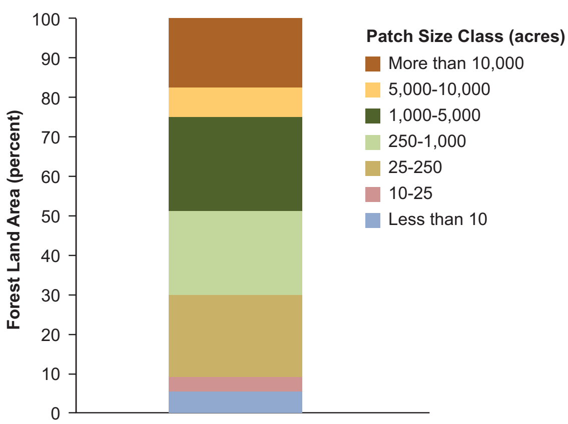


Figure 45.—Area of forest land by forest patch size class (derived from NLCD), New Jersey, 2006.

for tens of meters (Collinge 1996), so forest pixels were also characterized according to their location relative to edges. A commonly used threshold for edge effects is 30 to 90 m, or approximately 100 to 300 ft, after which interior forest conditions begin (Riemann et al. 2009). Using an aggressive definition, forest pixels were classified as being within 90 m (approximately 300 ft) of a developed edge or greater than 90 m (approximately 300 ft) from a developed edge. Fifty-three percent of New Jersey's forest land is subject to edge effects and lacks interior forest conditions.

What this means

Forest makes up a significant proportion of New Jersey's land base. How this forest land is arranged across the landscape affects ecological processes. Statewide, forest land is relatively balanced among the different patch size classes and 47 percent of forest land contains interior conditions. While this is encouraging, there are areas of concern. Continuous areas of forest land tend to be concentrated only in a few areas of the State. Meanwhile, the remaining forest is mixed among heavy residential and urban development, leaving behind small, isolated forest patches. These forest remnants contain high proportions of edge habitat and are often surrounded by habitat that is inhospitable to native vegetation and wildlife, which elevates the risk of invasion by nonnative species. Continued development will further fragment existing forest land and result in long-term or permanent loss of forest habitat.

Emerald Ash Borer

Background

The emerald ash borer (*Agrilus planipennis;* EAB) is a wood-boring beetle native to Asia. In North America, EAB has only been identified as a pest of ash and all native species of ash appear to be susceptible (Poland and McCullough 2006). Trees and branches as small as 1 inch in diameter have been attacked, and while stressed trees may be initially preferred, healthy trees are also susceptible (Cappaert et al. 2005). In areas with a high density of EAB, tree mortality generally occurs 1 to 2 years after infestation for small trees and after 3 to 4 years for large trees (Poland and McCullough 2006). Spread of EAB has been facilitated by human transportation of infested material. EAB was not found in New Jersey during the 2008 inventory, but the threat of EAB introduction has increased with the discovery of this pest in Maryland, Pennsylvania and New York State.

What we found

New Jersey's forest land contains an estimated 24.7 million ash trees (greater than 1-inch diameter) that account for 231.1 million cubic feet of volume. Ash is distributed across much of the State; however, the majority of ash is concentrated in northern New Jersey (Fig. 46). Ash is present on 475,000 acres, or 24 percent of New Jersey forest land, but is rarely the most abundant species in a stand (Fig. 47). Instead, ash generally makes up less than 25 percent of total live-tree basal area.

Due to a small sample size, mortality estimates for ash have large sampling errors. Still, ash mortality has significantly increased from the 1987 inventory, more than tripling from 535,000 to 5.1 million cubic feet (Fig. 48). While not statistically significant, the trend line suggests an increase occurred between 1999 and 2008. Ash mortality was only recorded in northern New Jersey (Fig. 49). Morris County, which has the most dense ash population, had the highest mortality of ash—35 percent of total mortality.

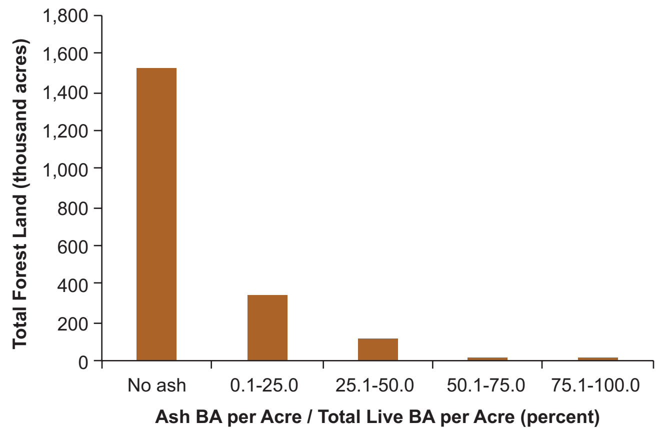


Figure 47.—Presence of ash on forest land, as a percentage of total live-tree basal area (BA), New Jersey, 2008.

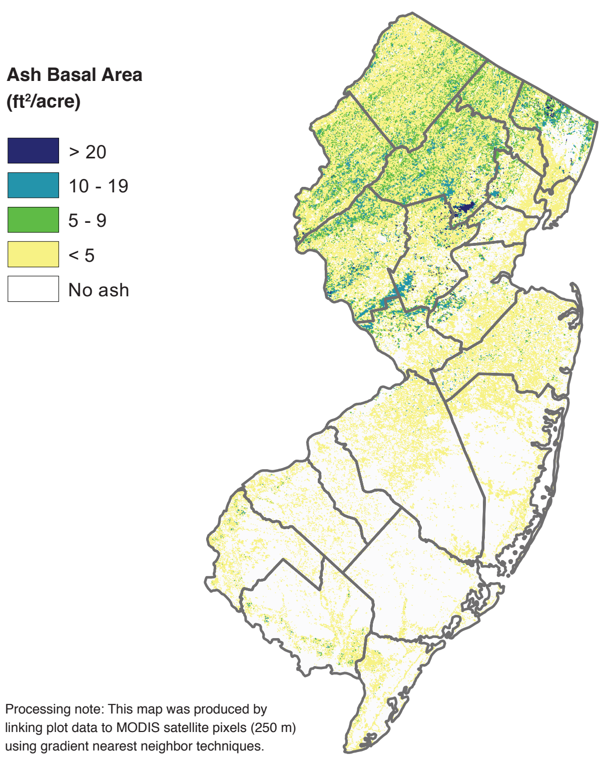


Figure 46.—Ash density on forest land, New Jersey, 2008.

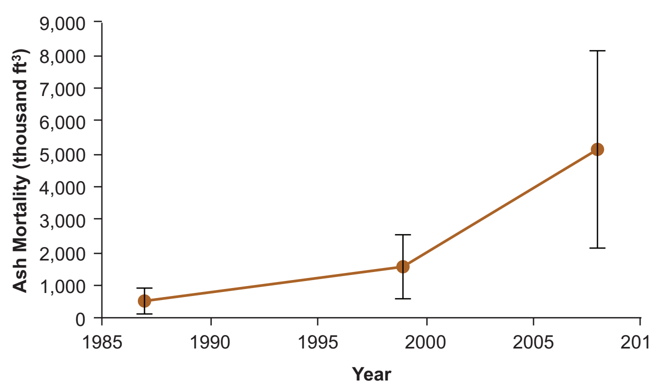


Figure 48.—Mortality of ash growing stock on timberland by inventory year, New Jersey, 1987-2008 (error bars represent a 68-percent confidence interval).

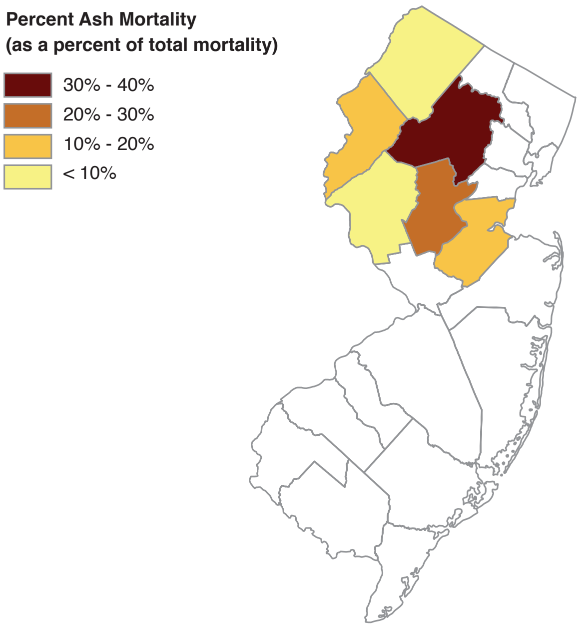


Figure 49.—Ash mortality expressed as a percent of total tree mortality on forest land by county, New Jersey, 2008.

What this means

Although EAB was not found in New Jersey during the 2008 inventory, its ability to cause extensive decline and mortality of ash makes EAB a serious threat to New Jersey's ash resource. Increases in ash mortality could indicate an underlying forest health problem, e.g., poor soils or disease. Counties with ash mortality also serve as good candidates for increased EAB survey efforts. As ash is an important component of New Jersey's forest resource, continued monitoring will help identify the long-term impacts of EAB should this insect be introduced to New Jersey.

Southern Pine Beetle

Background

Outbreaks of southern pine beetle (*Dendroctonus frontalis*; SPB) have been documented in the United States dating as early as the 1750s (Thatcher et. al 1980). SPB has since proven to be one of the most destructive pests of pine in the southern United States (Clarke and Nowak 2009). Southern New Jersey marks the northern most range of SPB and while pitch pine is a preferred host in New Jersey, it will also attack most pines including loblolly, shortleaf, pond and Virginia pines. Tree death results from girdling due to gallery construction by the beetle and blockage of water-conducting cells by the growth of blue stain fungi, spores of which are carried by SPB (Clarke and Nowak 2009). Periodically, populations of SPB reach outbreak proportions and cause extensive tree mortality.

What we found

With an estimated 186.2 million trees, pitch pine is the most numerous species on New Jersey's forest land. Pitch pine is found on the ridgetops of northwestern New Jersey, but it is primarily distributed throughout southern New Jersey, largely within the Pine Barrens (Fig. 50). Pitch pine occurs on 43 percent of forest land or 862.5 thousand acres (Fig. 51). When present in a stand, pitch pine is generally the dominant species, often making up greater than 75 percent of total live-tree basal area.

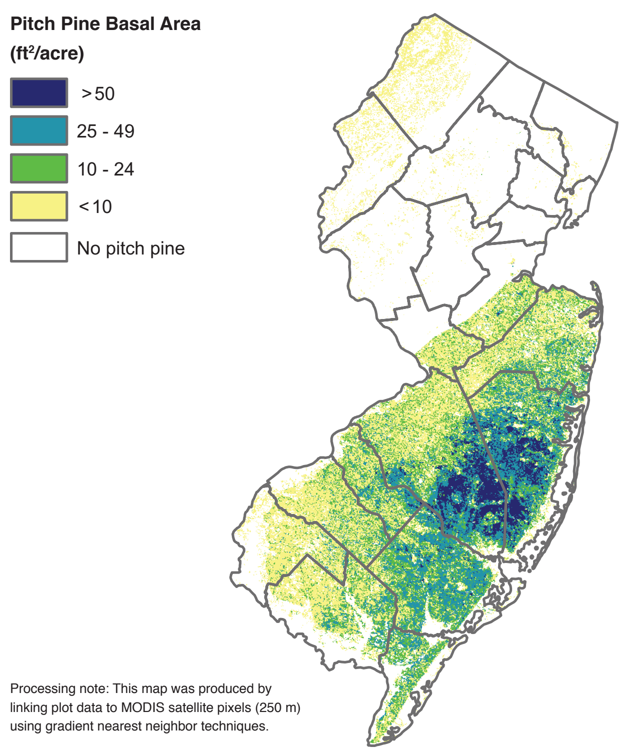


Figure 50.—Pitch pine density on forest land, New Jersey, 2008.

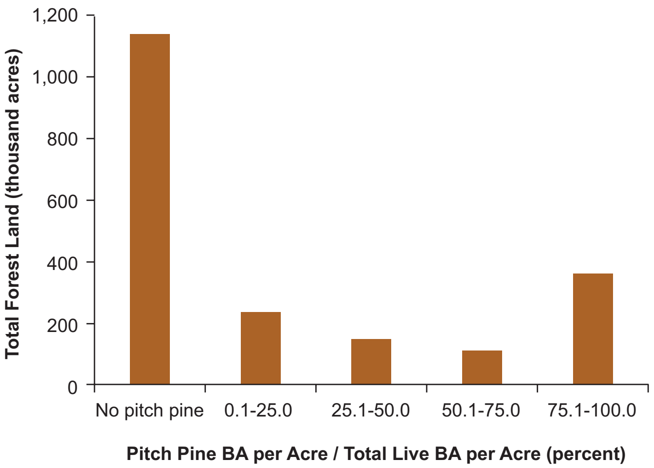


Figure 51.—Presence of pitch pine on forest land, as a percentage of total live-tree basal area (BA), New Jersey, 2008.

What this means

Pitch pine is a major component of New Jersey's forest resource, particularly in the southern half of the State, where it is the predominant species. Stand density is considered to be a critical factor in determining risk and expansion rate (Clarke and Nowak 2009). Therefore, the relatively high density of pitch pine stands increases the risk of an SPB outbreak. A major outbreak of SPB in southern New Jersey has the potential to affect a vast area and cause extensive pine mortality. In addition, large amounts of dead trees increase the risk of forest fire.

Hemlock Woolly Adelgid

Background

White 'wool' on the branches of eastern hemlock is a tell-tale sign of a hemlock woolly adelgid (*Adelges tsugae*; HWA) infestation (U.S. For. Serv. 2010). A tiny, sap-feeding insect from Asia, HWA was first reported in Virginia in 1951. By 1978, the adelgid had spread to Burlington County, New Jersey (Smith-Fiola et al. 2004). In the northern range of hemlock, tree decline and mortality generally occurs within 4 to 10 years of infestation (U.S. For. Serv. 2010). The rate of tree mortality increases if infested trees also experience drought, attack by secondary insects and diseases, or other stresses.

What we found:

Hemlock can be found across much of northern New Jersey, though its distribution is limited to cool, moist slopes and streambanks (Fig. 52; Harlow et al. 1996). There are an estimated 3.1 million hemlock trees (greater than 1 inch in diameter) on forest land that account for 23 million cubic feet of live volume. Average annual mortality of hemlock totaled 180 thousand cubic feet of growing-stock volume on timberland and 718 thousand board feet of sawtimber volume on timberland. Hemlock mortality continues to increase; when mortality is divided by volume, hemlock mortality is at its highest rate since 1987 (Fig. 53).

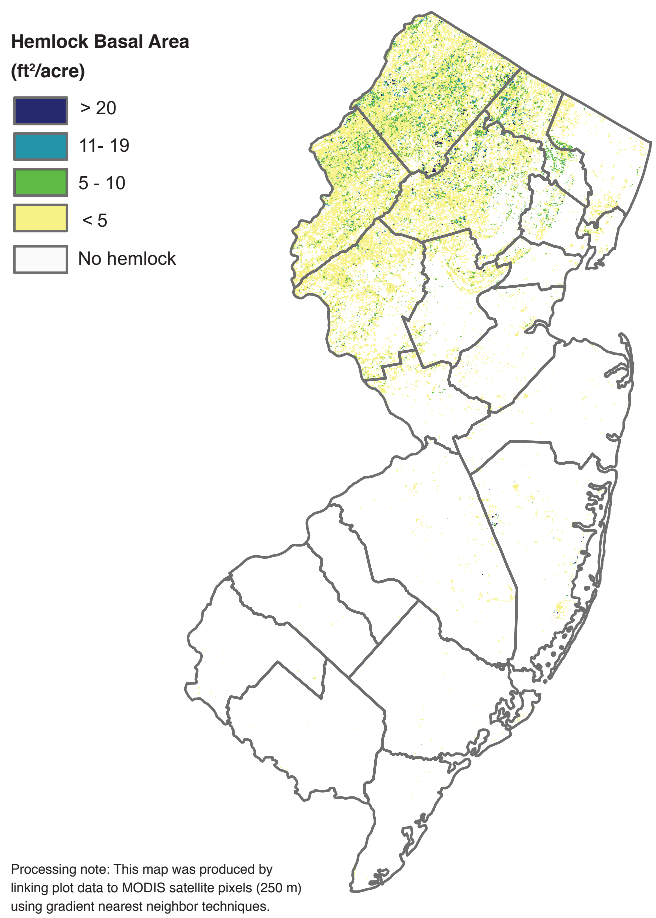


Figure 52.—Hemlock density on forest land, New Jersey, 2008.

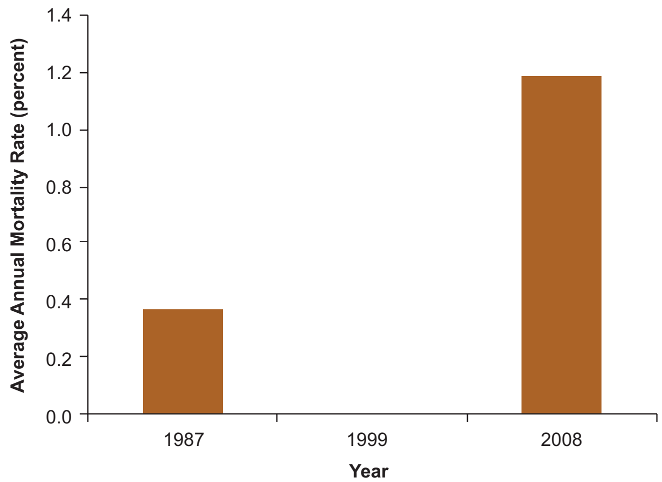


Figure 53.—Average annual mortality of hemlock growing stock per unit volume of growing stock on timberland (in percent) by inventory year, New Jersey.

What this means:

Hemlock represents a unique and important part of New Jersey's forests. Found in cool, moist ravines, on low ridges, and along lakeshores (Harlow et al. 1996), the loss of this species could affect soil stability and water temperature and quality. Hemlock occurs in both pure and mixed stands (Harlow et al. 1996). Therefore, hemlock mortality would impact a variety of species. Based on mortality trends, HWA has been especially damaging since 1999. Continued monitoring of the hemlock resource will help to quantify the effects of HWA in New Jersey.

Vegetative Diversity

Background

The diversity and abundance of vascular plant species are important indicators of the health of forest ecosystems. The status and trends in plant species richness provides information on the availability of wildlife habitat, carbon sequestration, fuel loadings, and disturbances, such as the spread of invasive plants and impacts of climate change. New Jersey has small sample of Phase 3 (P3) vegetative diversity plots, therefore, results should be interpreted with caution. As additional plots are measured, the accuracy of these results will improve.

What we found

All vascular plant species on eight P3 vegetative diversity plots were measured between 2007 and 2008. One hundred and seventeen different species were recorded. Plots had between 15 and 56 different species, averaging 29 species per plot. The understory component varied between northern and southern New Jersey (Table 1). Virginia creeper and a number of introduced species, including multiflora rose, Japanese honeysuckle, and golden clover, were the most abundant species in the north. Black huckleberry, lowbush blueberry, and roundleaf greenbrier were prevalent in the south. Seventy-four percent of recorded species are native to New Jersey, 13 percent of species are introduced, and 13 percent of species were not identified below genus (Fig. 54). Trees are the most common growth forms, followed by forbs/herbs and shrubs (Fig. 55).

Table 1.—Top understory species by region, growth habit, origin, and invasive status, New Jersey, 2007-2008.

	Species	Growth Habit	Origin	Invasive
Northern New Jersey	Virginia creeper	Vine	Native	No
	Multiflora rose	Vine	Introduced	Yes
	Japanese honeysuckle	Vine	Introduced	Yes
	Golden clover	Forb	Introduced	No
	Poison ivy	Vine	Native	No
	Japanese barberry	Shrub	Introduced	Yes
	Fox grape	Vine	Native	No
Southern New Jersey	Black huckleberry	Shrub	Native	No
	Lowbush blueberry	Shrub	Native	No
	Poison Ivy	Vine	Native	No
	Virginia creeper	Vine	Native	No
	Roundleaf greenbrier	Vine	Native	No
	Dwarf huckleberry	Shrub	Native	No
	Japanese honeysuckle	Vine	Introduced	Yes

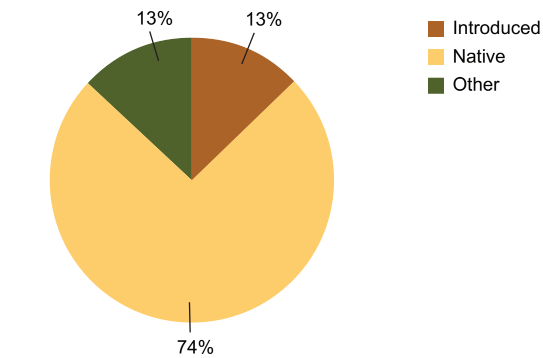


Figure 54.—Distribution of vascular plant species by origin, New Jersey, 2007-2008.

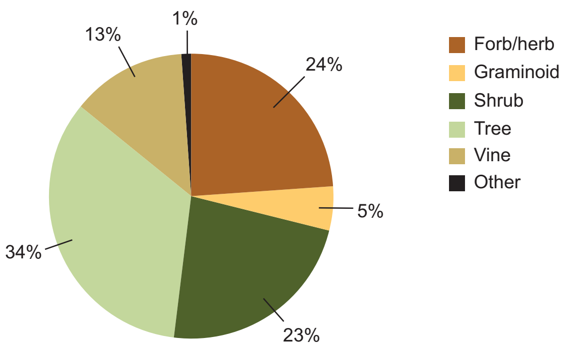


Figure 55.—Distribution of vascular plant species by growth habit, New Jersey, 2008.

What this means

New Jersey's forests support a multitude of vascular plant species. All plots contained a minimum of 15 different species, but higher plot averages indicate high species diversity across the State. Though most species that were identified are native to New Jersey, invasive plant species were also a factor, particularly in northern New Jersey (invasive species will be discussed in more detail in the following section). Vegetative diversity plots were initiated in 2007, so trends are difficult to ascertain at this time. However, future plant diversity inventories may reveal more about the status of forest vegetation and the impacts of fragmentation and invasive species.

Invasive Plants

Background

Invasive plants are becoming more prevalent in forest ecosystems. Their abundance in introduced environments can be attributed to high adaptability, the availability of disturbed habitats, and a lack of natural enemies, which allows them to outcompete and displace native species (Pimentel et al. 2000). Invasive plants are a concern because they alter natural plant communities and processes, threaten biodiversity, and contribute to a decrease in sustainability, productivity, and wildlife habitat. FIA assesses invasive plants in three ways. First, data on all vascular plants, including invasives, is collected on P3 vegetative diversity plots. Secondly, 20 percent of Phase 2 (P2) plots are deemed invasive plots on which the presence/absence of the 23 most common invasive plant species is recorded. Lastly, information on invasive trees is collected on all P2 plots.

What we found

Twenty-one species of invasive plants were found on 38 P3 and P2 plots across New Jersey (Fig. 56; Table 2).

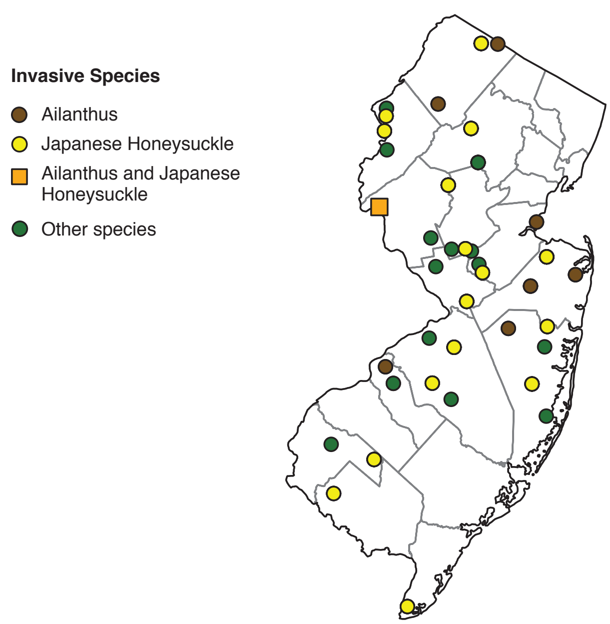


Figure 56.—Approximate location of plots with invasive plant species on forest land by species, New Jersey, 2007-2008.

Table 2.—List of invasive plants surveyed on forest land, in order of occurrence, New Jersey, 2007-2008.

Common Name	Genus species
Ailanthus	*Ailanthus altissima*
Japanese honeysuckle	*Lonicera japonica*
Multiflora rose	*Rosa multiflora*
Black locust	*Robinia pseudoacacia*
Nepalese browntop	*Microstegium vimineum*
Norway maple	*Acer platanoides*
Garlic mustard	*Alliaria petiolata*
Japanese barberry	*Berberis thunbergii*
Morrow's honeysuckle	*Lonicera morrowii*
Oriental bittersweet	*Celastrus orbiculatus*
Autumn olive	*Elaeagnus umbellata*
European privet	*Ligustrum vulgare*
Honeysuckle	*Lonicera* spp.
Amur honeysuckle	*Lonicera maackii*
Common buckthorn	*Rhamnus cathartica*
Phragmites	*Phragmites australis*
Glossy buckthorn	*Frangula alnus*
Leafy spurge	*Euphorbia esula*
Reed canarygrass	*Phalaris arundinacea*
Russian olive	*Elaeagnus angustifolia*
Tatarian honeysuckle	*Lonicera tatarica*

Some plots had as many as 11 different species; however, 63 percent of plots had either one or two different species (Fig. 57). Ailanthus was the most commonly occurring invasive, followed by Japanese honeysuckle and multiflora rose (Fig. 58). These three species account for nearly 50 percent of occurrences.

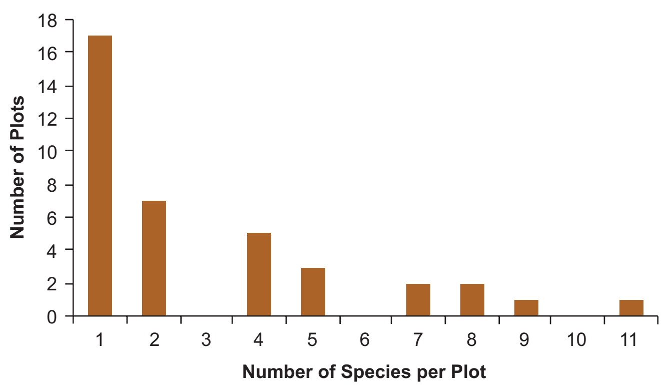


Figure 57.—Distribution of invasive plants observed on P2 and P3 plots (n=38), New Jersey, 2007-2008.

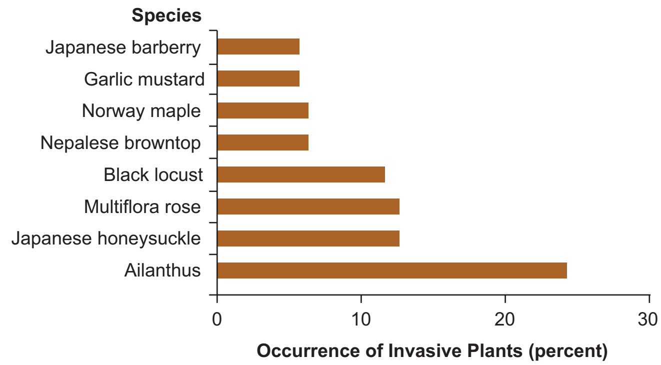


Figure 58.—Occurrence of the top eight invasive plants on P2 and P3 plots, New Jersey, 2007-2008.

What this means

Invasive plots were initiated in 2007, so a full cycle of these plots has not yet been completed. However, preliminary data shows that invasive plants are widely distributed across New Jersey. The extent to which these species cause harm has not yet been determined. As spread of these species continues, the number and abundance of native plants species will decline, resulting in a loss of overall species diversity and a reduction in the value and health New Jersey's forests.

Forest Age and Size

Background

New Jersey's forests provide habitat for numerous species of mammals, birds, reptiles, and amphibians, as well as for fish, invertebrates, and plants. Forest composition and structure affect the suitability of habitat for each species. Some species depend upon early successional forests or the ecotone (edge) between different forest stages. Yet other species require old growth forests or interior forests. Many species require multiple structural stages of forests to meet different phases of their life history needs. Abundance and trends in these structural and successional stages serve as indicators of population carrying capacity for wildlife species (Hunter et al. 2001).

The state of New Jersey developed a State Wildlife Action Plan (SWAP) that identifies species of greatest conservation need (SGCN), and threats to their habitats (NJDEP 2008). According to the Plan, "The greatest threat to New Jersey's wildlife is loss of habitat. Following habitat loss, habitat fragmentation is the second most serious threat to wildlife in New Jersey" (NJDEP 2008). The SWAP highlighted several 'suites of wildlife species' associated with forests, including forest-dwelling bats, interior forest cavity nesters, savannah and forest-edge cavity nesters, forest passerines (i.e., perching birds, sometimes referred to as songbirds), forest raptors, and forest-dwelling reptiles. Many of New Jersey's SGCN require interior forest habitat.

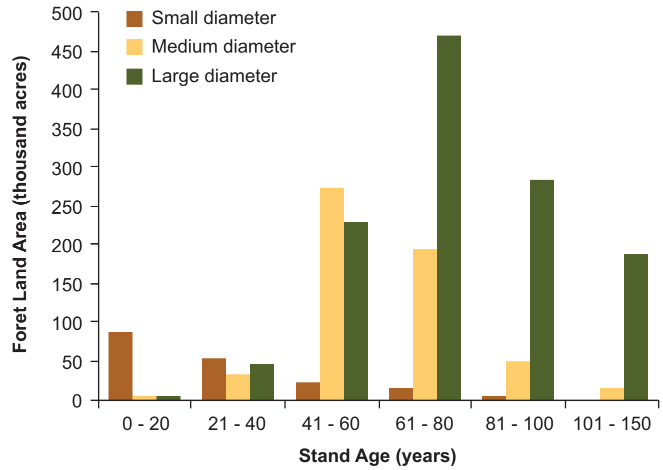


Figure 60.—Area of forest land by stand-age and stand-size class, New Jersey, 2008.

What we found

Area of the small diameter stand-size class on timberland decreased from 14 percent in 1987 to 9 percent in 2008 (Fig. 59). Concurrently, distribution of the large-diameter stand-size class increased steadily from 48 percent to 61 percent, with the medium-diameter class decreasing from 38 to 29 percent. Thirty-four percent of all New Jersey forest land is in stand-age classes between 61 and 80 years, and 77 percent is between 41 and 100 years. About 10 percent of forest land is over 100 years of age, but little, if any is older than 150 years. The small-diameter stand-size class predominates in forests of 0-20 years and the large-diameter class predominates in forests over 60 years of age (Fig. 60).

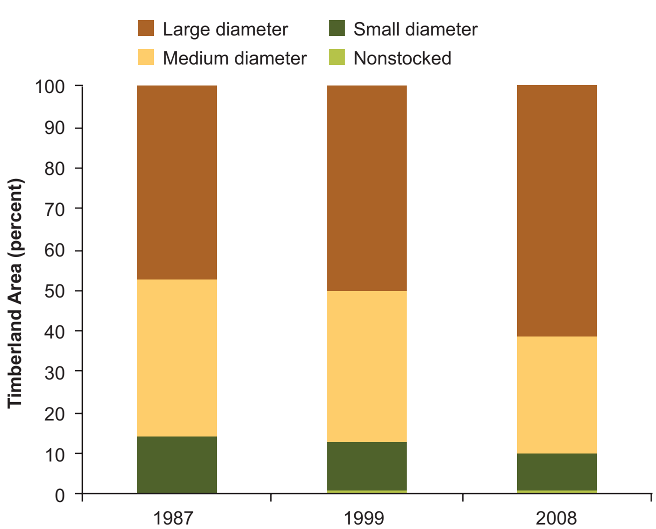


Figure 59.—Area of timberland by stand-size class and inventory year, New Jersey.

What this means

Decreasing abundance of both small- and medium-diameter stand-size classes is offset by increasing abundance in the large-diameter class. However, 85 percent of the large-diameter class is less than 100 years of age. Although both stand-size class and stand-age class provide indicators of forest successional and structural stage, the two attributes are not exactly interchangeable and are best viewed in combination. There is a need to monitor and maintain forest conditions in multiple stand-size and stand-age classes, including both early (young) and late (old) successional stages to provide habitats for all forest-associated species.

Standing Dead Trees

Background

Nesting cavities and standing dead trees (at least 5 inches d.b.h.) provide critical habitat components for many forest-associated wildlife species. Standing dead trees contain significantly more cavities than live trees (Fan et al. 2003). Standing dead trees that are large enough to meet habitat requirements for wildlife are referred to as snags. Standing dead trees serve as important indicators not only of wildlife habitat, but also for past mortality events and carbon storage. And, they serve as sources of down woody material, which also provides habitat features for wildlife. The number and density of standing dead trees, together with decay classes, species, and sizes, define an important wildlife habitat feature across New Jersey forests.

What we found

FIA collects data on standing dead trees of numerous species and sizes in varying stages of decay. Currently, more than 31 million standing dead trees are present in New Jersey's forests. This represents an overall density of 15.5 standing dead trees per acre of forest land. The other eastern softwoods species group contained 8.5 million standing dead trees (93 percent of which is attributable to a single species—Atlantic white-cedar), more than double the number of the next two highest species groups combined, select white oaks and other yellow pines (Fig. 61). Five species groups exceeded 5 standing dead trees per 100 live trees of the same species group: cottonwood and aspen (14.1), eastern hemlock (11.9), other eastern softwoods (8.9), eastern white and red pine (8.8 each), and select white oaks (7.8) (Fig. 62). Across New Jersey, more than 85 percent of standing dead trees were smaller than 11 inches d.b.h., with 47 percent between 5 and 6.9 inches d.b.h. (Fig. 63). The highest decay class had the fewest number of standing dead trees.

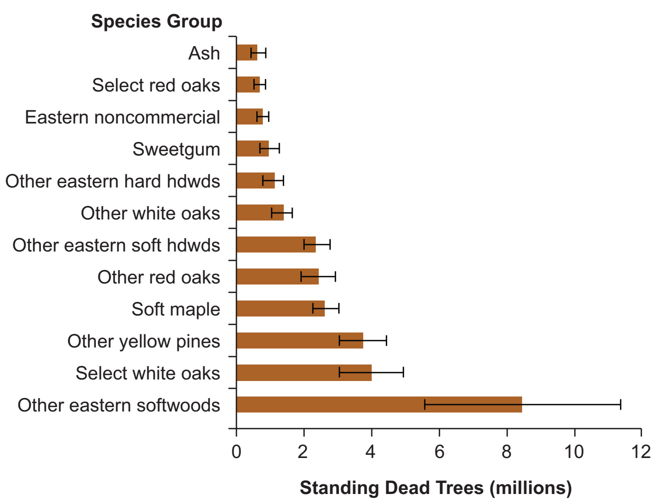


Figure 61.—Number of standing dead trees on forest land by species group, New Jersey, 2008 (error bars represent a 68-percent confidence interval).

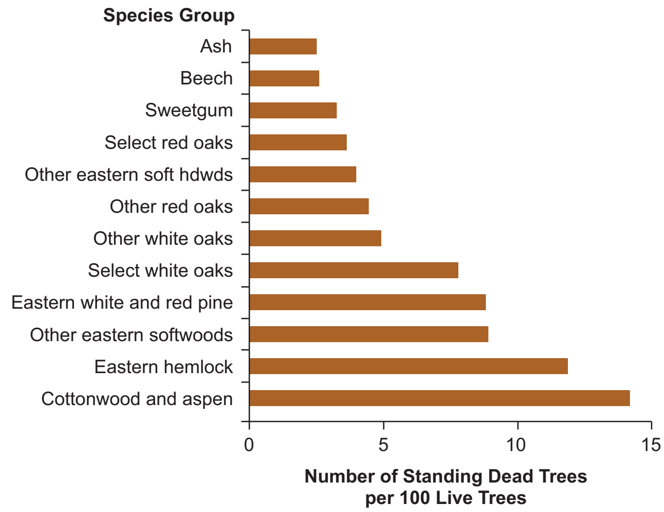


Figure 62.—Number of standing dead trees per 100 live trees on forest land by species group, New Jersey, 2008.

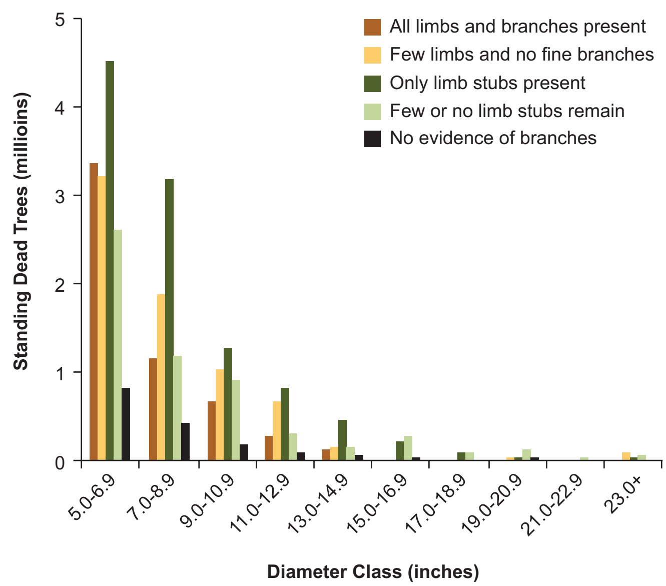


Figure 63.—Distribution of standing dead trees on forest land by diameter and decay class, New Jersey, 2008.

What this means

Standing dead trees result from a variety of potential causes, including diseases, insects, weather damage, fire, flooding, drought, and competition. They provide areas for foraging, nesting, roosting, hunting perches, and cavity excavation for wildlife. The state and federally endangered Indiana bat (*Myotis sodalis*), roosts primarily under exfoliating bark of snags during the breeding season. This species is listed among New Jersey's most important SGCN and is known or believed to occur in seven north-central counties. Providing a variety of forest structural stages and retaining specific features such as snags are ways that forest managers maintain the abundance and quality of habitat for forest-associated wildlife species in New Jersey.

Ozone

Background

Ozone is a naturally occurring component of atmosphere (Smith et al. 2008). Beneficial in the stratosphere, ozone becomes an air pollutant when found in high concentrations in the lower atmosphere. Elevated concentrations of ground-level ozone can adversely affect forested landscapes, causing direct foliar injury and reduced photosynthetic activity (Coulston et al. 2004). Prolonged exposure to high levels of ozone reduces tree growth, weakens tree defenses (increasing vulnerability to insects and disease), and may lead to changes in forest composition, regeneration, and productivity.

Susceptibility to ozone varies by species (Smith et al. 2008). Therefore, the effects of ozone are monitored using bioindicator plants, i.e., ozone-sensitive species that exhibit visible foliar symptoms or reduced growth in response to ambient levels of ozone pollution (Coulston et al. 2003, Smith et al. 2008). The use of bioindicator plants provides an indirect measure of air quality, identifying conditions that are favorable for the occurrence of ozone injury. Results represent 5-year rolling averages, where reported years denote the final year of inventory.

What we found

During the 2008 inventory, 35 biosites across New Jersey were sampled for ozone injury; 66 percent of plots contained injured plants and 8 percent of evaluated bioindicator plants had ozone damage (Table 3). The severity and amount of ozone damage at each biosite was used to calculate a biosite index. The biosite index is a

Table 3.—Ozone bioindicator data, New Jersey, 1998-2008.

Year	Number of biosites	Biosites with injury (%)	Number of plants evaluated	Number of plants with injury (%)
1998	39	69	2,002	28
1999	39	54	2,465	16
2000	42	40	3,044	10
2001	38	34	3,006	9
2002	41	41	3,598	9
2003	37	19	3,307	2
2004	35	31	3,116	5
2005	33	42	2,878	6
2006	38	53	3,376	7
2007	35	60	3,252	8
2008	35	66	3,226	8

Table 4.—Classification scheme for the FIA biosite index[a] (Smith et al. 2008)

Biosite Index	Bioindicator response	Assumption of risk	Possible impact	Relative air quality[b]
0 to < 5	Little or no foliar injury	None	Visible injury to highly sensitive species, e.g. black cherry	Good
5 to < 15	Light foliar injury	Low	Visible injury to moderately sensitive species, e.g. yellow poplar	Moderate
15 to < 25	Moderate foliar injury	Moderate	Visible and invisible injury. Tree-level response[c]	Unhealthy for sensitive species
≥ 25	Severe foliar injury	High	Visible and invisible injury. Ecosystem-level response[c]	Unhealthy

[a]The categorizations of the biosite index are subjective and based solely on expert opinion.

[b] Relative ozone air quality from a plant's perspective. See: EPA-456/F-99-002 July 1999; http://www.airnow.gov.

[c] According to the EPA's Proposed Guidelines for Ecological Risk Assessment (Federal Register 61(175): 47552-47631).

relative value describing the gradation of plant response that quantifies the degree of ozone injury on a plot; it is not intended as a measurement of harm (Woodall et al. 2010). Index values are grouped into four categories that describe plant response and identify the degree of risk due to ambient ozone exposure (Table 4; Smith et al. 2008). In 2008, 66 percent of biosites were in the no risk category, 14 percent showed low risk, 9 percent were at moderate risk, and 11 percent of biosites were in the high risk category. The trend in mean biosite index values shows a sharp decrease between 1998 and 2003, followed by a slight increase through 2008 (Fig. 64). Mean severity of ozone symptoms on injured foliage decreased between 1998 and 2008 for most species (Fig. 65). Sweetgum, blackberry, and milkweed had the highest severity of symptoms and incurred the most injury in 2008 (Fig. 66)

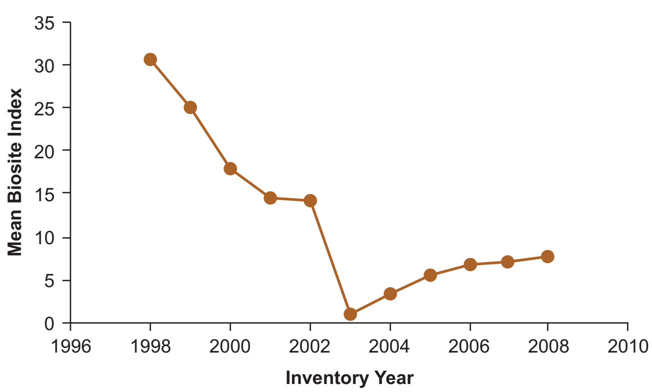


Figure 64.—Mean biosite index (unitless ratio of number of bioindicator plants with ozone damage by total number of sampled plots) by inventory year, New Jersey.

Ground-level ozone exposure is reported using the SUM06 index. This index, recorded for a 24-hour period over a 3-month growing season, represents the sum of all average, hourly ozone concentrations greater than 0.06 parts per million (ppm) (Coulston et al. 2004). Leaf damage can occur after exposure to ozone levels above 8 ppm-hours. Seedling growth (in natural forest stands) can be affected at levels between 10 and 15 ppm-hours (Heck and Cowling 1997). Yearly SUM06 values were averaged for a 5-year period between 2001 and 2005. During that time, most of New Jersey was exposed to ozone levels greater than 25 ppm-hours (Fig. 67).

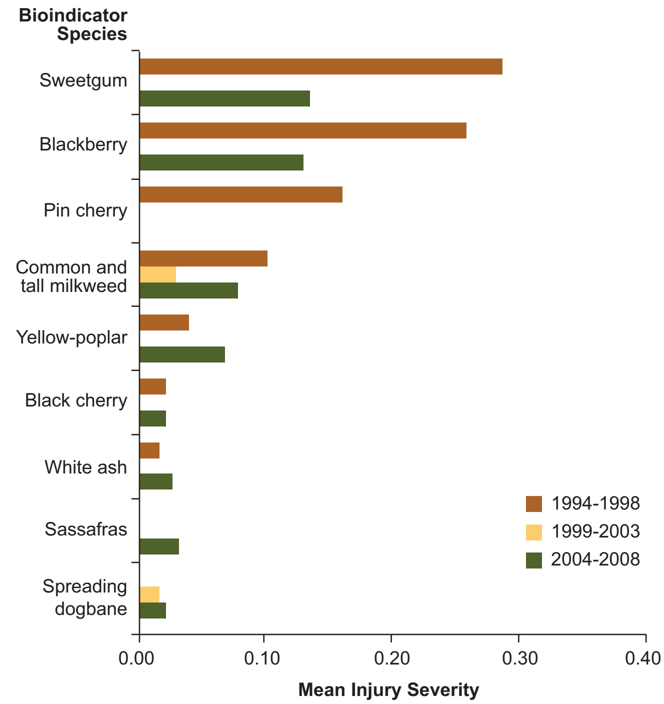


Figure 65.—Mean injury severity (unitless ratio of injury severity amounts for a given species at a biosite by total number of injured plants) by inventory year, New Jersey.

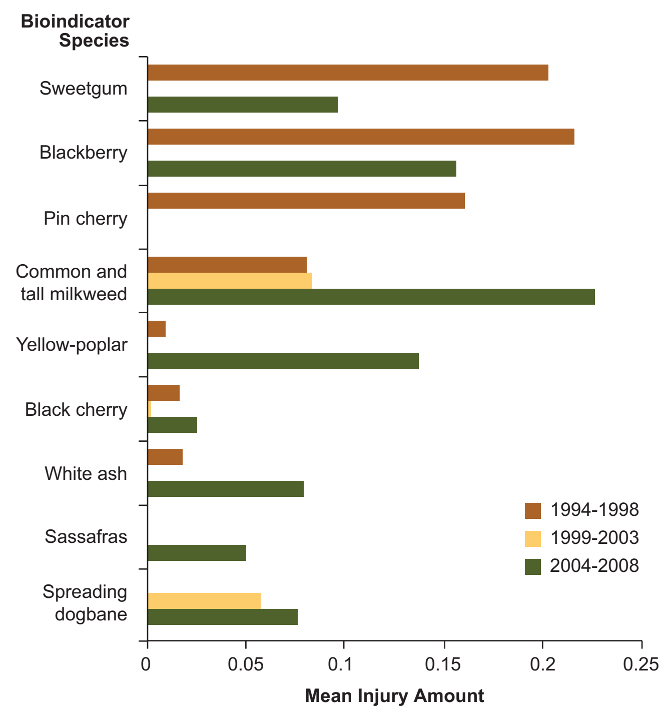
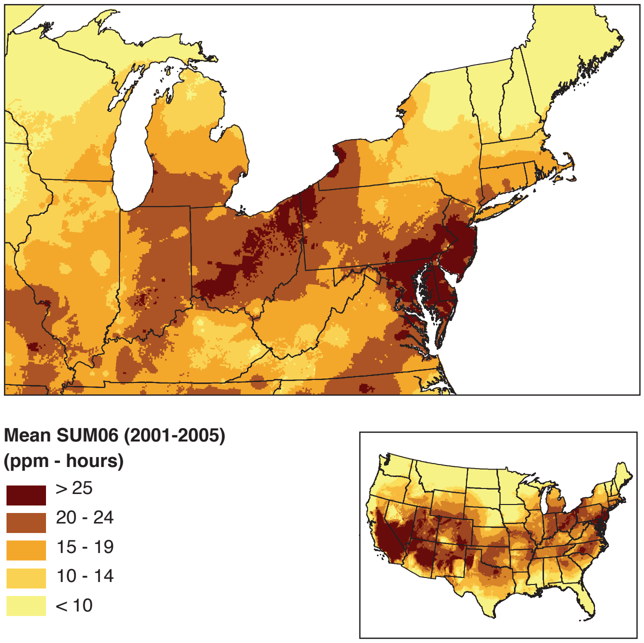


Figure 66.—Mean injury amount (unitless ratio of amount of injury for a given species at a biosite by total number of injured plants) by inventory year, New Jersey.



Source: U.S. Environmental Protection Agency, 2001-2005. J. Coulston, U.S. Forest Service.

Figure 67.—Mean observed ground-level ozone exposure reported as SUM06, New Jersey, 2001-2005.

What this means

Ozone injury was recorded on more than half of the biosites in New Jersey, however, a relatively small number of plants on those sites had ozone damage. Visible ozone injury, as indicated by the biosite index, has decreased since 1998. As forests across the State were exposed to elevated concentrations of ozone between 2001 and 2005, the potential for reduced growth and decreased forest health increases with continued exposure to high ozone levels. Ozone-induced stress will have the greatest impact on ozone-sensitive species (e.g., blackberry, sweetgum and yellow-poplar). Adverse effects on more dominant species such as oaks and maples will be less severe as a result of increased tolerance to ozone.

Lake at sunset. Photo used with permission of the New Jersey Forest Service.

Forest Economics

Rancocas State Park. Photo by Susan Crocker, U.S. Forest Service.

Growing-stock Volume

Background

Growing-stock volume is the amount of sound wood in live, commercial tree species that are 5 inches in d.b.h. or greater and free of defect. This measure has traditionally been used to ascertain wood volume available for commercial use. Estimates of the volume of growing stock are important considerations in economic planning and when evaluating forest sustainability.

What we found

Growing-stock volume on timberland has risen steadily since 1956 and currently totals an estimated 3.4 billion cubic feet (Fig. 68). The other yellow pines species group, which mainly consists of pitch pine, is the largest source of growing-stock volume, followed by soft maple and other red oaks (Fig. 69). Pitch pine, which accounts for 16 percent of growing-stock volume, is the most voluminous species on New Jersey timberland. Looking at changes in growing-stock volume by species group and diameter class, the other yellow pines have increased in volume in the smaller diameter classes (Fig. 70). In contrast, yellow-poplar has mainly increased within the larger diameter classes.

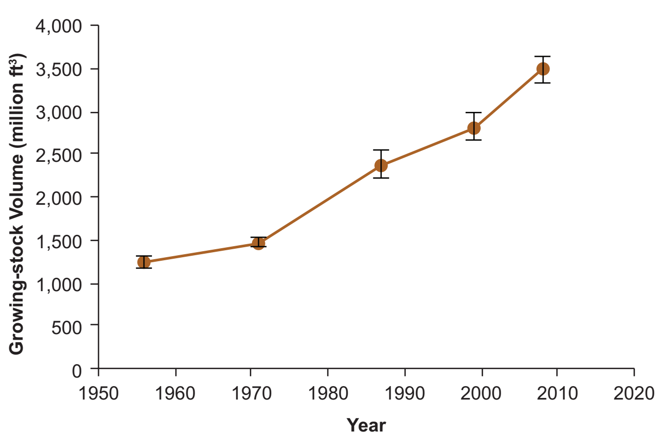


Figure 68.—Growing-stock volume on timberland by inventory year, New Jersey (error bars represent a 68-percent confidence interval).

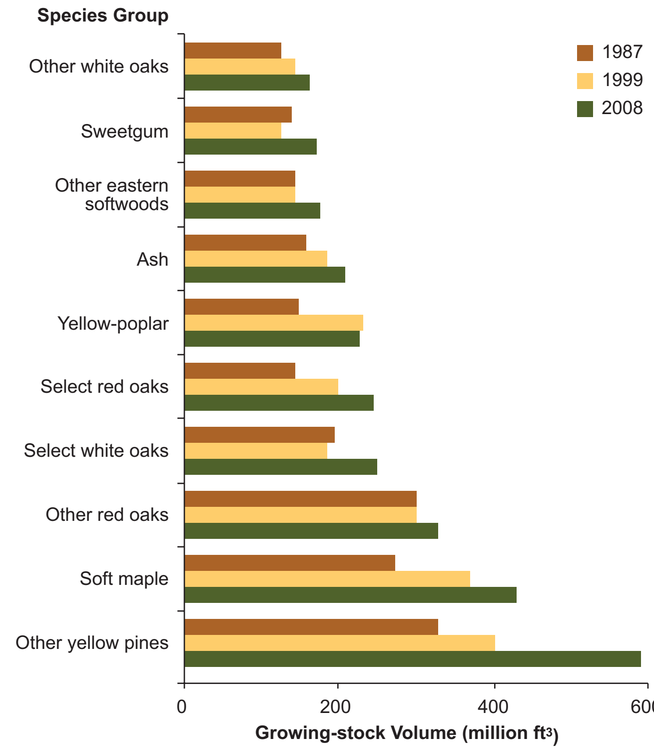


Figure 69.—Growing-stock volume of top 10 species on timberland by inventory year, New Jersey, 1987-2008.

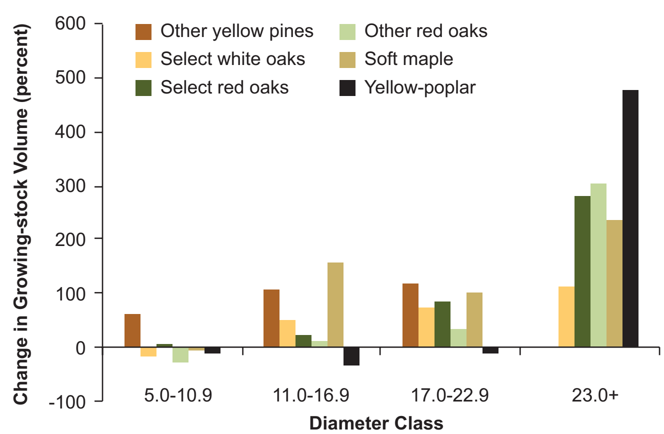


Figure 70.—Change in growing-stock volume of selected species groups on timberland by 6-inch diameter classes between 1987 and 2008, New Jersey.

What this means

Rising growing-stock volume can be attributed to tree growth (particularly yellow-poplar, oaks, and pitch pine) and relatively low mortality rates for most species, characteristics indicative of an aging forest. Volume increase varied by species group and diameter class. New Jersey's growing-stock volume appears to be increasing, however, as stands mature, sustainability issues (e.g., regeneration) should continue to be monitored.

Sawtimber Volume and Quality

Background

Sawtimber trees are live trees of commercial species that contain either one 12-foot or two noncontiguous 8-foot logs that are free of defect. Hardwoods must be at least 11 inches d.b.h. and softwoods must be 9 inches d.b.h. to qualify as sawtimber. Sawtimber volume is defined as the net volume of the saw log portion of live sawtimber, measured in board feet, from a 1-foot stump to minimum top diameter (9 inches for hardwoods and 7 inches for softwoods). Estimates of sawtimber volume are used to determine the monetary value of wood volume and to identify the quantity of merchantable wood availability.

What we found

Since 1956, the volume of sawtimber on New Jersey timberland has nearly quadrupled, reaching an estimated 11.3 billion board feet in 2008 (Fig. 71). Most species groups had gains in sawtimber volume since 1999 (Fig. 72). Select white oaks, hard maple, and other yellow pines (mainly pitch pine) had greater than 50 percent increases in the amount of sawtimber volume. Sawtimber quality is determined using a grading system that incorporates factors including diameter, log length, and the cull portion of the saw log. Tree grade is based on a scale of 1 to 4, with grade 1 representing the highest quality and grade 4 the lowest. Over the past decade, the quality of New Jersey sawtimber has remained consistent, with a large portion of higher grade sawtimber (Fig. 73). Currently, 43 percent of New Jersey's hardwood sawtimber is in grade 1.

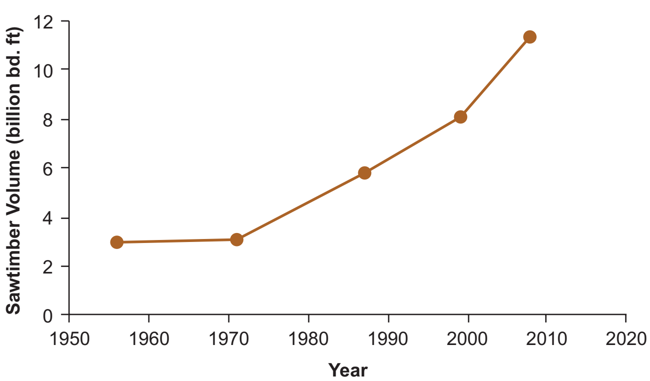


Figure 71.—Sawtimber volume on timberland by inventory year, New Jersey.

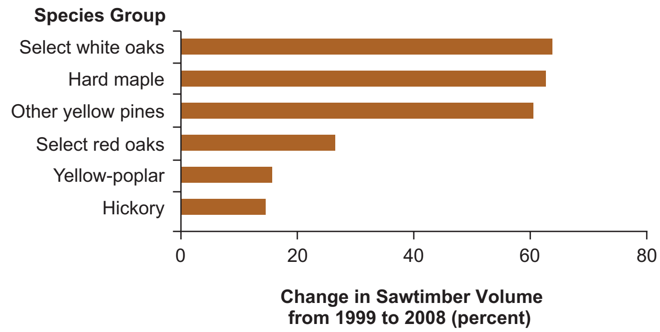


Figure 72.—Percent change in sawtimber volume on timberland for selected species groups, New Jersey.

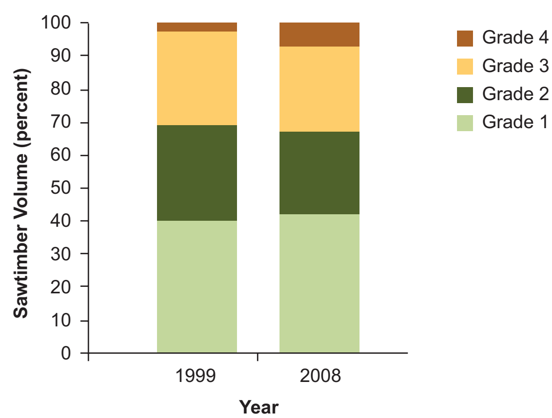


Figure 73.—Sawtimber volume for hardwood species on timberland by tree grade, New Jersey, 1999 and 2008.

What this means

New Jersey's sawtimber resource has been steadily increasing for decades. This is indicative of a stable and sustainable component of the forest ecosystem. If current trends continue, one would expect increasing sawtimber volumes into the foreseeable future. However, this assumption may not hold locally, or following unexpected forest disturbances (e.g., invasive pests, disease, or weather).

Timber Products

Background

The harvesting and processing of timber products produces a stream of income shared by timber owner, managers, marketers, loggers, truckers, and processors. Though relatively small, the wood products and paper manufacturing industries in New Jersey employed more than 16,000 people, with an average annual payroll of $723 million and a total value of shipments of $4 billion (U.S. Census Bureau 2010). To better manage the State's forests, it is important to know the species, amounts, and locations of timber being harvested.

What we found

Surveys of New Jersey's wood-processing mills are conducted periodically to estimate the amount of wood volume that is processed into wood products (Smith et al. 2009). This is supplemented with the most recent surveys conducted in surrounding states that processed wood harvested from New Jersey. In 2006, seven active primary wood processing mills were surveyed to determine the species that were processed and the source of wood material. These mills processed over 5.7 million board feet.

A total of 1.7 million cubic feet of industrial roundwood was harvested from New Jersey in 2006, including roundwood that was exported to primary wood processing mills in other states. Saw logs accounted for 78 percent of the total industrial roundwood harvested, pulpwood for 21 percent, and post, poles and pilings less than 1 percent (Fig. 74). All of the timber harvested for pulpwood is shipped to mills in other states. Pine species accounted for 27 percent of the total industrial roundwood harvest. Other important species harvested were red and white oaks, Atlantic white-cedar, yellow-poplar, and sweetgum (Fig. 75). An additional 250,000 cubic feet of wood was harvested for residential fuelwood.

In the process of harvesting industrial roundwood, 978,000 cubic feet of harvest residues were left on the ground (Fig. 76). More than 80 percent of the

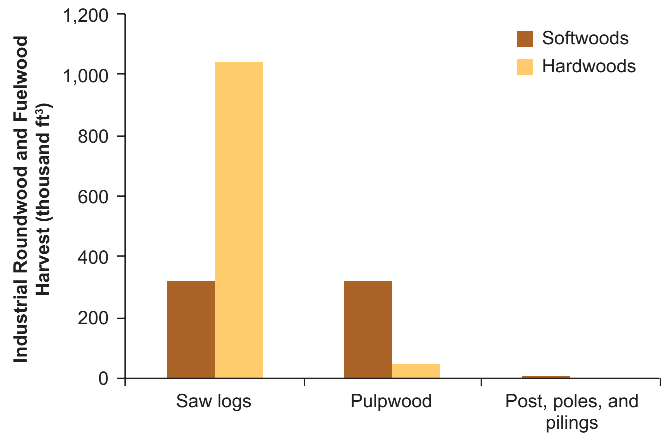


Figure 74.—Industrial roundwood and fuelwood production by product and major species group, New Jersey, 2006.

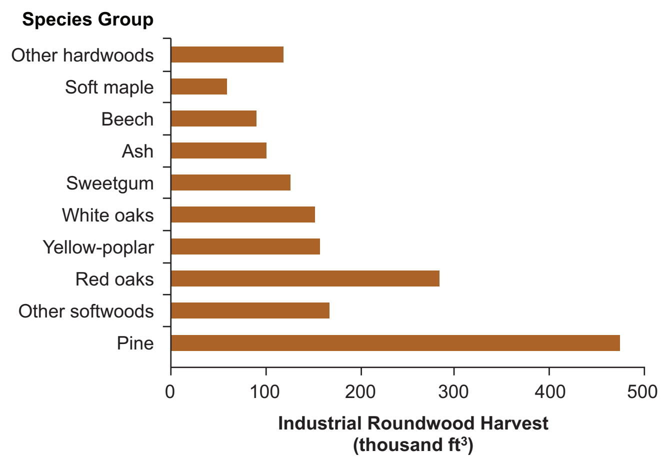


Figure 75.—Industrial roundwood harvested by species group, New Jersey, 2006.

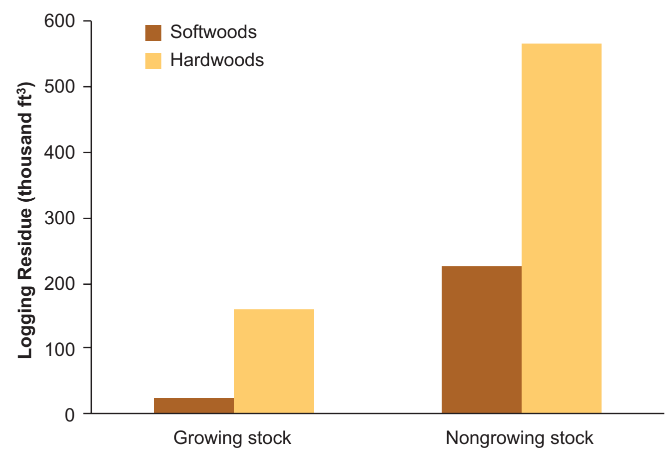


Figure 76.—Residue generated by industrial roundwood harvesting by growing stock and nongrowing stock, and softwood and hardwoods, New Jersey, 2006.

logging residue came from nongrowing-stock sources such as crooked or rotten trees, tops and limbs, and noncommercial species. The processing of industrial roundwood in the State's primary wood-using mills generated another 578,000 cubic feet (9,000 dry tons) of wood and bark residues. Sixty-eight percent of the mill residues were used for miscellaneous products such as animal bedding and mulch, and 15 percent was used for industrial and residential fuelwood (Fig. 77). Sixteen percent of mill residues produced were not utilized.

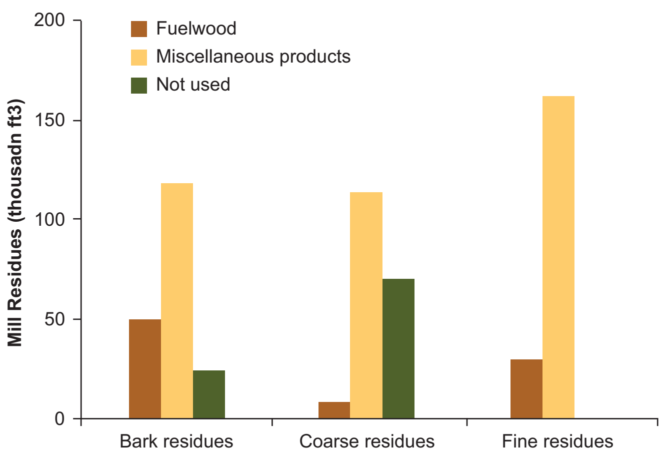


Figure 77.—Disposition of mill residues generated by primary wood-using mills, New Jersey, 2006.

What this means

All of the wood-processing facilities in New Jersey were sawmills processing primarily state-grown saw logs. These mills provide woodland owners with an outlet to sell timber and provide jobs in rural areas. The demand for wood products is likely to increase, placing a greater demand on the resource. An important consideration for the future of the primary wood-products industry is its ability to retain industrial roundwood processing facilities. The number of wood-processing mills has been steadily declining. The loss of processing facilities makes it harder for landowners to find markets for the timber harvested from management activities on their forest land.

Another important issue is the volume of harvest residues and mill residues that are generated in the State that go unused. Twenty percent of the harvest residue is from growing-stock sources, which could be used to produce products. Improved pulpwood markets could lead to better utilization of merchantable trees. The use of logging slash and mill residues for industrial fuelwood at cogeneration facilities or for wood pellet mills could also result in better utilization of the forest resource.

Data Sources

Forest Inventory

Information on the condition and status of forests in New Jersey was obtained from the Northern Research Station's Forest Inventory and Analysis (NRS-FIA) program. Previous inventories of New Jersey's forest resources were completed in 1956 (Webster and Stoltenberg 1958), 1971 (Ferguson and Mayer 1974), 1987, and 1999 (Griffith and Widmann 2001). Data from New Jersey's forest inventories can be accessed electronically on the DVD included with this report, or at: http://www.nrs.fs.fed.us/fia. For detailed information on inventory methods, see section "Statistics, Methods, and Quality Assurance" on the DVD.

National Woodland Owner Survey

Information about family forest owners is collected through the U.S. Forest Service's National Woodland Owner Survey (NWOS). The NWOS was designed to increase our understanding of owner demographics and motivation (Butler et al. 2005). Data presented here are based on survey responses from 35 randomly selected families and individuals who own forest land in New Jersey plus an additional 449 family forest owners in adjoining survey units from Delaware, New York, and Pennsylvania. For additional information about the NWOS, visit: www.fia.fs.fed.us/nwos.

Timber Products Output Inventory

This study was a cooperative effort of the former Northeastern Research Station and NRS-FIA. Using a questionnaire designed to determine the size and composition of New Jersey's forest products industry, its use of roundwood (round sections cut from trees), and its generation and disposition of wood residues, Forest Service personnel contacted via mail and telephone all primary wood-using mills in the State. Completed questionnaires were sent to NRS-FIA for processing. As part of data processing, all industrial roundwood volumes reported were converted to standard units of measure using regional conversion factors.

National Land Cover Data Imagery

Derived from Landsat Thematic Mapper satellite data (30-m pixel), the National Land Cover Dataset (NLCD) is a land cover classification scheme (21 classes) applied across the United States by the U.S. Geological Survey (USGS) and the U.S. Environmental Protection Agency (EPA). The NLCD was developed from data acquired by the MRLC Consortium, a partnership of Federal agencies that produce or use land-cover data. Partners include the USGS, EPA, U.S. Forest Service, and National Oceanic and Atmospheric Administration.

Mapping Procedures

Maps in this report were constructed using (1) categorical coloring of New Jersey counties according to forest attributes (such as forest land area); (2) a variation of the k-nearest-neighbor (KNN) technique to apply information from forest inventory plots to remotely sensed MODIS imagery (250 m pixel size) based on the spectral characterization of pixels and additional geospatial information; or (3) colored dots to represent plot attributes at approximate plot location.

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The first full annual inventory of New Jersey's forests reports more than 2.0 million acres of forest land and 83 tree species. Forest land is dominated by oak-hickory forest types in the north and pitch pine forest types in the south. The volume of growing stock on timberland has been rising since 1956 and currently totals 3.4 billion cubic feet. The average annual net growth of growing stock from 1999 to 2008 averages 94.6 million cubic feet per year. This report includes additional information on forest attributes, land use change, carbon, timber products, and forest health. The included DVD provides information on error estimates, quality assurance of data collection, tables, and raw data.

KEY WORDS: inventory, forest statistics, forest land, volume, biomass, carbon, growth, removals, mortality, forest health, New Jersey

DVD Contents

New Jersey's Forests 2008 (PDF)

New Jersey's Forests: Statistics, Methods, and Quality Assurance (PDF)

New Jersey Inventory Database (CSV file folder)

New Jersey Inventory Database (Access file)

Field guides that describe inventory procedures (PDF)

Database User Guides (PDF)

New Jersey's Forests 2008 Statistics, Methods, and Quality Assurance

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