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Abstract

This report summarizes the second annual inventory of New York's forests, conducted in 2008-2012. New York's forests cover 19.0 million acres; 15.9 million acres are classified as timberland and 3.1 million acres as reserved and other forest land. Forest land is dominated by the maple/beech/birch forest-type group that occupies more than half of the forest land. The sound wood volume on timberland has been rising and is currently 37.4 billion cubic feet, enough to produce saw logs equivalent to 93.7 billion board feet. On timberland, the average annual growth in volume of live trees outpaced removals by a ratio of 2.1:1. The net change in volume averaged 1.1 percent per year. This report includes additional information on forest attributes, land use, forest fragmentation, forest ownership, forest health indicators, timber products, statistics, and quality assurance of data collection. Detailed information on forest inventory methods and data quality are available online at http://dx.doi.org/10.2737/NRS-RB-98.

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Cover: Overlooking the St. Regis Canoe Area, Adirondacks, NY. Softwood and hardwood species blanket the landscape. Photo by Richard Widmann, U.S. Forest Service.

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New York Forests, 2012

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Foreword

Most land in New York, if left alone, will naturally support trees. Forests encompass nearly the entire natural terrestrial environment in New York. The condition of New York's forests should be of interest and concern to everyone in the State. Forests support jobs in timber products industries, tourism, and sports; and provide services such as clean air and water, habitat for wildlife and surroundings to simply enjoy nature. The ultimate goal is to keep forest as forest and to keep forest ecosystems functioning naturally while providing a full range of benefits and services for today and for generations to come. Decisions on how to manage forests are everybody's responsibility; however, more often than not information to support decisions is lacking.

The Northern Research Station, Forest Inventory and Analysis program of the U.S. Forest Service uses a permanent network of ground plots spanning the United States to inventory the forests of the Nation. Data are collected annually and consistently, enabling the monitoring of change over time and seamless comparisons among states. Having current inventory information, such as that reported here, helps in making better decisions about New York forests and planning for its future.

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Down woody material is a store of carbon and provides habitat for wildlife. Photo by Richard Widmann, U.S. Forest Service.

Highlights

On the Plus Side

- New York's forest land area increased slightly in this inventory period to 19.0 million acres. Forest land in New York may be nearing a peak as conversion of forests for developed uses continues and farm land reversion to forest slows. Of the 19.0 million acres, 15.9 million are classified as timberland, and 3.1 million acres are classified as reserved and other forest land. The State is 63 percent forested.
- One-fourth of New York's forest land (4.8 million acres) is publicly owned; this does not include publicly owned easements on private land.
- A combination of public and private ownerships enhances the benefits and ecological services provided by New York's forests. The many diverse ownerships create private market opportunities while protecting critical areas and providing for public recreation.
- Many of the reasons that forest landowners give for owning forest land align closely with goals stated in "New York's Forest Resource Assessment and Strategy, 2010-2015" (NY DEC, n.d.b). This report discusses the State's broad goals to "keep New York's forests as forests" and "to keep ecosystems functioning naturally to provide the full range of benefits and services." Ninety percent of family forest owners with 10 acres or more want to keep their wooded land wooded and at least two-thirds of owners rank protecting biological diversity, water resources, and wildlife habitat as very important or important.
- New York's forests are a rich mix of stands of varying sizes, ages, and stocking levels. The continued shift to larger trees and the increase in area of sawtimber-size stands indicates that New York's forests are maturing.
- On timberland, red maple and sugar maple are the most numerous trees 5 inches and larger in diameter at breast height (d.b.h.), followed by hemlock, species of ash, and beech. On State owned reserved forest land in the Adirondack Park, American beech is the most common tree 5 inches d.b.h. and larger, followed by sugar maple and hemlock.
- Sound wood volume, net sound volume, growing-stock volume, and sawtimber volume on New York have increased by 4.9, 4.4, 2.3, and 7.9 percent, respectively, on timberland since 2007. Volume increases have been continuous since 1950.

- Volume has continued to shift toward the larger diameter classes. Between 2007 and 2012, net volume has decreased by 3.5 percent in diameter classes less than 11 inches, while volume of trees 15 inches and larger has increased by 13.2 percent; both softwood and hardwood species exhibit this pattern.
- Average annual change components as a percentage of current inventory indicates that gross growth was 3.2 percent; mortality, 1.1 percent; net growth, 2.1 percent; and removals, 1.0 percent for an average annual net increase in volume of 1.1 percent. The ratio of net growth to removals averaged 2.1:1 from 2007 to 2012 on timberland.

Issues to Watch

- The area in sapling/seedling size stands, or early successional forest, has been declining. This results in a decline of wildlife species that require early-successional habitats.
- Fragmentation is changing how New York's forests function and is affecting forest sustainability. Fragmentation diminishes the benefits and services forests provide and makes forest management more difficult.
- Forty-seven percent of forest land is less than fully stocked with live trees but when only growing-stock trees are considered, the less than fully stocked level increases to 62 percent. The broad extent of stands that are less than fully stocked indicates that much disturbance, natural and human-caused, has occurred in New York's forests. The 3.5 million acres of timberland that are poorly stocked with growing-stock trees or nonstocked represents a loss of potential growth. The increase in stands that are poorly stocked with growing-stock trees is a threat to the long-term sustainability of harvesting quality timber from New York's forests.
- The proliferation of small beech trees in the aftermath of beech bark disease (BBD) infection, also known as beech brush, can inhibit the reproduction of other species. High numbers of beech saplings in some areas are interfering with the regeneration of other species. While the number of beech saplings has increased, numbers of saplings for species associated with beech have decreased since 2007. These species include sugar maple (-13 percent), red maple (-9 percent), and white pine (-10 percent).
- Beech and ash seedlings collectively represent 35 percent of all seedling-size trees. Despite the many small beech and ash trees, these species will likely decreases in importance in New York's forests because of insects and diseases. It is unlikely that

many beech trees will reach a large size because of beech bark disease. This will limit the future availability of beech and ash for producing timber products and for producing hard mast for wildlife.

- Ash mortality is not currently high but will likely increase as emerald ash borer spreads in New York. Emerald ash borer is expected to cause significant costs to municipalities, property owners, and the forest products industries in the State.
- New York has more hemlock volume than any other state. As hemlock woolly adelgid continues to spread north and west from the Catskill-Lower Hudson areas into the rest of the State (likely over the next two decades), it will move into forests where densities of eastern hemlock are considerably higher.
- Much of the timber growing is of low value because of species and quality. Volume increases occurred across all hardwood tree grades, and though the proportions of total board-foot volume by grade remained nearly unchanged, volume increased more in the tie/local-use class than in the higher valued grades 1 and 2.

Rensselaer County, wildland-urban interface (WUI). Photo by Mike Hoppus, U.S. Forest Service, retired, used with permission.

Background

Wetland species dominate the shore of this tributary of Little Tupper Lake. Photo by Richard Widmann, U.S. Forest Service.

An Overview of Forest Inventory

What is FIA?

The Forest Inventory and Analysis program, commonly referred to as FIA, is the nation's forest census. It was established by the U.S. Congress to "make and keep current a comprehensive inventory and analysis of the present and prospective conditions of and requirements of the forest and range lands of the United States" (Forest and Rangeland Renewable Resources Planning Act of 1974; 16 USC 1601 [note]). FIA has been collecting, analyzing, and reporting on the nation's forest resources for over 80 years with the first FIA inventory of New York's forests completed in 1953. Information is collected on the status and trends of the extent, composition, structure, health, and ownership of the forests. This information is used by policy makers, resource managers, researchers, and the general public to better understand forest resources and to make more informed decisions about their fate.

What is this report?

This report is a summary of the findings from the sixth survey of the forest resources of New York conducted by FIA. Data for this survey were collected between 2008 and 2012, but throughout this report, we refer to 2012 as the inventory year.

The results of the survey are divided into chapters that focus on forest features, forest health, and forest economics. Details about the data collection, estimation procedures, and statistical reliability are included in the section "Statistics, Methods, and Quality Assurance," at http://dx.doi.org/10.2737/NRS-RB-98. The website also includes a glossary and numerous tables summarizing the results reported here.

A Guide to Forest Inventory

What is a tree?

Trees are perennial woody plants with central stems and distinct crowns. The Forest Inventory and Analysis (FIA) program defines a tree as any perennial woody plant species that can attain a height of 15 feet at maturity. A complete list of the tree species measured in New York during this inventory is included in the appendix. Throughout this report, the size of a tree is usually expressed as diameter at breast height (d.b.h.), in inches. This is the diameter, outside the bark, at a point 4.5 feet above ground.

What is a forest?

A forest is a collection of trees and most people would agree on what a forest is. But in order for statistics to be reliable and comparable, a definition must be created to avoid ambiguity.

FIA defines forest land as land that is at least 10 percent stocked with trees of any size or formerly having had such tree cover and not currently developed for nonforest use. Generally, the minimum area for classification as a forest must be at least 1 acre in size and 120 feet in width. There are more specific criteria for defining forest land near streams, rights-of-way, and shelterbelt strips (U.S. Forest Service 2012).

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

FIA classifies forest land into three categories:

- Timberland—forest land that is producing or is capable of producing crops of industrial wood and is not withdrawn from timber utilization by statute or administrative regulation. These areas are capable of producing in excess of 20 cubic feet per acre (equivalent to about ¼ cord) per year of industrial wood in natural stands. Inaccessible and inoperable areas can be included.
- Reserved forest land is all forest land that is withdrawn from timber utilization through statute without regard to productive status, e.g., state parks, national parks, and Federal wilderness areas.
- Other forest land consists of forest land that is not capable of growing 20 cubic feet per acre (equivalent to about ¼ cord) per year and is not restricted from harvesting, e.g., some surface-mined areas with extremely degraded soil and some poorly drained areas where water inhibits tree growth. Sometimes such forest lands are referred to as being “less productive” or “unproductive” with respect to wood fiber production.

Since 2002, the annual inventory design allows us to report volumes on all forest land in New York. We now have one set of remeasured plots across all forest land with associated estimates of growth, removals, and mortality. Prior to the 2002-2007 inventory cycle (referred to as the 2007 inventory) in New York, for most attributes, FIA only included the data collected on timberland plots. As a result, trend analyses that use data prior to 2002 are limited to timberland for many attributes.

How do we estimate a tree's volume?

The volume of a tree, or any other object, is equal to the amount of liquid displaced by it. To estimate a live tree's volume, FIA uses volume equations that have been developed for each tree species group found within the region. Individual tree volumes are based on species, diameter, and height. FIA reports volume in cubic feet and board feet (International ¼-inch rule). Board-foot volume measurements are only applicable for sawtimber-size trees. In New York, wood often is measured in cords (a stack of wood 8 feet long by 4 feet wide and 4 feet high). A cord of wood consists of about 79 to 85 cubic feet of solid wood and the remaining 43 to 49 cubic feet are bark and air.

How is forest biomass estimated?

The U.S. Forest Service has developed estimates of specific gravity for a number of tree species (U.S. Forest Service 1999). These specific gravities are applied to estimates of tree volume to estimate the biomass of merchantable trees (weight of the bole). Regression models are used to estimate the biomass of stumps (Raile 1982), limbs, and bark (Hahn 1984), and belowground stump and coarse roots (Jenkins et al. 2004). Currently, FIA does not report the biomass of foliage. FIA can 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 no moisture content; oven-dry weight is used to report biomass in this report. On average, 1.9 tons (2,000 pounds/ton) of green biomass equals 1 ton of oven-dry biomass.

Forest Inventory Sample Design

FIA has established a set of permanent inventory plots across the United States that are periodically revisited. Each plot consists of four 24-foot subplots for a total area of approximately one-sixth of an acre. Each plot is randomly located within a hexagon that is approximately 6,000 acres in size. Therefore, each plot represents about 6,000 acres of land and can be used to generate unbiased estimates and associated sampling errors for attributes such as total forest land area. Full details of sample design and estimation procedures are available in Bechtold and Patterson (2005) and a summary explanation is included in the Statistics, Methods, and Quality Assurance section of this report found at http://dx.doi.org/10.2737/NRS-RB-98.

Understanding FIA Data

Before 2000, FIA inventories were completed every 10 to 20 years. With these periodic inventories, it took decades to identify trends. With the new annual inventory, some trends will be easier to identify because a subset of observations (approximately 20 percent) are made every year. It is still necessary to look over long time periods because many trends like forest succession can be difficult to discern in short time spans. Definitions, methods, location, ownership, precision, scale, and temporal trends are important factors to consider when analyzing FIA data. Estimates are derived from sample plots throughout a state. Larger geographic areas will contain more plots and thus produce more reliable estimates. For example, there usually are not a sufficient number of plots within a county or single forest type with which to provide reliable estimates. It also is important to consider the degree to which a variable can be measured precisely. For instance, a stand variable, such as age, is not as precise as forest type; and a tree variable, such as crown dieback, is not as precise as diameter. Location and ownership also are important considerations when analyzing the status and trends of forests. Forest resources can vary by geographic unit and ownership group.

Some definitions and procedures have changed among inventories. Because of these changes, some comparisons and estimates should be made with caution.

As previously stated, the annual inventory measures a subset of observations (about 20 percent) every year. After 5 years of data collection, an analysis is completed and a report created based on the full set, or “cycle” of plots. This creates a yearly moving window of 5-year cycles. The last year of each full cycle is used to identify the full set of plots. For example, the cycle of plots measured from 2008 through 2012 are collectively labeled the 2012 inventory and were used to produce this 2012 report. The 2007 inventory is the first annual inventory to include the complete cycle of annual inventory plots and was collected over a 6-year period (Widmann et al. 2010).

To improve the consistency, efficiency, and reliability of the inventory, updates have been implemented over time. Major changes occurred with the annual inventory that started in 1999. For the sake of consistency, a new, national plot design was implemented by FIA units throughout the United States in 1999 (see Statistics, Methods, and Quality Assurance). Estimates for the 2012 inventory use the most recent updated methods.

What is the National Woodland Landowner Survey

The National Woodland Owner survey is conducted periodically by the Forest Service. It is aimed at increasing our understanding of woodland owners who are the critical link between forests and society (Butler et al. in press). The most recent survey was conducted 2011-2013. Questionnaires were mailed to individuals and private groups who own the woodlands where FIA has established inventory plots. Results from New York, included in this report, are based on 310 responses from family forest owners in the most recent survey (Butler et al. in press).

Where can I find additional information?

Detailed information on forest inventory methods, data quality estimates, and important resource statistics can be found in the "Statistics, Methods, and Quality Assurance" section found at http://dx.doi.org/10.2737/NRS-RB-98. This website also contains most of the data used in this report, which is also accessible through EVALIDator online resource (Miles 2014). Some graphs and tables in the printed portion of this report show only a sample of the prominent categories and values available for summarizing data. Tables found at the website may have more categories; summary values and custom tables can also be created with EVALIDator. Definitions of tables and fields are available in the database users manual (Woudenberg et al. 2010).

An important public web tool is the Forest Inventory data online (FIDO) website (http://apps.fs.fed.us/fido/). FIDO gives the public access to the all Forest Inventory and Analysis databases with which allows anyone to generate tables and maps of forest statistics through a web browser without having to understand the underlying data structures.

Data access tools, previous reports for New York, and additional information are available at www.nrs.fs.fed.us/fia.

Introduction

This report summarizes FIA's second cycle of annual forest inventory for New York covering the years 2008 through 2012 and referred to as the 2012 inventory. These inventories are a cooperative effort of the Northern Research Station's Forest Inventory and Analysis program (NRS-FIA), the New York Department of Environmental Conservation (NY DEC), and the landowners of New York. During the 2012 inventory, plots from the first annual inventory (2002-2007, Widmann et al. 2012) were remeasured. In addition, the 2012 inventory includes the first remeasurement of plots on State-owned forest land in the Catskill and Adirondack Preserves. Previous periodic inventories did not include plots in the Catskill and Adirondack Preserves, though estimates of forest land for these areas are included in the results.

FIA uses a permanent network of ground plots spanning the entire United States. Data are collected consistently across the Nation enabling comparisons among states and regions. Having current inventory information continually available is important in making management decisions about New York forests and in planning for the future.

New York is subdivided into eight geographic inventory units (Fig. 1).These units group counties that have similar forest cover, soil, and economic conditions. The geographic units are better than counties for summarizing forest data because they contain a sufficiently large number of plots to make reliable estimates with lower sampling errors. Also because plots are stratified at the unit level, estimates for units are more accurate than county estimates. Analysis in this report is presented at the State and geographic unit levels. County level data, which are included in the summary tables found at http://dx.doi.org/10.2737/NRS-RB-98, or available by querying the database using online tools, should be used with caution.

History

Most of the forests of New York are in some stage of recovery from the impact of humans (Thompson 1966). In 1880, the year when farm acreage peaked in the State, there were 24 million acres in farms, including farm woodlots that accounted for almost five-sixths of the total land area in the State. Concurrently, forest land reached a low point of 6 million acres. If not farmed, most land was cut over for timber. Many acres of farm land were marginal for growing crops and soon abandoned as agriculture moved west. By 1907 the area of forest land had increased to nearly 11 million acres and by 1953 to more than 14 million acres. Increases in forest land area have continued, though the trend has slowed considerably in recent years. The recovery of New York's forests, starting in the mid-19th century and continuing through the 20th century, has given land managers a second chance to conserve natural habitats and sustainably manage New York's 19 million acres of forest into the future. With the increase in forest land comes a return of the ecosystem services provided by forests, although compositionally many of these reforested areas are different than the early forests that previously occupied the land. Yet, with the exception of about 1 percent of forest land planted in nonnative softwood plantations, New York's forests are dominated by native trees. The recovery of New York's forests has occurred alongside increases in population, urban sprawl, and forests supplying the raw materials that are vital to the State's forest products industry.

In the absence of human interference, nonforest land in New York reverts to forest, except a few areas such as marshes, the tops of a few mountains, and dune areas on the coast. Consequently, forests represent the bulk of New York's natural landscapes. It is here that wildlife find habitat, where the forest industry obtains its raw resource, and from where most of the State's rivers emerge. Most of these forests (Long Island being an exception) also have experienced few naturally catastrophic disturbances (such as fire, hurricanes, and drought) and thus tend to be dominated by stands of large size trees.

The condition of New York's forest land has steadily improved since the late 1800s but there have been some setbacks. Since chestnut blight (*Cryphonectria parasitica*) and gypsy moth caterpillar (*Lymantria dispar dispar*) struck in the 1920s, the list of destructive exotic insects and diseases found in New York continues to grow with new additions becoming more frequent. In the 1970s, Dutch elm disease (*Ophiostoma ulmi*) devastated elms in the State. More recent forest health problems, which are addressed in this report, include the emerald ash borer (*Agrilus planipennis*), beech bark disease (*Neonectria faginata* or *ditissima*), and hemlock woolly adelgid (*Adelges tsugae*). Additionally, nonnative invasive plants continue to be introduced and spread in New York's forests and the continuing sprawl of urban areas into rural areas is predicted to be a major factor affecting forests. These threats and others make it challenging to manage New York's future forests.

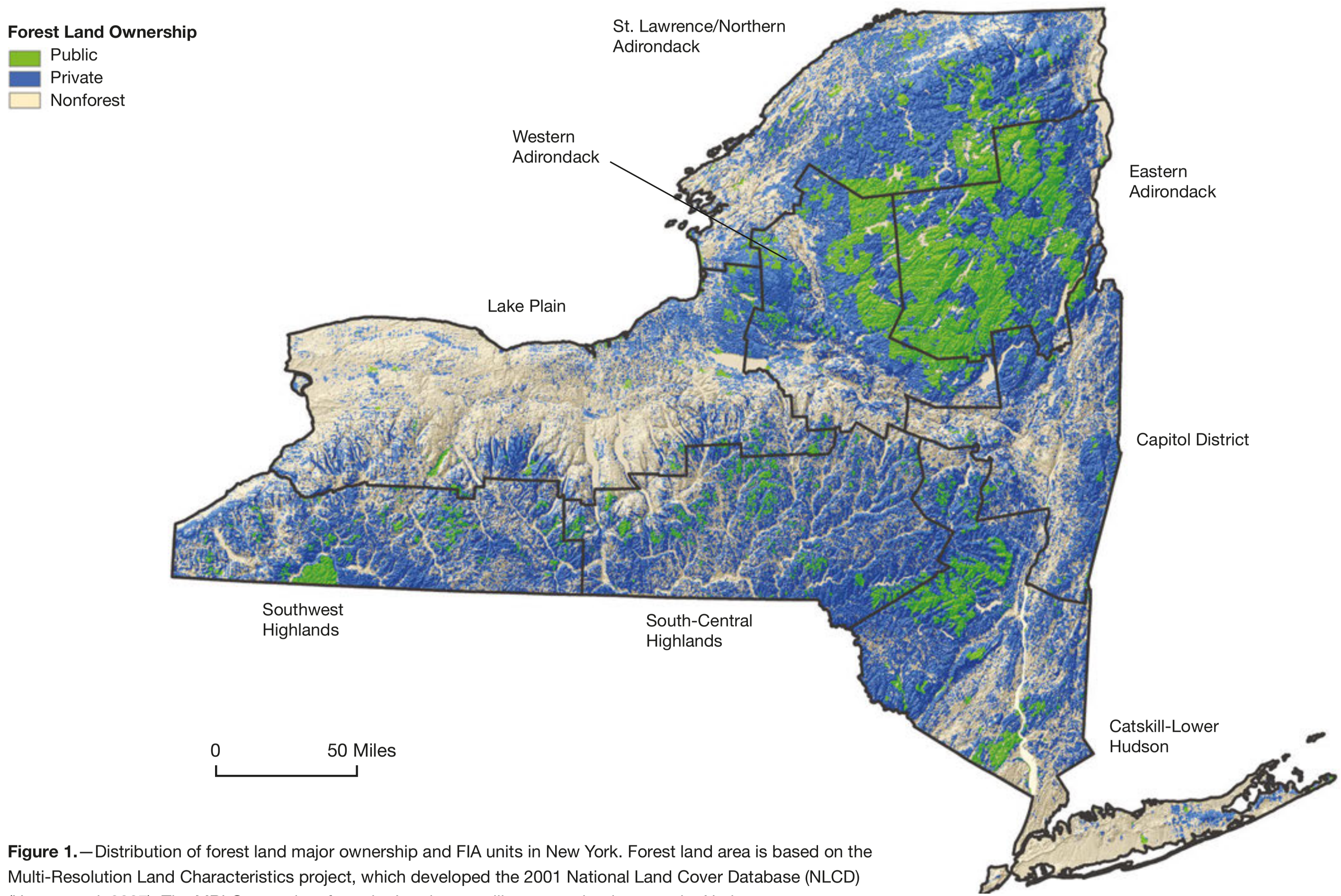


Figure 1.—Distribution of forest land major ownership and FIA units in New York. Forest land area is based on the Multi-Resolution Land Characteristics project, which developed the 2001 National Land Cover Database (NLCD) (Homer et al. 2007). The MRLC uses data from the Landsat satellite to map land across the Nation.

Forest Features

Trees grow slowly in the harsh conditions on top of Ampersand Mountain, Adirondacks, New York. Photo by Richard Widmann, U.S. Forest Service.

Area

Background

Forest land and timberland area are vital measures for assessing forest resources. These measures are the foundation for estimating numbers of trees, wood volume, and biomass. Trends in forest land area are an indication of forest sustainability, ecosystem health, and land use practices. Gains and losses in forest area directly affect the amount of goods and services, including wood products, wildlife habitat, recreation, and watershed protection that forests can provide.

What we found

New York's forest land area increased by 2 percent since 1993 and now occupies 63 percent of the State's land area, or about 19.0 million acres (Figs. 2, 3). Successive inventories have shown increases in forest land area, although most of the increase occurred before 1980. Since 1980, the rate of increase has been slowing. The 46,000-acre increase (based on all measured plots during the 2007 and 2012 inventory cycles,) during the past 5 years is well within the bounds of sampling error of plus or minus 127,000 acres at 1 standard deviation. Increases in forest land area have corresponded with decreases in farmland (Fig. 4). Since 1953, the amount of farmland has decreased by 9.1 million acres (including farm woodlots), while forest land has increased by 4.6 million acres.

The slight increase in forest land statewide does not mean that some areas did not experience losses in forest land. If only plots that changed land use are used to compare the 2007 inventory to the 2012 inventory, these plots tell us that losses of forest land were about 331,000 acres and that these losses were offset by gains of 529,000 acres of nonforest area reverting into forest, indicating a net change of 198,000 acre in forest land since 2007 (Fig. 5). These changes are not fully depicted in net forest land changes previously mentioned, because the number of plots that comprise the 2012 sample is different than the number of plots in 2007. In the 2012 sample, 9 percent of plot owners denied field crews access to their land, up from 7 percent in 2007, resulting in the number of plots in in the 2012 inventory to be less than in 2007. The result is that the area each plot represents changed between 2007 and 2012 and estimates of area change are less precise. Estimates of forest land gains and losses that use only remeasured plots applies a constant area per plot expansion factor, and result in a better estimate of net change than that from comparing inventories.

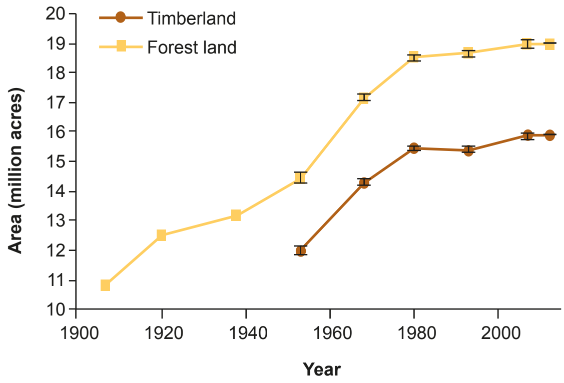
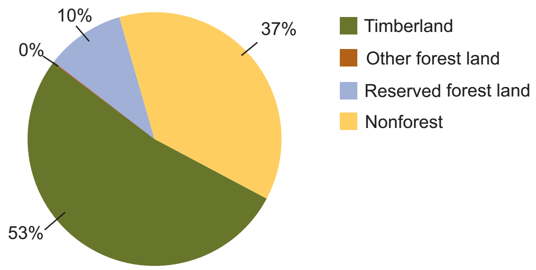


Figure 2.—Area of forest land and timberland in New York by inventory year, and estimation of forest land area for 1907, 1920, and 1938 (Smith et al. 2009). Error bars represent 68 percent confidence intervals around the estimated mean.



Total forest land = 19,005,500 acres, 63%

Figure 3.—Land area by major use, New York, 2012.

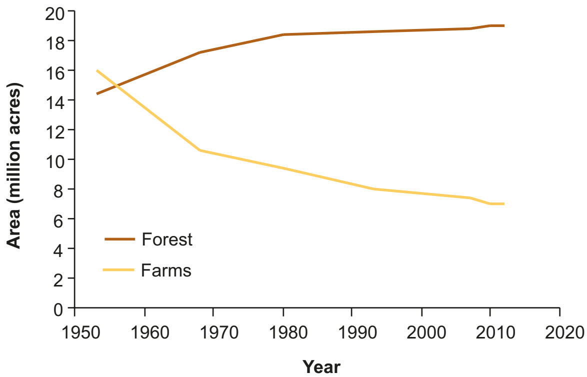


Figure 4.—Area in forest land and farms (including farm woodlots), New York, 1950-2012 (data source: U.S. Census of Agriculture 2010).

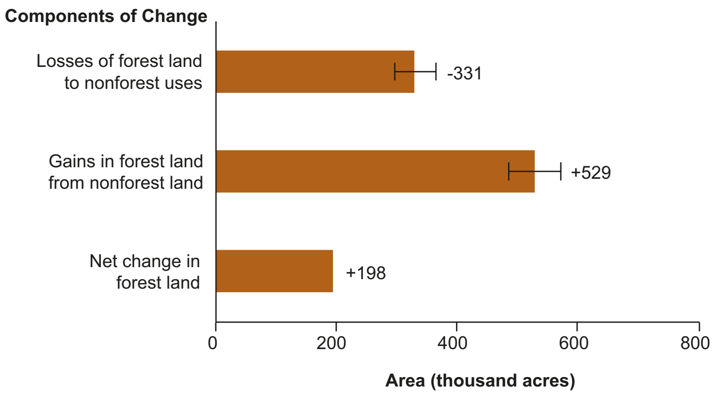


Figure 5.—Change in forest land, New York, 2007 to 2012. Error bars represent 68 percent confidence intervals around the estimated mean.

Eighty-four percent of New York's forest land, 15.9 million acres, is classified as timberland. Timberland increased by 508,000 acres since 1993, although only 62,000 of this increase occurred between 2007 and 2012. The area of forest land reserved from harvesting has slowly increased with each successive inventory to 3.0 million acres and now represents 16 percent of forest land or 10 percent of the State's total land area. Other forest land is relatively rare, amounting to less than half a percent of total forest land.

The proportion of land in forest cover varies with topography. Areas where the land is too rough to farm or difficult to develop have higher portions in forest. The Eastern Adirondack unit has 93 percent of its area in forest, the greatest of all units. It is followed by the Western Adirondack and St. Lawrence/Northern Adirondack units, each 74 percent forested (Fig. 6). The Lake Plain unit has the least area of forest, 40 percent of the total area. Between 1968 and 1993, the Lake Plain unit experienced the largest percentage increase in forest land (23 percent), but has experienced decreases since 1993 (Fig. 7). The southern tier of units also experienced increases since 1968: the Southwest Highlands (16 percent increase), South-Central Highlands (18 percent), and Capital District (18 percent). However, forest land has been stable in the South-Central Highlands unit since 2008. The Eastern Adirondack unit was the only unit to experience losses in forest land since 1968. Most of the land in this unit is within the Adirondack Park and more than half the forest land in this unit is classified as reserved. In recent years, forest land area in this unit remained fairly constant, with changes since 2007 within the range of sampling error.

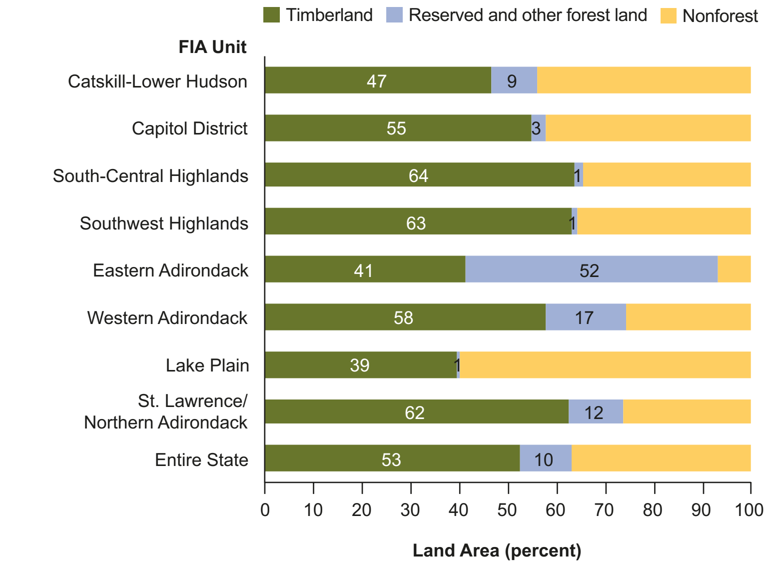


Figure 6.—Percentage of forest land by category and FIA unit, New York, 2012.

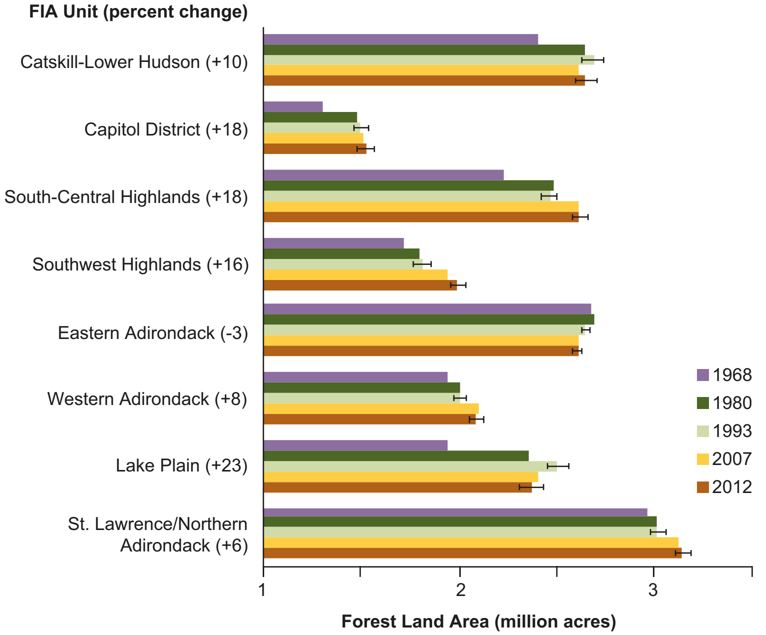


Figure 7.—Forest land area by FIA unit and by inventory year, New York. Percent change from 1968 to 2012 in parentheses beside unit name. Error bars represent 68 percent confidence intervals around the estimated mean.

What this means

Across the State, losses of forest land due to development have been more than offset by gains in forest land, mainly due to farm land reverting to forests through natural regeneration. This has been occurring over the last century, though in recent years net additions to forest land have slowed. In the 2012 inventory, the magnitude of forest land increase is less clear because of the increase in landowners that deny field crews access to their land to remeasure plots. Comparing estimates of total forest land from the 2007 inventory to the 2012 inventory shows a small increase (46,000 acres) in forest land, while changes based only on plots that changed land use between the 2007 and 2012 inventory indicate a somewhat larger, but still small, increase (198,000). Although the net change in total forest land is small, a substantial amount of land has changed land use, shifting into or out of a forested condition.

Using forest area as a broad measure of sustainability, New York's forests appear to be sustainable, though there are no guarantees that increases in forest land will continue. Continued development of forest land for nonforest uses, such as the clearing of forests for roads, housing and shopping centers, and the slowing in farm land losses may indicate that the area of forest land in New York is nearing a peak. Future changes in New York's forest land will depend on the pace of land development and to a great extent on the economics of farming. New dairy products such as Greek style yogurt have revitalized dairy production in some areas and recent interest in growing grasses and willows for biofuels production may further slow the reversion of marginal agricultural land to forest land. Recently there has been some forest loss due to forest clearing for additional corn production to feed dairy cows. Projected changes in forest area under various scenarios are discussed later in this report.

The Lake Plain unit, the least forested in New York, has a long history of agriculture, and includes many urban centers (Buffalo, Rochester, and Syracuse). The land is relatively flat, allowing the land to be used for higher value uses than timber production. This contrasts with the rugged landscapes of the three Adirondacks units. Here forests predominate and many forested acres are low in productivity. In the heavily-forested Eastern Adirondack unit, any development is likely to occur at the expense of forest land.

Not all forest land is the same. The benefits and services forests provide vary greatly by ownership, proximity to development, and forest characteristics such as species composition, stand size, and past management or lack thereof. Additionally, a growing number of threats to forests, from introduced exotic species to global climate change, will also affect New York forests' ability to continue to provide benefits and services that people have come to expect.

Trees growing on timberland represent the resource base upon which the forest products industry relies and are considered potentially available for harvesting. Discussions later in this report on urbanization and the woodland owner study provide more details on how much timberland is actually available and is being actively managed for timber products. Much of the focus of this report is on trees growing on the 15.9 million acres of timberland.

Ownership

Background

The availability and quality of forest resources, for recreation, timber, wildlife habitat and other things, are determined by management decisions made by landowners. New York's diverse owners provide opportunities and benefits depending on their individual priorities for owning forest. Some of the actions that owners take, good and bad, have consequences that cross ownership boundaries. This is especially true for actions that affect the ecological services that forests provide, such as air and water purification, flood control, climate regulation, biodiversity, and scenic landscapes. Forests also contribute to the overall economic activity in a region. Because of these shared benefits from forests, it is in the public interest to promote good stewardship of both public and private forests.

By understanding the priorities of private forest landowners, leaders of the forestry and conservation communities can better help landowners meet their needs, and in so doing, help conserve the State's forests for future generations. The National Woodland Owner Survey (NWOS), conducted by the U.S. Forest Service's FIA program, evaluates private forest land owners' demographics, attitudes, management objectives, and concerns (Butler et al. in press). The most dominant, diverse, and dynamic group of owners is the one least understood. It is represented by individuals, families, farmers, and small family corporations and partnerships, and is collectively referred to as "family forest owners." The NWOS has most recently (2011-2013; Butler et al. in press) focused on family forest owners with 10 acres or more of forest land. More information on the NWOS can be found at: http://www.fia.fs.fed.us/nwos/

What we found

Public owners hold 4.8 million acres, or 25 percent of New York's forest land. This does not include publicly owned easements on private land. The State owns nearly 4.1 million acres, amounting to 21 percent of the forest land in New York (Fig. 8). Included in this total are nearly 3 million acres of State-owned forests classified as reserved from cutting, mostly in the Adirondack and Catskills preserves and other State parks. The Federal Government holds 156,000 acres (1 percent) in various agencies, including the Fish and Wildlife Service, Department of Defense, and the Finger Lakes National Forest. Local governments hold 560,000 acres (3 percent). Forest acreage in public ownership has shown slow, but steady increases since 1953. More recently, an estimated 150,000 acres of forest land shifted from private to public ownership between 2007 and 2012.

Public ownership is not distributed evenly across the State. In the Eastern Adirondack unit, 58 percent of the forest land is publicly owned, whereas in the Lake Plain unit only 11 percent is publicly owned (Fig. 9). Generally, public ownership of forest land increases with increases in elevation; about half the 2.5 million acres of forest land above 2,000 feet is in public ownership, whereas only 15 percent of the 5.9 million acres below 1,000 feet is in public ownership (Fig. 10).

Private owners hold 14.2 million acres—75 percent of the State's total forest land. Of this, corporations own an estimated 2.7 million acres (14 percent of forest land) and family forest owners hold 10.8 million acres (57 percent) of the State's forest land. The other private ownership category holds 4 percent and includes nonfamily partnerships, non-governmental conservation organizations, and tribal land.

The NWOS found that forest owners with at least 1 but less than 10 acres tend to have different characteristics than owners of larger tracts. The NWOS estimated this group includes 588,000 owners (+/- 133,000 owners) holding a collective 1.6 million acres (+/- 249,000 acres). This includes 1.3 million acres in family forest ownerships. Although 74 percent of owners are private ownerships with less than 10 acres they comprise only 8.5 percent of the total forest land and only 11 percent of private forest land.

An estimated 200,000 family forest owners own at least 10 acres of forest land, totaling 9.3 million acres of forest land. This represents half the forest land in New York (Fig. 11). Most of these 200,000 owners indicate that they own forest land for reasons other than financial ones. When asked to score a list of 17 reasons for owning forest land as to importance, two-thirds or more of these owners rated as important or very important the following reasons: to enjoy beauty or scenery, to protect or improve wildlife habitat, for privacy, to protect nature or biological diversity, and to protect water resources (Fig. 12). This contrasts with the 24 percent of owners,

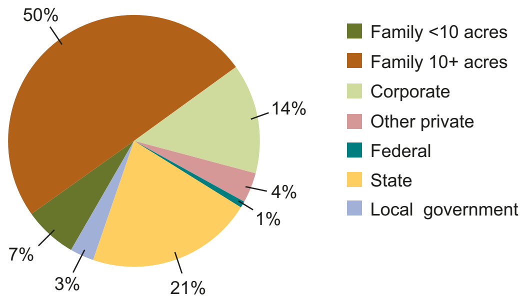


Figure 8.—Percentage of forest land by ownership category, New York, 2012.

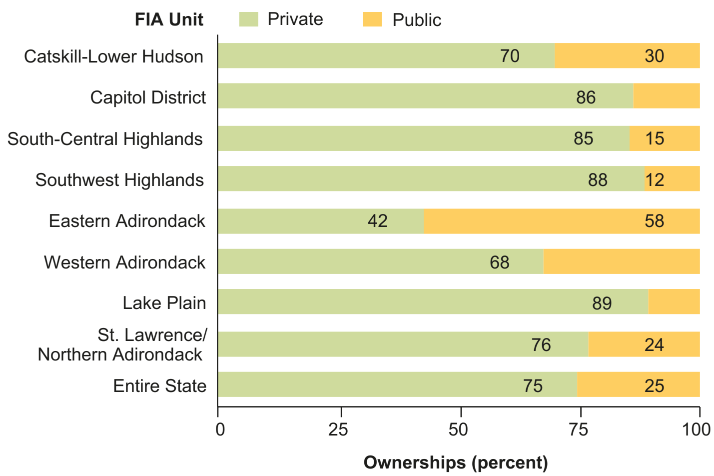


Figure 9.—Percentage of forest land in public and private ownerships by FIA unit, New York, 2012.

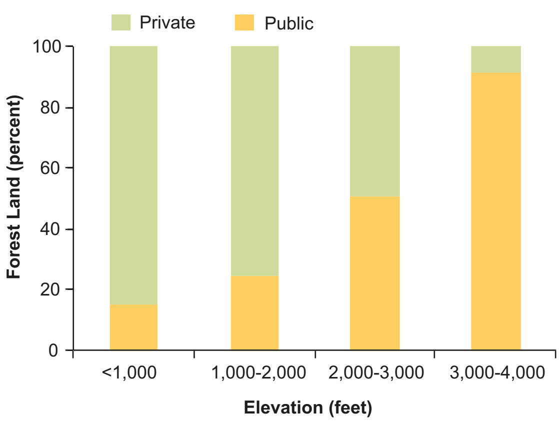


Figure 10.—Percentage of forest land by elevation and ownership category, New York, 2012.

Figure 11.—Number of family forest owners and acres of forest land in ownerships of 10+ acres, by size of forest land holdings, New York, 2011-2013.

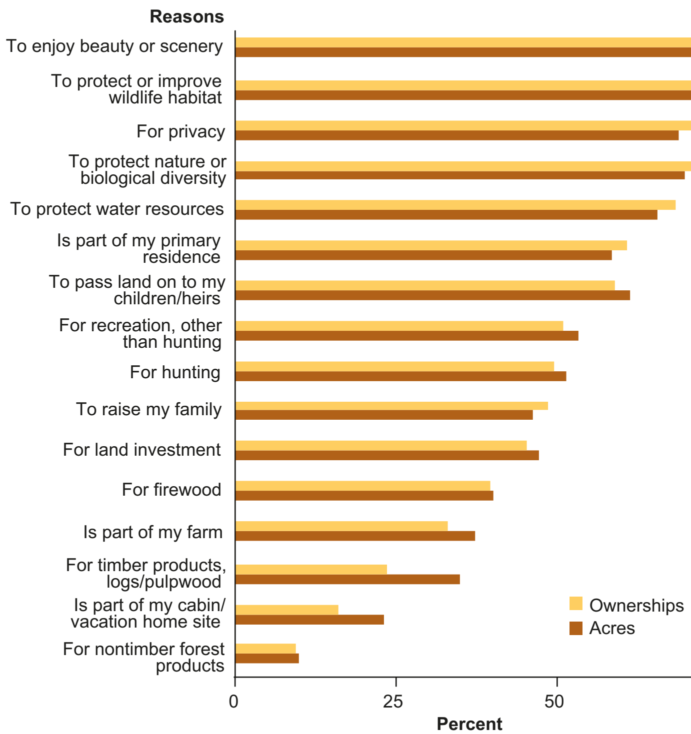


Figure 12.—Reasons for owning forest land by percentage of owners and area owned, for ownerships of 10+ acres, New York, 2011-2013. These proportions refer to landowners who ranked each objective as very important or important on a 5-point Likert scale. Categories are not exclusive.

holding 35 percent of the forest land (family forest 10 acres or more), that rated "for timber products, logs/pulpwood" as important or very important (Fig. 12). Although many nonfinancial reasons were highly rated, land investment was rated as important or very important by 45 percent of owners holding 47 percent of family forest acreage (in holdings of at least 10 acres) (Fig. 12). Additionally the NWOS found that the 200,000 family forest ownerships with 10 or more acres have the characteristics listed in Table 1.

Table 1.—Summary of selected owner attributes of family forest land of 10+ acres in New York, 2011-2013

Owner:	Owners (percent)	Acres (percent)
Uses woodland property as primary residence	72	67
Uses woodland property as vacation home	19	29
Is retired	40	47
Is 55 years old or older	67	71
Is 65 years old or older	35	40
Has owned land for more than 25 years	37	47
Has an annual income below $100,000	75	66
Receives no income from wooded land owned	91	84
Has posted land to restrict public access	75	85
Plans to improve wildlife habitat in next 5 years	47	49
Wants their wooded land to stay wooded	90	91
Is likely or extremely likely to give away land in the next 5 years*	16	18
Felt getting advice on how to transfer land to next generation would be helpful or very helpful*	40	44
Felt that timber production was an important or very important reason for owning forest land*	24	34
Has cut trees for personal use	63	69
Has cut trees for commercial reasons	41	53
Has cut or removed trees for own use in past 5 years	53	57
Has cut or removed trees for sale in past 5 years	17	25
Plans to cut trees for own use in next 5 years	56	59
Plans to cut trees for sale in next 5 years.	17	29
Has not received forest management advice	84	73
Has a written management plan	9	19
Is not familiar with cost share programs	75	68
Is not familiar with forestry related tax programs	86	74
Felt getting advice on woodland management would be helpful or very helpful*	54	58
Felt getting advice on more favorable tax policies would be helpful or very helpful*	64	72

*includes two highest responses on a five-point Likert scale

These include:

- Of family forest owners with 10 or more acres, 90 percent of owners with 91 percent of acreage want their wooded land to stay wooded.
- Seventy-two percent of family forest owners with 10 or more acres use their woodland property as a site for their primary residence, and 19 percent use their woodland property as a vacation home site. These two uses account for 67 percent and 29 percent of acreage in holding of 10 or more acres, respectively.
- Nine percent of family forest owners, with 10 acres or more, have written management plans; and hold 19 percent of the forest land in this group.
- Of family forest owners with 10 or more acres, 41 percent, holding 53 percent of the forest land, have cut trees for commercial use and 63 percent of owners with 69 percent of the forest land have cut trees for personal use. In the next 5 years, 17 percent of owners with 29 percent of the forest land plan to harvest timber for sale from their land.
- Few owners have received advice on managing their forest land. For family forest owners with 10 or more acres, 84 percent of owners with 73 percent of forest land in this group, say they have not received management advice and most owners are unaware of cost share programs or forestry related tax programs, though most owners felt that it would be helpful or very helpful to get advice on woodland management and taxes.
- Of family forest owners with 10 acres or more, 75 percent of owners with 85 percent of forest land have posted their land.
- Generally, owners with 10 acres or more are older with 35 percent at least 65 years old and 40 percent retired. Land ownership has been a long-term commitment, as 37 percent of owners have owned their land for over 25 years.
- Most family forest owners with 10 or more acres are not wealthy. Seventy-five percent of owners have annual incomes under $100,000 and few receive income from their forest land. Ninety-one percent of owners with 84 percent of the forest land in this category receive no income from their forest land.
- Many of the reasons that forest landowners give for owning forest land align closely with goals stated in New York's Forest Resource Assessment and Strategy report (NY DEC, n.d.b). This report's broad goals are to "keep forest as forest" and "to keep ecosystems functioning naturally to provide the full range of benefits and services." Ninety percent of owners with 10 acres or more want to keep their wooded land wooded and at least two-thirds of owners rank protecting biological diversity, water resources and wildlife habitat as very important or important.

What this means

A quarter of New York's forest land (4.8 million acres) is publicly owned. Management of these lands is restricted by more rules and regulations than management of privately owned forest. This is especially true for forest land in the Adirondack and Catskill Preserves that are constitutionally protected from harvesting, and in State parks where forest land is protected by policy from commercial tree cutting. These areas account for most of the 3 million acres that are categorized as reserve forest. Most of the other 1.8 million acres of public forests is in State forests, State Wildlife Management Areas, or owned by the Federal Government. These forests are professionally managed for a broad range of goods and services and allow the sustainable use of natural resources. Although publicly owned forests receive a high level of protection, they are still vulnerable to impacts from acid deposition, climate change, invasion by exotic plants, insects and diseases, and natural disasters.

Across all ownerships, both public and private, management plans likely exist on 46 percent of forest land. This includes large corporate owners and private owners with holding of less than 10 acres, and assumes that plans exist on all publicly owned land. The present pattern of increased public ownership at higher elevations shows that many headwater forests are protected, which benefits downstream communities.

Because three-fourths of New York's forest land is held by hundreds of thousands of private landowners, decisions by these owners will have a great influence on New York's future forest. To promote forest sustainability in the State, private land owners need to be encouraged to practice stewardship and conservation. Family forest ownerships with 10 acres or more hold 88 percent of the family forest acreage but represent only one-fourth of all forest owners. Targeting government programs at these owners would be more cost efficient than trying to reach all owners, but would exclude the 1.3 million acres of family forests in ownerships of less than 10 acres.

The low priority given by landowners to timber production does not mean that landowners will not harvest trees. The relatively high number of owners who actually harvest or have harvested trees, means that when conditions are right, many landowners will harvest trees, although the low priority and lack of written management plans suggests that these harvests are not part of a long-term management plan.

The high number of owners who are 65 years or older (35 percent) and the large amount of land held by owners who are likely to give away land in the next 5 years (16 percent of owners holding 18 percent of the family forest land) foretell a large turnover of forest land. At the time ownership is transferred, forest land becomes vulnerable to unsustainable harvesting practices and division into smaller parcels. Currently many owners are unfamiliar with programs to promote forest stewardship and management. The turnover of forest land to new owners will amplify the need for services, such as advice on sustainable forest management.

Generally, having both public and private ownerships enhances the benefits and ecological services provide by New York's forests. These diverse ownerships create private market opportunities while protecting critical areas and providing for public recreation. Although public ownerships are not distributed evenly across the State, all units have at least some public forest land (Fig. 9). These forests provide a wide range of recreational opportunities for both residents and tourists.

Urbanization and Fragmentation of Forest Land

Background

The expansion of urban lands that accompanies human population growth often results in the fragmentation and urbanization of remaining natural habitat (Wilcox and Murphy 1985). Forest fragmentation and habitat loss diminish biodiversity and are recognized as a major threat to animal populations worldwide (Honnay et al. 2005, Rosenberg et al. 1999), particularly for species that require interior forest conditions for all or part of their life cycle (Donovan and Lamberson 2001), are wide-ranging, slow-moving, and/or slow reproducing (Forman et al. 2003, Maine Audubon 2007). Forest fragmentation can also affect forest ecosystem processes through changes in microclimate conditions, and it affects the ability of tree species to move in response to climate change (Iverson and Prasad 1998). Changes in the size of remaining forest patches, in their level of connectivity to other large patches, in the amount of general forest cover surrounding each patch, and in the amount of forest-nonforest edge, all directly affect the amount and quality of interior forest and consequently the species and ecosystem functions that depend on these interior conditions. The same factors also affect the ease with which exotic, invasive, or generalist species can gain a foothold, the ability of wildlife species to move across the landscape, and the ability of the forest to protect the quality and quantity of surface and ground water supplies.

Spatial landscape pattern metrics help quantify these different characteristics of fragmentation. Metric values are sensitive to the resolution of the land cover data source used (Moody and Woodcock 1995), similar to the way that animal species see the landscape very differently depending on the scale at which they operate—e.g., the same patch that supplies interior forest conditions for one species is viewed as an unsuitable fragment by another. Since important forest ecosystem processes operate at different scales, in this report we examine current levels of fragmentation at two scales. We have adapted a spatial integrity index (SII) developed by Kapos et al. (2000) for the global Forest Resources Assessment (FRA). The SII integrates three facets of fragmentation affecting some aspect of forest ecosystem functioning—patch size, local forest density, and patch connectivity to core forest areas—to create a single metric for comparison. Since even acceptably low misclassification rates in the source land cover data can be magnified into substantial errors in metric values (Langford et al. 2006, Shao and Wu 208), we have calculated spatial integrity at the two scales corresponding to two of the most reliable and widely available sources of data—the 30 m (98.4 ft) scale of the 2011 National Land Cover Dataset (NLCD 2011) (Jin et al. 2013), and the 250 m (820 ft) scale of the 2009 FIA forest cover dataset (Wilson et al. 2012). Both scales fall within the 10 to 1000 km^2 (2,471 to 247,091 acres) scale at which pattern process linkages are often of greatest management interest (Forman and Godron 1986).

In the SII calculation, core forest is defined by patch size and local forest density within a defined local neighborhood area. An unconnected forest fragment is defined by its patch size, local forest density, distance to a core forest area, and the spatial integrity of all other forest lands are scaled between these two ends. Table 2 identifies the thresholds used to define both core forest and unconnected fragments, at the 250 m and 30 m scales, respectively.[1] These two scales capture a relatively broad range of definitions for core forest and spatial integrity that should encompass the scales appropriate for understanding impacts on a wide range of wildlife species and ecosystem processes affected by forest fragmentation.

The population of New York increased by 2.1 percent between 2000 and 2010, to 19.4 million. During that same time period, the number of housing units increased by 5.2 percent (U.S. Census Bureau 2010). Stated another way, between 2000 and 2010 housing units increased at a pace 2.5 times the rate of increase in population, a trend not unique to New York. In recent decades this housing growth has occurred not only in increasing suburban rings around urban areas but also in rural areas. Lepczyk et al. (2007), Theobald (2005), and Hammer et al. (2004) observed that among the areas facing rapid increases in housing density now and predicted into the future are amenity-rich rural areas around lakes and other forested recreation areas. The 23

[1] Riemann, R. Unpublished information. Adaptation of a spatial integrity index to 30 m and 250 m scales, and its application across the northeastern United States.

Table 2.—Spatial integrity index (SII) parameters used in calculations at each scale

Definition of Core	Scale 250 m (820 ft)	30 m (98 ft)
Patch size	>1,544 acres	>22 acres
Local forest density	90%	90%
Neighborhood radius	0.78 mile	0.09 mile
Definition of Unconnected Fragment	**250 m (820 ft)**	**30 m (98 ft)**
Patch size	>30 acres	>2.5 acres
Local forest density	10%	10%
Neighborhood radius	0.78 mile	0.09 mile
Distance to core	>4.2 miles	>0.5 miles

percent increase in the number of reported second homes from 2000 to 2010 could be a partial reflection of this trend in New York (U.S. Census Bureau 2010). This can put additional pressure on forested areas even above the general increases in population density and housing density.

What SII identifies as core does not represent completely intact forest conditions because it is calculated from forest canopy and does not consider underlying house densities or proximity to roads. Using the definition of wildland-urban interface (WUI) intermix from Radeloff et al. (2005) (greater than 15.5 houses per square mile [6 per square km]), we identified how much forest, particularly core or intact forest land, coincided with these areas. The WUI is described as the zone where human development meets or intermingles with undeveloped wildland vegetation. It is associated with a variety of human-environment conflicts. Radeloff et al. (2005) have defined this area in terms of the density of houses (WUI "intermix" areas), the proximity to developed areas (WUI "interface" areas), and percentage of vegetation cover. We used WUI intermix maps intersected with forest land in the 2011 NLCD (Jin et al. 2013) to examine changes in the amount of forest land co-occurring with WUI house densities.

Roads are another important urbanization impact affecting forest lands that is not completely captured by either of the previous two indices. In New York State as a whole, 35 percent of the forest land was within 650 feet of a road of some sort, and 61 percent was within 1,310 feet (calculated from NLCD 2006 forest land [Fry et al. 2011] and U.S. Census Bureau 2000 roads). Roads have a variety of effects: direct hydrological, chemical, and sediment effects; serving as vectors for invasive species; facilitating human access and use; increasing habitat fragmentation; and wildlife mortality. Actual impacts will vary depending on road width, use, construction, level of maintenance, and hydrologic and wildlife accommodations (e.g., Charry 2007, Forman et al. 2003). But given the levels observed in New York, cumulative ecological impacts from roads should be an important consideration. Riitters and Wickham (2003) found that the Catskills and the northern New York-New England forest region represented some of the few remaining areas in the eastern United States with large proportions of their forest land area outside immediate influence of roads.

What we found

Considering SII classes at the 250 m scale, 58 percent of the forest land in New York is core forest, 24 percent has high integrity, 9 percent has medium integrity, 1 percent has low spatial integrity, and 8 percent of the forest is in unconnected fragments. At the 30 m scale, with 22 acres or greater considered core forest, 73 percent of the forest land in New York is core forest, 4 percent has medium spatial integrity, 17 percent has high integrity, and 6 percent of the forest is in unconnected fragments. Table 3 shows a breakdown of SII values by FIA unit for both scales.

Forest connectivity is highest in the Eastern Adirondack Unit and lowest on Long Island (Fig. 13). Large areas of forest such as the Adirondacks and the Catskills, among others, clearly stand out. At the 30 m scale, the lower threshold of 22 acres for defining core forest means that more forest patches are considered core. Figure 14 compares the SII classes between the two scales for an area around the Capital District. Note that the forest landscape data being used are depicting tree cover only and do not incorporate the presence of any development that might be associated with or underlying this tree cover.

Forest land with sufficient underlying housing density to qualify as WUI areas has been steadily increasing. In 1990, 24 percent of the forest land was in low and medium density WUI. In 2000 this increased to 27 percent of the forest land, and in 2010 it was 29 percent of the forest land in New York. The spatial distribution of forested WUI is depicted in Fig. 15, and Table 4. Five of the 9 units have greater than 30 percent of forest in WUI and the Catskills-Lower Hudson unit has greater than 50 percent. These underlying housing densities are poorly captured by the tree canopy cover data used in the calculation of spatial integrity above. When we integrate SII results at the 250 m scale with the WUI classes, 12 percent of New York's forest land moves from being core forest to lower spatial integrity classes, decreasing the proportion of forest land in the core class from 58 percent to 46 percent. At the 30 m scale, 19 percent of New York's forest land moves from being core to a lower spatial integrity class—from 73 percent to 54 percent of forest land.

Table 3.—Proporttion of forest land by spatial integrity index (SII) class at the 250 m and 30 m scales, by FIA unit

FIA Unit	Forest by 30 m spatial integrity class					Forest by 250 m spatial integrity class				
	Forest fragment	Low SII	Medium SII	High SII	Core forest	Forest fragment	Low SII	Medium SII	High SII	Core forest
	percent					*percent*				
St. Lawrence/ Northern Adirondack	3	0	3	14	80	4	1	8	19	68
Lake Plain	19	1	9	27	44	33	4	22	24	18
Western Adirondack	4	0	4	16	75	6	1	6	14	72
Eastern Adirondack	0	0	0	5	94	0	0	0	5	95
Southwest Highlands	4	1	5	23	68	2	1	12	39	47
South-Central Highlands	4	0	3	19	73	3	1	10	41	46
Capitol District	11	1	5	19	64	16	2	13	28	41
Catskill-Lower Hudson	5	0	4	15	76	5	1	7	26	61
Long Island*	39	1	7	19	34	97	0	0	3	0
State	6	0	4	17	73	8	1	9	24	58
State after incorportating WUI areas	6	1	5	34	54	8	3	10	32	46

*Separated from Catskill-Lower Hudson Unit

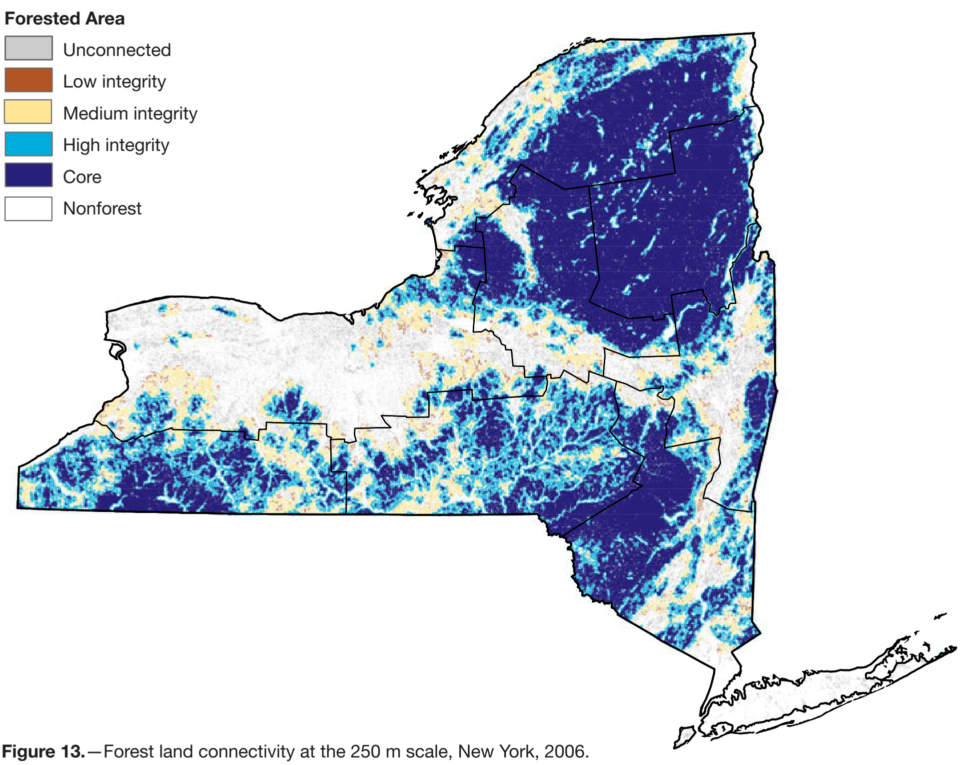


Figure 13.—Forest land connectivity at the 250 m scale, New York, 2006.

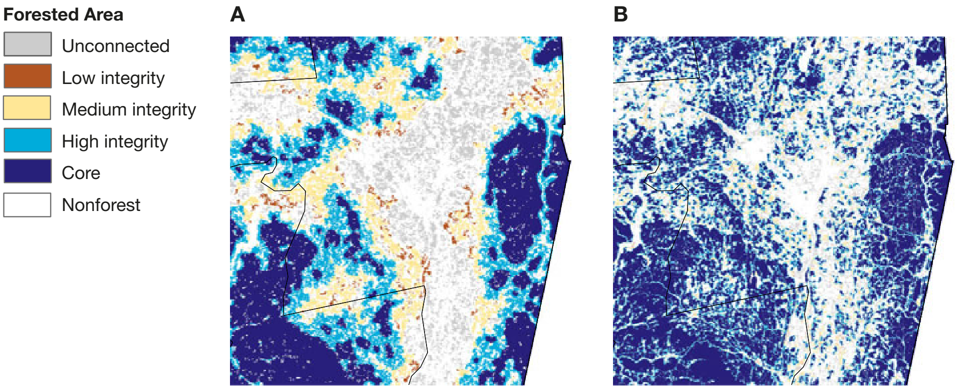


Figure 14.—Forest land connectivity at the 250 m scale (A) and 30 m scale (B) in the Capital unit, New York, 2006.

Roads remain pervasive in the landscape, existing even in areas that appear to be continuous forest land from the air. In 2000, 20 percent of the forest area in the Eastern Adirondacks is within 650 feet of a road, and 72 percent of the forest land in Long Island is within 650 feet of a road (U.S. Census Bureau 2000). Much of this area, particularly on Long Island, coincides with WUI areas of housing development. However, it is worth noting that the roads included in the U.S. Census Bureau data (TIGER files) do not include many minor roads not associated with housing development, and that including these minor roads actually doubles road densities in areas like northern Wisconsin (Hawbaker and Radeloff 2004).

What this means

Whether we look at the 250 m or the 30 m scales, if we incorporate the WUI areas into our definition of spatial integrity, only about half of the forest land in New York meets the definition of core forest, and about 10 percent of the forest land is in unconnected fragments or has low spatial integrity. Bringing roads into the calculation, even at the levels available in the 2000 Census TIGER dataset, reduces the integrity of some areas still further.

Forest fragmentation is recognized as a major threat to wildlife populations, particularly for species that require interior forest conditions for all or part of their life cycle or are wide-ranging or slow-moving, increases edge conditions which can change micro-climate conditions and ecosystem processes, and limits the ability of plants and animals to move in response to climate change (e.g., Forman et al. 2003, Honay et al. 2005, Iverson and Prasad 1998).

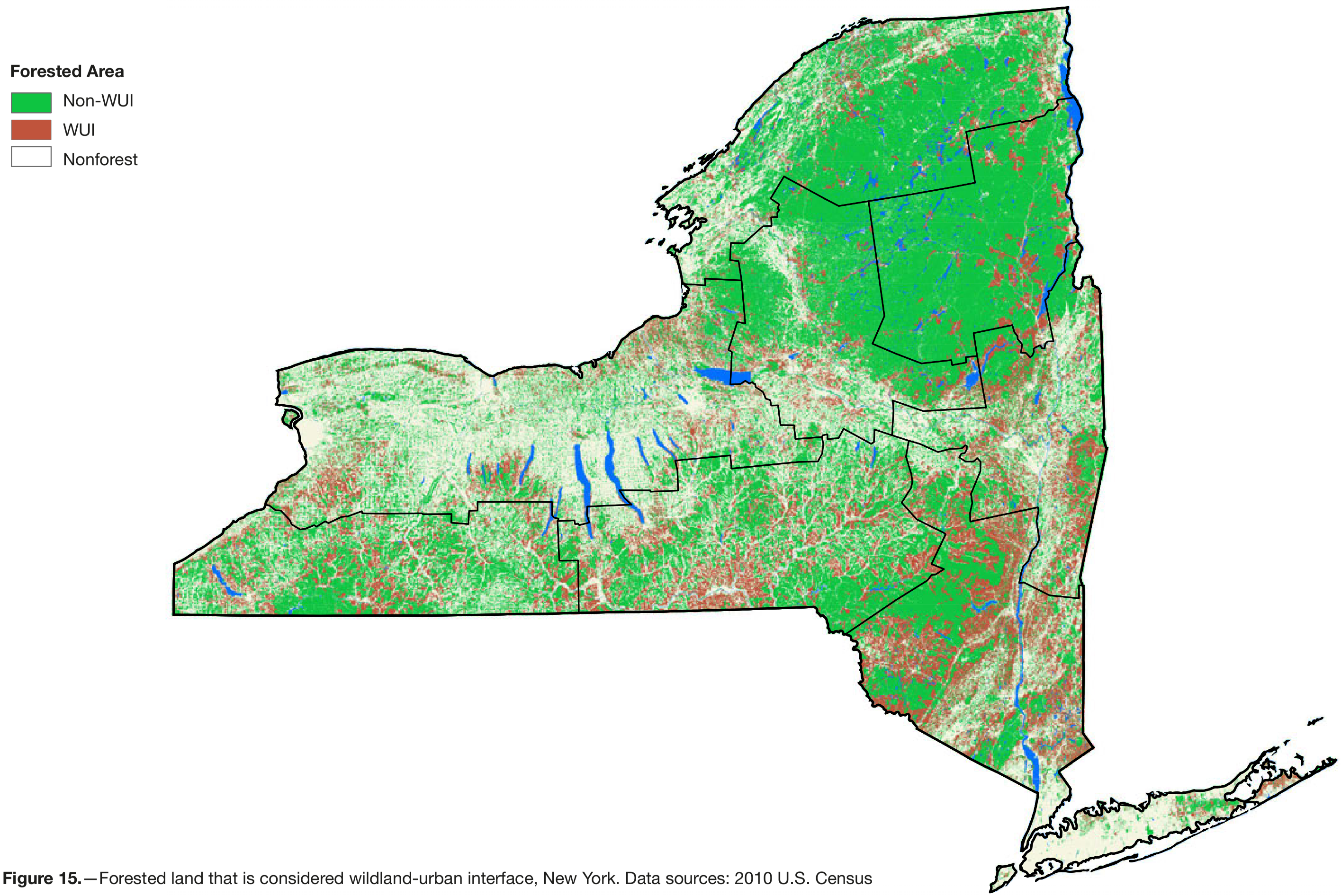


Figure 15.—Forested land that is considered wildland-urban interface, New York. Data sources: 2010 U.S. Census and 2011 National Land Cover Database; see text for references.

Table 4.—Forest land in the wildland-urban intermix, by FIA unit, New York

FIA Unit	Forest land	
	Percent	Acres
St. Lawrence/Northern Adirondack	15	426,503
Lake Plain	38	727,718
Western Adirondack	19	363,754
Eastern Adirondack	11	304,169
Southwest Highlands	27	554,242
South-Central Highlands	31	860,247
Capitol District	45	675,224
Catskill-Lower Hudson	52	1,428,932
Long Island*	40	74,660
State	29	5,415,449

*Separated from Catskill-Lower Hudson Unit

Urbanization increases the proximity of people, development, and other anthropogenic pressures to natural habitats. Both urbanization and forest fragmentation change the way in which humans use forest land, frequently decreasing the likelihood that it will be managed for forest products and increasing its use for outdoor recreation, although urbanization has also been observed to increase the incidence of "posting" forested land, which decreases outdoor recreation opportunities and alters local cultural use of forest (Butler 2008, Kline et al. 2004, Wear et al. 1999). Continuing fragmentation, parcelization, and urbanization can be barriers to stewardship if the result is forest tracts that are too small or too isolated for effective management (Shifley and Moser, in press).

Invasive species and introduced pests are also a concern, as is the ability of forest systems to adapt to changes in season, temperatures, rainfall patterns, and relative phenological shifts associated with climate change. An intact functioning forest also is critical in protecting both surface and groundwater resources (McMahon and Cuffney 2000, Riva-Murray et al. 2010).

Fragmentation and urbanization are changing how New York's forests function and affect forest sustainability. Fragmentation diminishes the benefits and services forests provide and makes forest management more difficult. As New York's population continues to sprawl into rural areas, fragmentation of forest land is a growing concern to land managers. Factors that increase fragmentation, such as development incursions into core and high integrity forest areas, should become the focus of conservation activities. In addition, the characteristics and maintenance of roads and development can also play a role in their actual impact on the resilience of forest land and its ability to continue to supply the forest products and ecosystem services we expect and need.

Forest Resource Attributes

This stand of white birch will eventually transition to a stand of red spruce and balsam fir as the white birch decline. Photo by Richard Widmann, U.S. Forest Service.

Forest Structure

Background

How well forests are populated with trees is determined by two measurements: the trunk diameter taken at 4½ feet above the ground and referred to as diameter at breast height (d.b.h.), and by the number of trees. Generally, as stands mature and trees become larger, the number of trees per acre decreases and stand volume increases. The number of trees per acre and their diameters are used to determine levels of stocking. Stocking is a measure of tree density and is used to determine how well a site is being utilized to grow trees. Stocking levels for New York's forests are based on "all live trees" or only "growing-stock trees." Growing-stock trees are economically important and do not include noncommercial species (e.g., hawthorn, striped maple, and eastern hophornbeam) or trees with large amounts of cull (rough and rotten trees). In fully stocked stands, trees are using all of the potential of the site to grow. If stands are not disturbed, stocking levels increase over time as trees naturally reproduce and grow. As stands become overstocked, trees become overcrowded, growth slows, and mortality increases. In poorly stocked stands, trees are widely spaced, or if only growing-stock trees are included in the stocking calculations, the stands can contain many rough and rotten trees with little or no commercial value. Poorly stocked stands can develop on abandoned agricultural land or can result from major disturbances such as windstorms, disease outbreaks, wildfires, or poor harvesting practices. Poorly stocked stands are not expected to grow into a fully stocked condition in a reasonable amount of time whereas moderately stocked stands will. Comparing stocking levels of all live trees with that of growing-stock trees shows how much of the growing space is being used to grow trees of commercial importance and how much is occupied by trees of little or no commercial value. Disturbances, such as harvesting, remove trees from stands and lower stocking levels. As stocking levels are lowered, changes in species composition, diameter distribution, and the quality of the residual trees become of increasing concern to forest managers. At low levels of stocking, tree regeneration becomes a concern as well.

Tree diameter measurements are used by FIA to assign a stand-size class to sampled stands. The categories are determined by the class that accounts for the most stocking of live trees per acre. Sapling or small-diameter stands are dominated by trees less than 5 inches d.b.h. Poletimber or medium-diameter stands have most trees at least 5 inches d.b.h. but less than the large-diameter stands. Sawtimber or large-diameter stands consist of a preponderance of trees at least 9 inches in d.b.h. for softwood species and 11 inches d.b.h. for hardwood species.

What we found

The number of live trees by diameter class illustrates a classic reverse J-shaped curve with many small-diameter trees and decreasing numbers for larger trees (Fig. 16). Although this resembles the diameter distribution of an uneven-aged forest, it illustrates a composite made up of stands of many different ages and stand-size classes. Although the diameter class broadly reflects age class, there is considerable variation. Many of the smaller diameter trees are actually much older than their size alone would indicate. Each successive inventory shows a shift in numbers of trees toward larger diameter classes. Since 1993 there has been a decrease in the numbers of sapling-size trees (1 to 4.9 inches in diameter) (Fig.17). The 2012 inventory was the first to document a decrease in the numbers of trees in the 6- and 8-inch diameter classes, while numbers of trees continue to increase in diameter classes above the

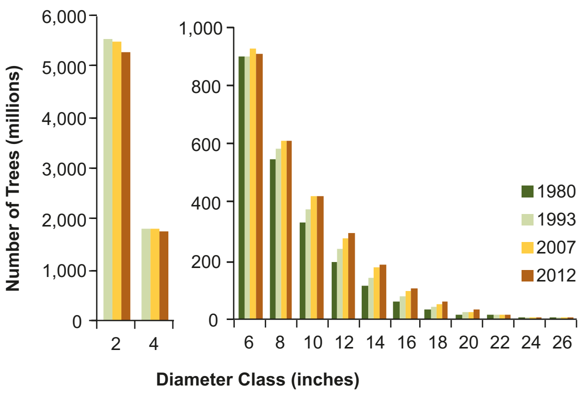


Figure 16.—Number of live trees by diameter class on timberland by inventory year, New York.

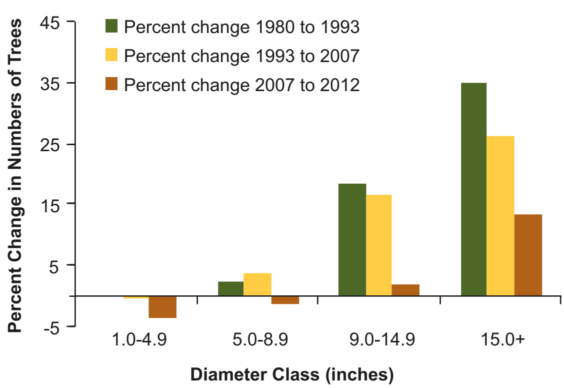


Figure 17.—Percentage change in the number of live trees by diameter class and inventory year, New York. Note different numbers of years in each period.

10-inch class. This has occurred while the number of trees 5 inches and larger has remained relatively unchanged. In 2012, there was an average of 167 trees 5 inches and larger per acre of timberland in New York (Fig. 18), an increase of one tree per acre since 2007. The Lake Plain unit has 156 trees per acre, the lowest density in the State; the Eastern Adirondack unit has the highest, with179 trees per acre (Fig. 19). Tree diameters averaged the highest in the South-Central Highlands, Capitol, and Catskill-Lower Hudson units, all having an average tree diameter of 9.8 inches. Statewide, the average diameter for trees increased from 9.3 inches in 2007 to 9.5 inches in 2012.

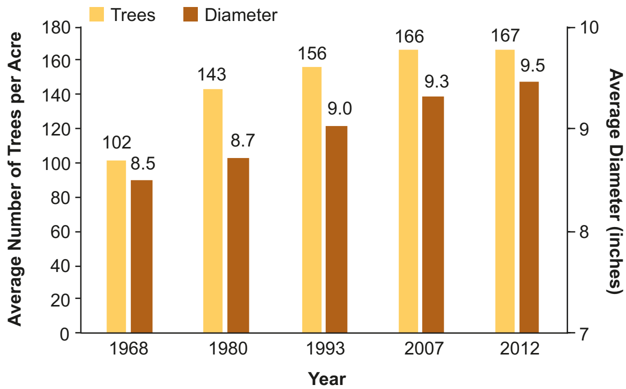


Figure 18.—Average number and diameter of trees (d.b.h. 5 inches and larger) on timberland, by inventory year, New York. Data for 1968 includes only growing-stock trees.

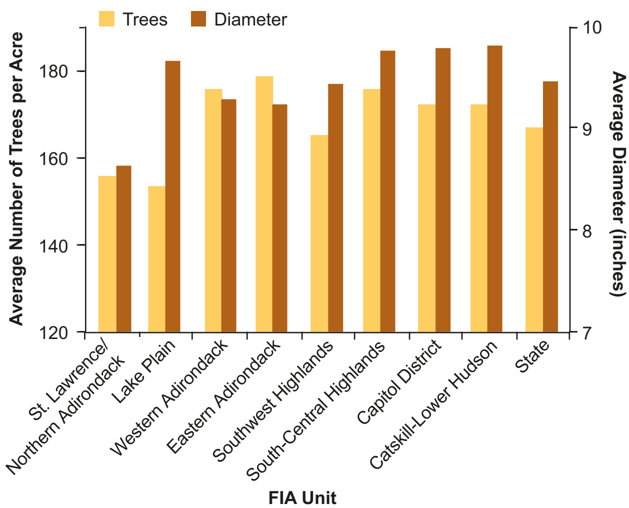


Figure 19.—Average number (left axis) and diameter (right axis) of trees 5.0 inches diameter and larger on timberland, by FIA unit, New York, 2012.

The shift to larger size trees has brought about an increase in stands dominated by sawtimber-size trees (Fig. 20). Sawtimber-size stands continue to increase at the expense of poletimber and seedling/sapling-size stands. In 2012, 60 percent (9.5 million acres) of timberland in the State was in sawtimber-size stands. Poletimber stands decreased in 2012 and now total 4.3 million acres, (27 percent) of timberland. Seedling/sapling stands and nonstocked forest land continued to decrease and is currently 2.0 million acres (13 percent) of timberland.

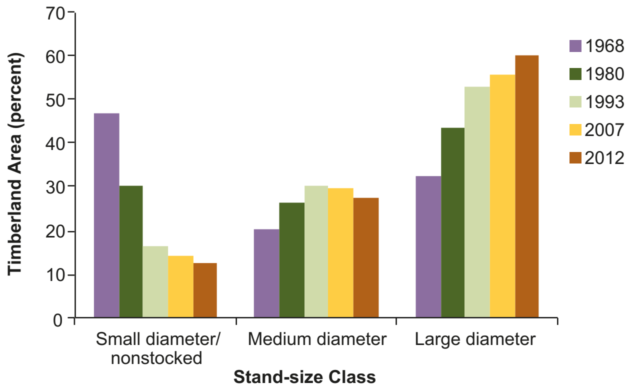


Figure 20.—Percentage of timberland area by stand-size class and inventory year, New York.

Of the area currently classified as seedling/sapling and nonstocked stands, 249,000 acres (13 percent) was in a nonforest land use in 2007. Seedling/sapling and nonstocked stands comprise 97,000 acres (8 percent) of the 1.2 million acres of timberland that had evidence of timber harvesting since the 2007 inventory.

New York has a higher proportion of timberland in seedling/sapling-size stands (12.8 percent) than the surrounding states of Ohio (12.4 percent), Pennsylvania (10.8 percent), Connecticut (5.9 percent), Massachusetts (4.9 percent), and Vermont (7.8 percent). It also has a lower portion of timberland in sawtimber-size stands than all the surrounding states.

There are 8.4 million acres (52.9 percent) of timberland that are fully stocked or overstocked with live trees, 5.7 million acres (35.8 percent) have medium stocking, and 1.8 million acres (11.3 percent) are either poorly stocked or nonstocked (Fig. 21). Since 2007, there has been very little change in stocking levels. None of the geographic units stand out as having notably higher or lower stocking levels than the State as a whole (Fig. 22).

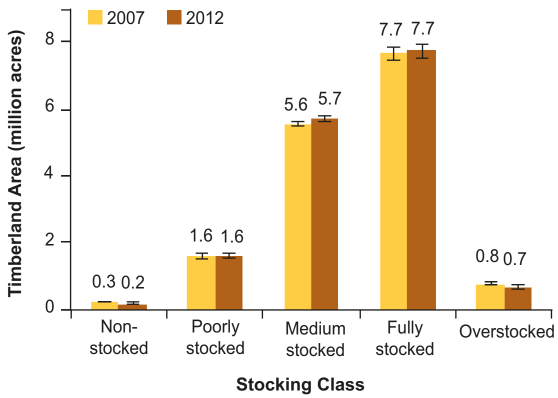


Figure 21.—Timberland area by stocking class based on all live trees, New York 2007, and 2012. Error bars represent 68 percent confidence intervals around the estimated mean.

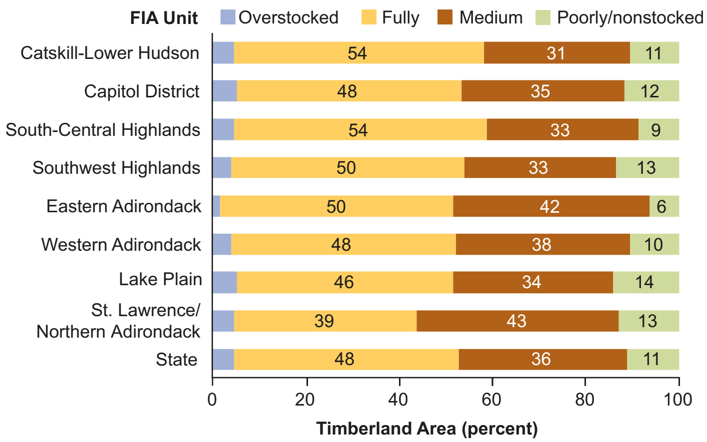


Figure 22.—Percentage of timberland area by stocking class based on all live trees and FIA unit, New York, 2012.

Considering only the commercially important growing-stock trees, 2.9 million acres have poor stocking, this is 1.3 million acres more than when including all trees (Fig. 23). This was a 13 percent (344,000 acre) increase since 2007. Most of acreage in these stands is in older age classes and/or in stands dominated by large trees. Sixty-eight percent of the acres is in age classes more than 40 years old, (Fig. 24), and 83 percent is in sawtimber or poletimber-size stands (Fig. 25). On the 1.2 million acres of timberland that had evidence of cutting since the 2007 inventory, 20 percent (241,000 acres) is now poorly stocked or nonstocked with growing-stock trees. New York's timberland is still fairly young. In 2012, the overstory trees on 47 percent of timberland averaged less than 60 years old.

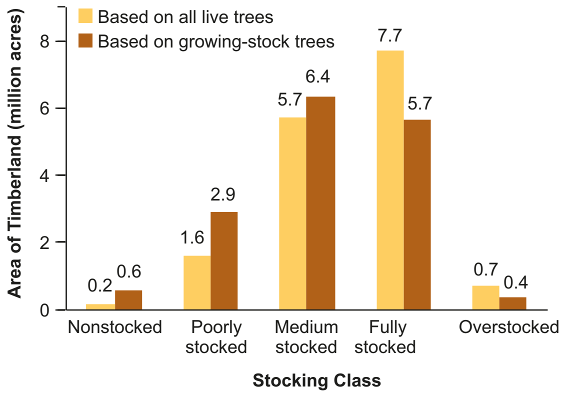


Figure 23.—Timberland area by stocking class based on all live trees, and on growing-stock trees, New York, 2012.

Figure 24.—Timberland area by stand-age class and stocking class, for growing-stock trees, New York, 2012.

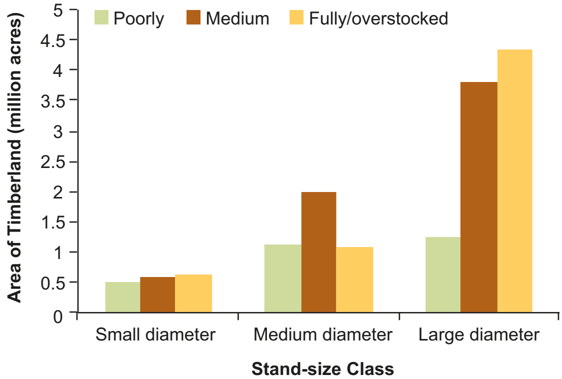


Figure 25.—Timberland area by stand-size class and stocking class based on growing-stock trees, New York, 2012.

What this means

The continued trend toward larger size trees and an increase in area of sawtimber-size stands indicates that New York's forests are continuing to mature. Although average diameter has increased and the average number of trees 5 inches in diameter per acre has remained stable, overall stocking levels have not improved as would be expected. This probably indicates that while in some stands stocking levels are increasing, in other stands, harvests are reducing stocking and canceling out these improvements. Harvest disturbance resulting from carefully planned forest management creates growing space for tree regeneration and supports New York's timber products industry. But when done poorly, harvesting can promote the growth of undesirable trees and reduce future management opportunities.

The 13 percent of forest land in seedling/sapling stands are likely the result of farmland reverting to forest and deliberate stand-replacement harvests. Currently agricultural land reverting to forest is a major source of seedling/sapling stands. In stands with evidence of harvesting, the low percentage in the seedling/sapling size class reflects the lack of even-age management and the preference to do "selective harvesting" of a relatively small number of larger trees that do not promote regeneration. The area in seedling/sapling stands, or early successional forest, has been trending downward throughout the northeastern portion of the country for at least the last 50 years. This trend will likely continue as the area in agriculture stabilizes and less land reverts to forest, and because commonly used harvesting practices typically do not reduce stands to this level. This is a concern because it could lead to the decrease in habitat for wildlife species that require early-successional habitats. Continued losses of seedling/sapling stands will lead to an imbalance in the age structure of forests across the State and will create difficulty with regeneration of some favored canopy species.

The 6.1 million acres of timberland in fully stocked and overstocked stands present opportunities for forest management. Managing these stands can keep them growing optimally. Thinning overstocked stands leads to growth on residual trees and provides wood for utilization and income to landowners.

Forty-seven percent of timberland is less than fully stocked with live trees. When considering only growing-stock trees, the percentage increases to 62 percent. This broad extent of stands that are less than fully stocked indicates that New York's forests have undergone significant disturbance, natural and human-caused. The 3.5 million acres of timberland that are nonstocked or poorly stocked with growing-stock trees represents a loss of potential growth. Trees in these stands are either widely spaced or the stands contain many low value trees that occupy growing space that could otherwise be used to grow quality timber. These stands may have originated as farmland that has reverted to forest or from poor harvesting practices. These stands also might have arisen from acceptable forestry practices, such as shelterwood or seed tree harvesting. The age, stand size, and magnitude of these poorly stocked stands suggest that many are likely the result of poor harvesting practices rather than reverting pasture land or acceptable practices. Poorly stocked stands include 2.0 million acres that are more than 40 years old, and 2.4 million acres are dominated by medium- and large-size trees. Selective harvest practices that remove the best trees and leave smaller, low quality trees with no effort to establish regeneration (e.g., high-grading), often result in poorly stocked forest land (Nyland 1992).

Even well-planned regeneration practices can result in poor stocking due to regeneration difficulties. Poorly stocked stands represent a challenge to forest managers because these stands contain little value to pay for improvement and though they are often considered a sign of poor management, they still provide wildlife habitat. The difference in stocking levels, when using only growing-stock trees versus all live trees, implies that many low quality trees have been left behind after harvesting. These cull and noncommercial species occupy space and inhibit effective new growth of more valuable trees. Retaining large numbers of residual trees during harvest also impedes the start of new age classes that are important to maintaining forest health and future timber supplies (Nyland 1992). The increase in stands that are poorly stocked with growing-stock trees is a threat to the long-term sustainability of harvesting quality timber from New York's forests.

Not all forests are the same. New York's forests are a rich mix of stands of varying sizes, ages, and stocking levels. Each provides different habitats and levels of timber production. While young stands provide unique early successional wildlife habitat features that are not provided by sawtimber-size stands, they also offer opportunities for further increases in New York's timber resource. Besides offering diverse habitats and providing a steady flow of wood products, forests that contain stands of multiple sizes might be more resistant to devastating outbreaks of insects and diseases.

Forest Composition

Background

The species composition of a forest is the result of the long-term interaction of climate, soils, disturbance, competition among trees species, and other factors. Causes of forest disturbances in New York include timber harvesting, windstorms, ice storms, insects and diseases (e.g., Dutch elm disease, emerald ash borer), droughts, wildfires, and land clearing followed by abandonment. As forests recover from disturbances and mature, changes in growing conditions favor the growth of shade-tolerant species over shade-intolerant species in the understory, unless forest management practices intervene to work toward the perpetuation of shade intolerants.

Forest attributes recorded by FIA that describe forest composition include forest type, forest-type group, and numbers of trees by species and size. Forest types describe groups of species that frequently grow in association with one another and dominate the stand. Similar forest types are combined into forest-type groups. Changes in area by forest type are driven by changes in the species composition of the large diameter trees, and while these large trees represent today's forest, the composition of the smaller diameter classes represents the future forest. Comparisons of species composition by size can provide insights into future changes in overstory species.

What we found

The 2012 inventory identified 96 tree species, 56 forest types, and 13 forest-type groups. A complete list of tree species found in New York can be found in the appendix. The maple/beech/birch forest-type group covers 8.4 million acres (53 percent) of New York's timberland, and the oak/hickory forest-type group covers another 3.0 million acres (19 percent) (Fig. 26). These broad species groups have undergone little change in extent since 2007.

The maple/beech/birch forest-type group is composed of many species. This group accounts for 90 percent of the sugar maple and beech volume, but these species represent only 24 percent and 8 percent of the total volume in the group, respectively. Other important species in the group include red maple, eastern hemlock, white ash, and yellow birch (Fig. 27).

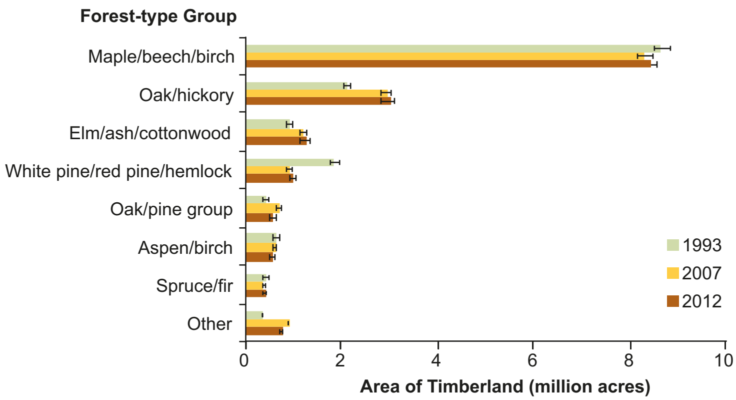


Figure 26.—Area of timberland by forest-type group and inventory year, New York. Error bars represent 68 percent confidence intervals around the estimated mean.

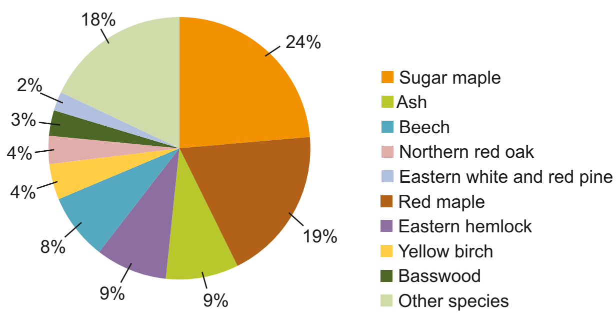


Figure 27.—Statewide species composition within the maple/beech/birch forest-type group on timberland, as a percent of total volume in the group, New York, 2012.

Ash are the most numerous species[2] in the seedling size class (trees less than 1-inch d.b.h. and greater than 1-foot tall), representing about 20 percent of all seedlings, followed by beech, sugar maple, red maple, and black cherry (Fig. 28).

The ranking of saplings (trees 1- to 4.9- inches d.b.h.) is somewhat different than that of seedlings (Table 5). Beech is the most numerous sapling followed by red maple, sugar maple, and ash species. These species account for 46 percent of all saplings. Number of beech saplings have increased by 14 percent since 2007, as the total number of saplings of all species has decreased by 4 percent. Red maple and

[2] Throughout this report, ash species refer to three species in the genus *Fraxinus*: white ash (*F. americana*), black ash (*F. nigra*), and green ash (*F. pennsylvanica*). White ash is the most common in New York, but all three are present.

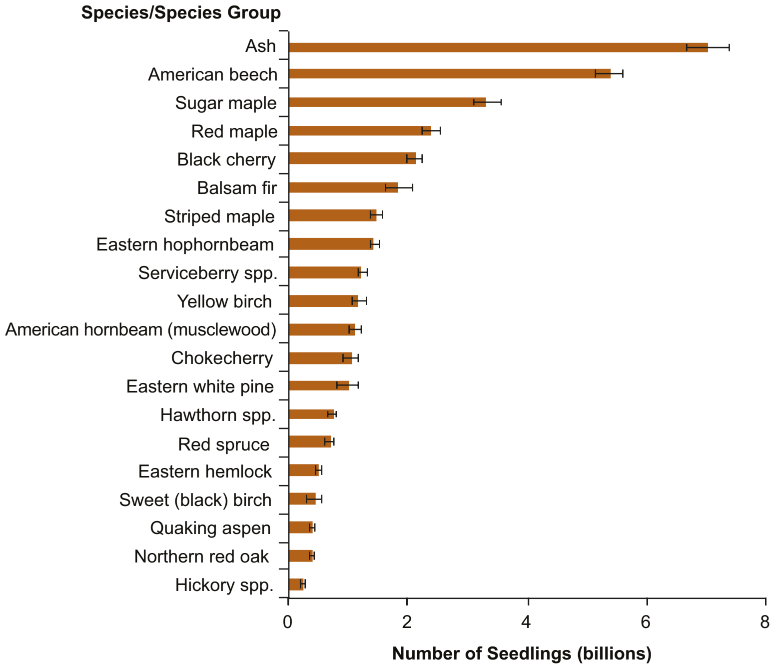


Figure 28.—Species ranked by number of seedlings (less than 1-inch d.b.h. and at least 1-foot tall), New York, 2012. Error bars represent 68 percent confidence intervals around the estimated mean.

sugar maple saplings decreased by 9 and 13 percent, respectively. Other important species that experienced decreases in sapling numbers since 2007 are white pine (-10 percent), paper birch (-15 percent), and northern red oak (-5 percent).

Among trees 5-inches d.b.h, and larger, red maple is the most numerous followed by sugar maple, hemlock, and white ash (Fig. 29). And if only trees 15-inch and larger diameter are considered, eastern white pine is the most common species followed by red maple and sugar maple. Twenty-one percent of the trees 15 inches and larger are white pine.

Beech is better represented in diameters less than 10 inches than in larger diameter classes (Fig. 30). In the current inventory, beech represents 12 percent of the trees less than 11 inches in diameter, but only 3 percent of trees greater than 15 inches (Fig. 31). This contrasts with northern red oak and white pine, which represent 1 and 2 percent of trees in the 2- and 4-inch diameter classes, but 10 and 13 percent of trees larger than 15 inches. Sugar maples are fairly well distributed across diameter classes and represent at least 11 percent of trees in each diameter class.

Table 5.—Ranking of sapling numbers by species (trees at least 1 inch and less than 5 inches d.b.h.) 1993, 2007, and 2012; total number of stems 2012; and percent change 2007 to 2012, and 1993 to 2007, on timberland, New York

Rank 1993	Rank 2007	Rank 2012	Species	Millions of stems 2012	Percent change 2007-2012	Percent change 1993-2007
3	3	1	Beech	978	14	24
1	1	2	Red maple	871	-9	-5
2	2	3	Sugar maple	749	-13	1
4	4	4	Ash	670	-1	13
8	5	5	Balsam fir	348	2	16
6	6	6	Eastern hophornbeam	305	-7	4
5	7	7	Hawthorn spp.	290	-6	-6
7	8	8	Hemlock	266	-3	-10
11	9	9	Striped maple	236	4	2
9	10	10	American hornbeam, musclewood	234	8	-15
12	12	11	Yellow birch	225	19	-2
10	11	12	Black cherry	193	-7	-11
19	13	13	Red spruce	191	3	64
17	14	14	Serviceberry spp.	176	-3	37
14	16	15	White pine	150	-10	-13
15	15	16	American elm	138	-17	-8
18	18	17	Gray birch	104	-9	-10
23	20	18	Sweet birch	94	3	24
16	17	19	Quaking aspen	87	-33	-10
22	21	20	Hickory	75	-8	11
13	19	21	Apple spp.	72	-27	-48
20	22	22	Northern white-cedar	70	-12	-28
21	23	23	Northern red oak	65	-5	-13
25	24	24	American basswood	50	-22	49
24	25	25	Paper birch	46	-15	-7

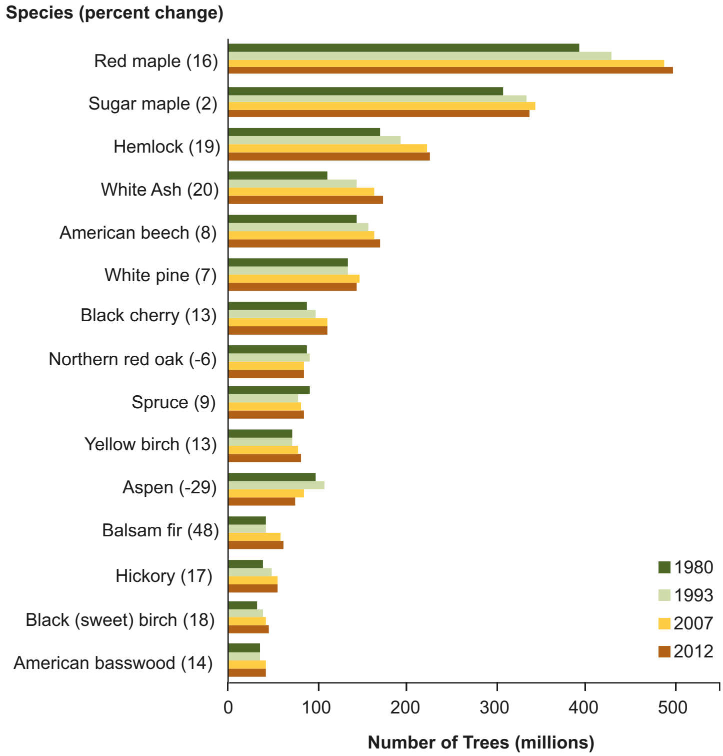


Figure 29.—Top 15 species on timberland, ranked by numbers of trees (5 inches in diameter and larger in 2012), with estimated numbers for previous inventory years. Percent change from 1993 to 2012 shown in parentheses.

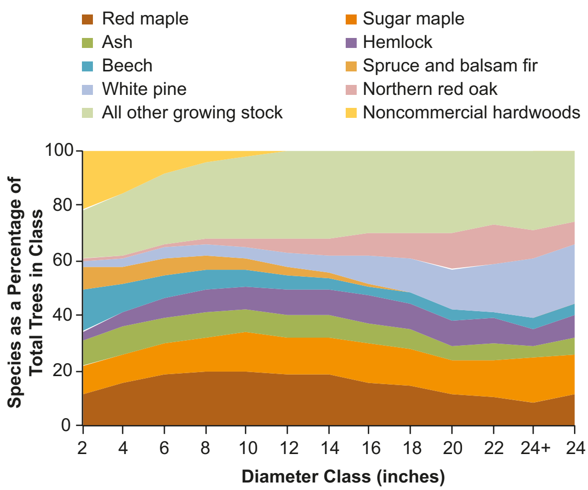


Figure 30.—Species composition as a percent of all trees in each diameter class on timberland, New York, 2012.

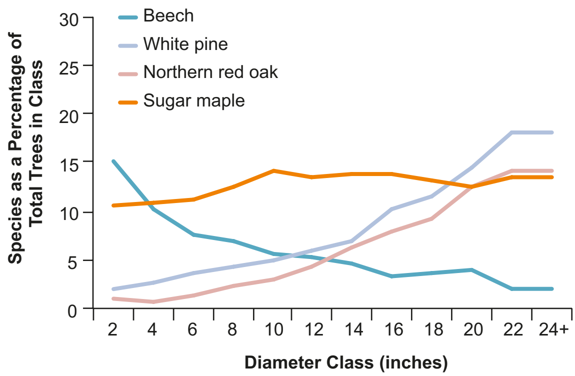


Figure 31.—Beech, white pine, northern red oak, and sugar maple as a percentage of all trees in each diameter class on timberland, New York, 2012.

What this means

New York is dominated by the maple/beech/birch forest-type group. The small shift in the area between forest-type groups since 2007 does not fully depict the underlying shifts occurring in species composition. Because the forest type metric is heavily influenced by large-diameter trees, changes in the composition of small-diameter trees that occupy the understory are not yet adequately reflected in changes by forest-type groups.

On timberland, red maple and sugar maple lead in numbers of trees 5 inches and larger d.b.h. followed by hemlock, species of ash, and beech. Red and sugar maples have large numbers of seedling- and sapling-size trees, are tolerant of shaded conditions, and are not affected by major insect or disease outbreaks at this time. Therefore, they will likely continue to dominate New York's timberland. Hemlock, beech, and ash trees are each currently being attacked by outbreaks of hemlock woolly adelgid (HWA), beech bark disease (BBD), and emerald ash borer (EAB), respectively. Each of these is discussed later in this report.

Beech is the most numerous sapling and the second most numerous seedling, but few of these trees are expected to grow to large diameter trees because of BBD. Mortality from BBD tends to increase with diameter and trees less than 10 inches d.b.h. are at low risk (Mize and Lea 1979). As beech trees are infected by beech bark disease, copious root suckers are produced (Nyland 2008). The increase in numbers of beech sapling is likely due to root suckering after partial harvests where beech are left as residual trees. One contributing factor to numerous beech seedlings and saplings is that beech is one of the least preferred browse species for white-tailed deer (*Odocoileus virginianus*). Other factors include the species high shade tolerance, and the infrequency of wildfire, to which beech is very susceptible. The proliferation of small beech in the aftermath of BBD infection, also known as beech brush, can interfere with the regeneration of other species.

Despite high numbers of small beech and ash trees, the outlook for these species is difficult to assess given the impacts of insect and disease outbreaks. It is unlikely that many beech trees will reach large size because of BBD, although beech will likely persist in the understory and in many cases dominate stands. Emerald ash borer is a relatively new insect pest and to date, ash trees have exhibited little or no resistance to EAB, so the future of ash is bleak. Insects and diseases will limit the future value of beech and ash for producing timber products and for producing hard mast for wildlife. Land managers should work to promote the regeneration of other species. This would include enhanced deer management techniques.

Hemlock, the third most numerous species of trees larger than 5 inches, has fewer seedlings relative to other species and hemlock sapling numbers have been decreasing, too. In maturing forests such as New York's, it could be expected that hemlock, a very shade tolerant species, would do well in the understory. It is the most shade tolerant of all tree species in North America and can withstand suppression from overstory trees for as long as 400 years (Godman and Lancaster 1990). But hemlock is readily browsed by white-tailed deer, the likely cause of low numbers of hemlock seedling and saplings. HWA maybe also a contributing factor in some areas because it reduces the vigor of large hemlocks thereby reducing seed production.

Although changes in forest composition will take decades and be influenced by disturbances, many of the trees that will comprise the future forest canopy are now growing in the understory. The future species composition of canopy trees will likely change to more closely reflect that of species now growing in the understory.

Volume on Timberland

Background

Estimates of volume provide the opportunity to evaluate trends in the wood resource, potential uses of that wood, and its economic value. FIA reports tree volume as sound and net volume of live trees and growing-stock trees (cubic feet), and sawtimber trees (board feet, International ¼-inch rule), and biomass (dry tons). Each of these measures characterizes the wood resource in a different way and provides insights into its use and management. Biomass estimates help quantify carbon storage. Because of changes in procedures, comparisons to past inventories are less consistent for some measures than others.

FIA calculates a cubic foot volume for all trees 5-inches in diameter and larger. The sound volume of live trees includes deductions for rotten and missing wood, while net sound-wood volume, also referred to a net volume, makes additional deductions for tree form, including sweep, crook, and forks, but includes qualifying sections of cull trees (trees with more than two-thirds cull due to rot and form or are of a noncommercial species). Growing-stock volume is the most restrictive of the volume estimates. Growing-stock trees must be of commercial species and less than two-thirds cull. The requirements to qualify as growing stock make it the most subjective of the volume measures. Sawtimber is the volume in the saw-log portion of growing-stock trees. The minimum diameter for sawtimber trees is 11 inches for hardwood species and 9 inches for softwood species.

What we found

There are 37.4 billion cubic feet of sound wood volume on New York timberland (Fig. 32), a 4.9 percent increase since 2007. Eighty percent of this volume, 29.8 billion cubic feet, is contributed by growing-stock volume in growing-stock trees. Also contained within the boles of growing-stock trees is an additional 3.2 billion cubic feet of sound wood that is too defective to qualify as growing-stock volume. Trees not meeting growing-stock standards either because they have large amounts of defect or are noncommercial species are classified as rough and rotten “cull” trees. Rough and rotten cull trees account for a combined 4.4 billion cubic feet and represent 10 percent (rough) and 2 percent (rotten) of sound volume on timberland. Besides the volume of trees growing on timberland, there is an additional 8.9 billion cubic feet of sound volume growing on reserved and other forest land, a 3.6 percent increase since 2007. Though the volume on reserved land is not available for harvesting, it provides habitat for wildlife and many ecosystem services, including carbon storage.

Volume increases since 2007 are a continuation of a 60-year trend (Fig. 33). Since 2007, increases have been observed in sound wood volume (4.9 percent), net sound volume (4.4 percent), growing-stock volume (2.3 percent), and saw timber volume (7.9 percent) on New York timberland.

Volumes have shifted toward the larger tree diameter classes (Fig. 34). Between 2007 and 2012, net volume has decreased by 3.5 percent in diameter classes less than 11

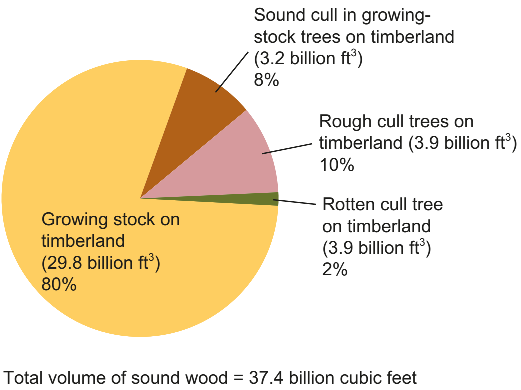


Figure 32.—Components of live sound wood volume on timberland, New York, 2012.

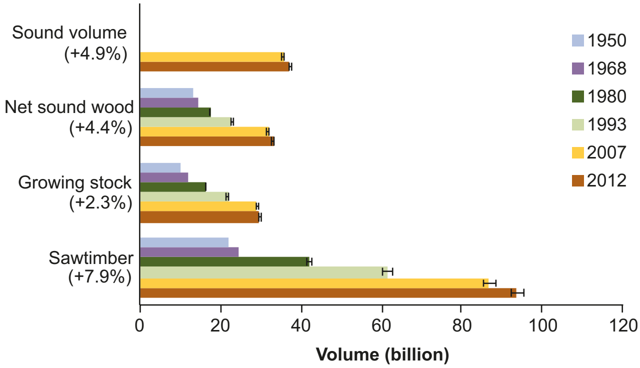


Figure 33.—Four measures of volume on timberland by inventory year, New York. Percent change from 2007 to 2012 is shown in parentheses. Volume measurements are in billion cubic feet except sawtimber, which is measured in billion board feet. Error bars represent 68 percent confidence intervals around the estimated mean.

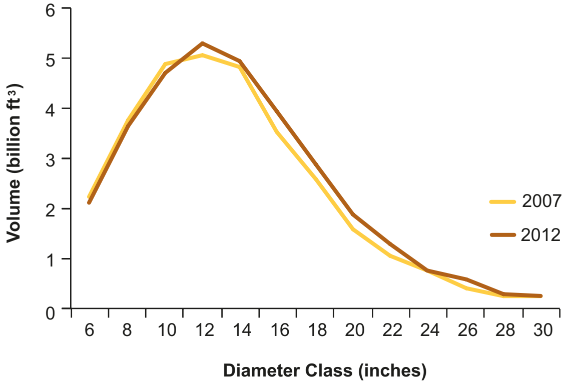


Figure 34.—Net volume by diameter class on timberland, New York, 2007 and 2012.

inches, while volume in trees 15 inches and larger has increased by 13.2 percent (Fig. 35). Both softwood and hardwood species show this pattern. All of the gains in volume were in trees large enough to produce saw logs.

Red maple continues to be the most voluminous species followed by sugar maple, white and red pine (combined), and species of ash (Figs. 36, 37). Volume changes were inconsistent across species. While most major species exhibited increases in volume, net volume decreases were observed for sugar maple, aspen, and American basswood. The largest percentage increases in volume were for ash species, northern red oak, and hemlock (Fig. 36).

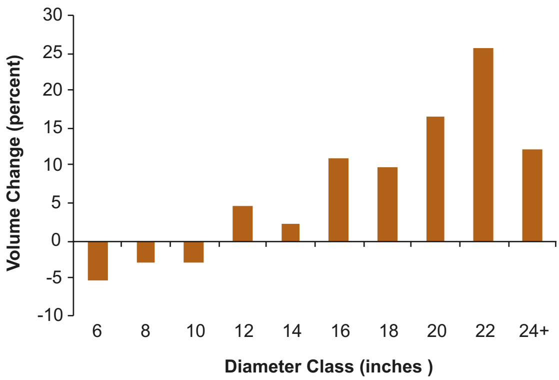


Figure 35.—Percent change in net volume by diameter class on timberland, 2007 to 2012, New York.

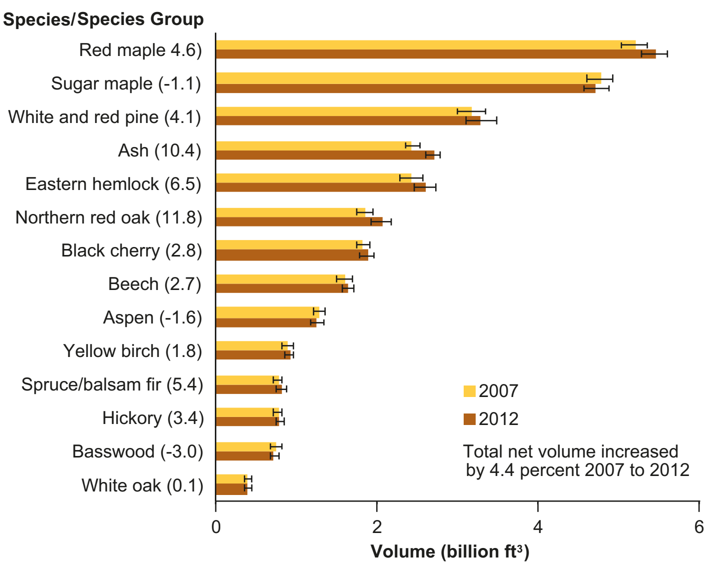


Figure 36.—Net volume by species 2007 to 2012, on timberland, New York. Percent change is shown in parentheses. Error bars represent 68 percent confidence intervals around the estimated mean.

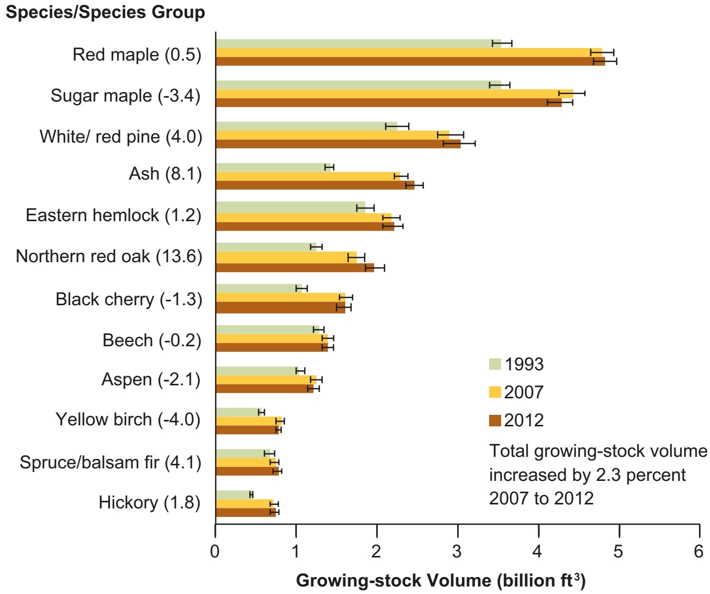


Figure 37.—Growing-stock volume by species on timberland, New York, 1993, 2007, and 2012. Percent change, 2007 to 2012, shown in parentheses. Error bars represent 67 percent confidence intervals around the estimated mean.

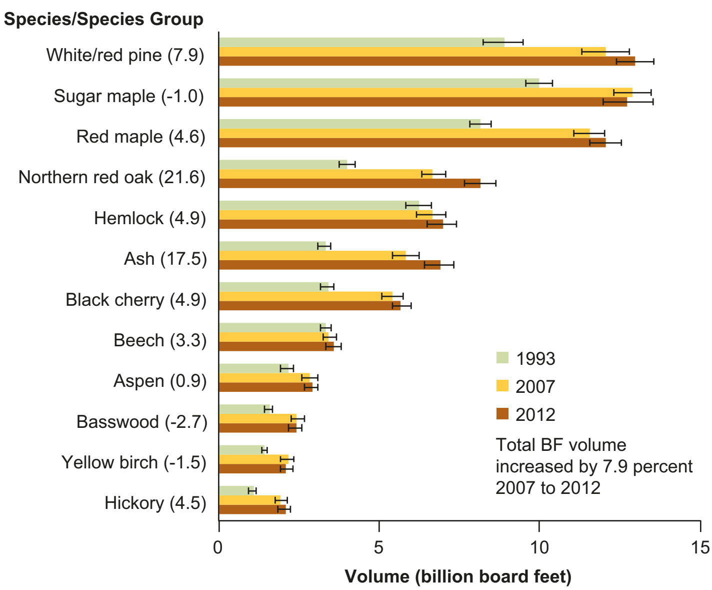


Figure 38.—Sawtimber volume in board feet (International 1/4 inch rule) on timberland by species, New York, 1993, 2007 and 2012. Percent change, 2007 to 2012, shown in parentheses. Error bars represent 68 percent confidence intervals around the estimated mean.

Sawtimber volume on timberland increased by 7.9 percent and now totals 93.7 billion board feet. White and red pine (combined), are the leading sawtimber species, by volume, followed by sugar maple, red maple, northern red oak, and hemlock (Fig. 38). Since 2007, northern red oak and ash have had the largest increases in board foot volume, 21.6 and 17.5 percent, respectively. Volume decreases were observed in sugar maple (-1.0 percent), yellow birch (-1.5 percent), and basswood (-2.7 percent).

The distribution of hardwood sawtimber by tree grade changed very little between the 2007 and 2012 inventories. Thirty-five percent of hardwood sawtimber volume was contained in trees graded 1 and 2 in 2007 and 2012 (Fig. 39). In absolute terms, the volume in grades 1 and 2 increased by 4 percent to 24 billion board feet, while volume in the lowest grade (tie/local use) increased by 8 percent to 13 billion board feet. Of the major species in the State, northern red oak and basswood have the largest percentage of their volume in grades 1 and 2, each with more than half their volume in these valuable grades (Fig. 40). Sugar maple is the leading species in board foot volume and has nearly a third of its volume in grade 1 and 2. Among the other major species in the State, beech had the lowest portion of volume in grades 1 and 2 (8 percent) and the highest portion in the low tie and local use grade (61 percent). Beech, red maple, and aspen species typically grade poorly and represent a fifth of the total sawtimber resource.

On a per-acre basis, sound wood volume in live trees averages 2,349 cubic feet per acre of timberland (Fig. 41). Per-acre volumes were highest in the Catskill-Lower Hudson unit and lowest in the St. Lawrence/Northern Adirondack unit. The Catskill-Lower Hudson Unit had a 7.6 percent increase in volume per acre since 2007, the largest percentage increase. In the Eastern Adirondack unit, per-acre volume decreased by 2.3 percent since 2007.

Among the units, the species with the greatest net volume differ, but across all units, the top ten species represent at least three-fourth of the total net volume in each unit (Table 6). Red maple and sugar maple ranked in the top five species by net volume in every unit in the State. Eastern white pine reaches its highest portion of net volume in the Capitol District Unit where it accounts of 17.0 percent of the net volume and increased by 14.0 percent since 2007. Ash ranks third in the Lake Plain, Southwest Highlands, and South-Central Highlands units where it represents 13.6, 11.1 and 9.5 percent of net volume, respectively. Ash increased by at least 11 percent in each of these units since 2007. The ranking of species by net volume on timberland is similar to that on all forest land, although beech and red spruce rank higher on forest land because of their higher occurrence on reserved forest land in the Adirondack Park.

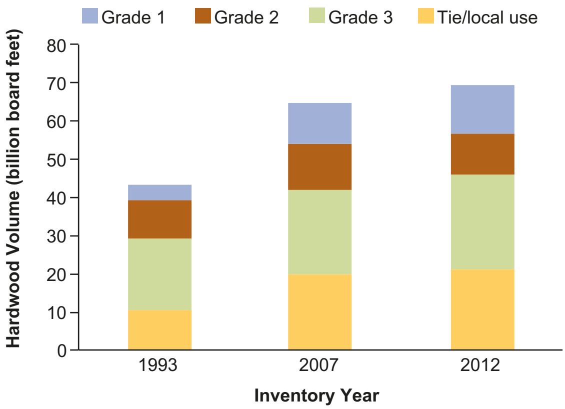


Figure 39.—Hardwood volume by tree grade and inventory year, New York.

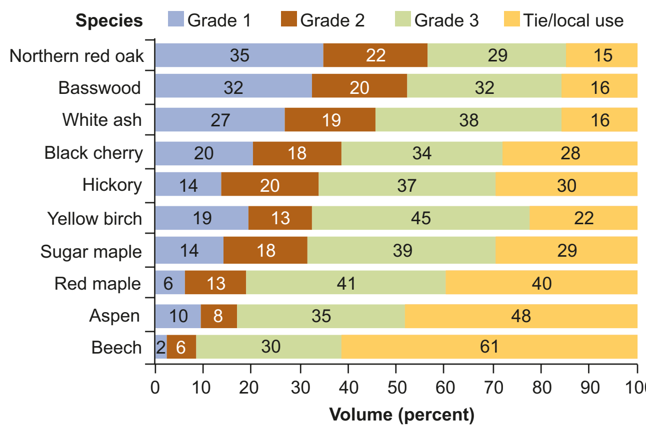


Figure 40.—Percentage of saw log volume by tree grade for major species, New York, 2012.

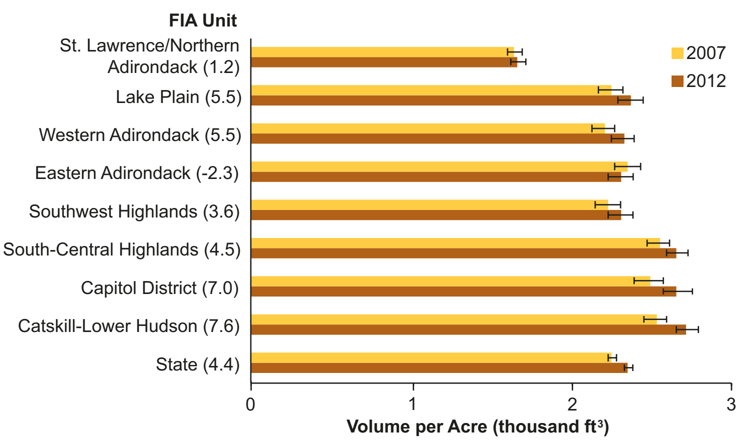


Figure 41.—Average sound wood volume of live trees per acre of timberland by unit, New York. Percent change from 2007 to 2012 is shown in parentheses. Error bars represent 68 percent confidence intervals around the estimated mean.

Table 6.—Top ten species by FIA unit, ranked by 2012 volume: also includes net volume by species, percent of unit volume and percent change in volume 2007 to 2012, on timberland, New York

FIA Unit	Species/ Species Group	Volume in Unit 2012 (million ft^3)	Volume as a percent of unit volume	Volume percent change 2007-2012
St. Lawrence/ Northern Adirondack	Red maple	694	17.6	-0.1
	Sugar maple	621	15.8	-3.8
	Eastern white pine	391	9.9	9.7
	Ash	247	6.3	9.0
	Black cherry	240	6.1	6.8
	American beech	200	5.1	0.4
	Hemlock	196	5.0	-1.2
	Yellow birch	177	4.5	-5.7
	Aspen	160	4.1	-11.3
	Balsam fir	153	3.9	10.2
Lake Plain	Red maple	717	14.8	2.8
	Sugar maple	704	14.5	-4.1
	Ash	662	13.6	15.1
	Black cherry	361	7.4	-0.9
	Eastern hemlock	235	4.8	6.2
	Silver maple	231	4.8	13.5
	American basswood	190	3.9	-6.4
	Northern red oak	189	3.9	16.9
	American beech	185	3.8	5.2
	Aspen	184	3.8	0.0
Western Adirondack	Red maple	703	21.1	8.1
	Sugar maple	479	14.4	-4.6
	Eastern hemlock	334	10.0	9.9
	Eastern white pine	303	9.1	6.9
	Black cherry	260	7.8	0.2
	American beech	208	6.2	10.5
	Ash	207	6.2	12.5
	Yellow birch	204	6.1	2.8
	Balsam fir	92	2.8	6.9
	Red spruce	88	2.6	0.7
Eastern Adirondack	Sugar maple	439	18.4	-0.9
	Eastern hemlock	284	11.9	2.2
	Eastern white pine	283	11.9	-18.4
	American beech	262	11.0	6.2
	Red maple	226	9.5	-2.7
	Yellow birch	171	7.2	-4.3
	Northern red oak	122	5.1	-1.1
	Red spruce	98	4.1	-6.3
	Ash	85	3.6	9.6
	Paper birch	76	3.2	-15.0

(Table 6 continued on next page)

(Table 6 continued)

FIA Unit	Species/ Species Group	Volume in Unit 2012 (million ft^3)	Volume as a percent of unit volume	Volume percent change 2007-2012
Southwest Highlands	Red maple	665	16.7	8.8
	Sugar maple	651	16.3	4.8
	Ash	440	11.1	11.2
	Black cherry	299	7.5	16.1
	Eastern hemlock	291	7.3	7.1
	Northern red oak	265	6.7	2.4
	Aspen	236	5.9	0.0
	Eastern white pine	200	5.0	-2.1
	American beech	183	4.6	1.1
	American basswood	100	2.5	-8.6
South-Central Highlands	Red maple	1232	20.5	7.1
	Sugar maple	919	15.3	0.3
	Ash	570	9.5	12.7
	Eastern hemlock	526	8.8	2.4
	Eastern white pine	521	8.7	5.4
	Northern red oak	413	6.9	15.5
	Black cherry	395	6.6	4.4
	American beech	296	4.9	-0.6
	Aspen	152	2.5	-15.5
	Red pine	150	2.5	-8.5
Capitol District	Eastern white pine	576	17.0	14.0
	Red maple	418	12.3	4.3
	Sugar maple	389	11.5	3.3
	Eastern hemlock	343	10.1	9.7
	Northern red oak	341	10.1	-2.4
	Ash	141	4.2	12.0
	Aspen	118	3.5	4.7
	Hickory	115	3.4	10.9
	Black cherry	105	3.1	1.7
	American beech	104	3.1	-7.6
Catskill-Lower Hudson	Red maple	776	14.7	3.1
	Northern red oak	640	12.1	27.4
	Sugar maple	504	9.5	-2.7
	Eastern white pine	429	8.1	9.8
	Eastern hemlock	370	7.0	15.0
	Ash	330	6.2	58.4
	Sweet birch	257	4.9	19.8
	Chestnut oak	217	4.1	17.9
	American beech	190	3.6	3.1
	Black cherry	182	3.4	-6.8

What this means

Continuous volume increases have brought New York's timber resource to record levels for all the measures of volume. Most of the inventory volume is in trees that meet minimum requirements to qualify as growing-stock trees. Volume increases are concentrated on sawtimber-size trees, which explain why increases in board-foot volume (+7.9 percent) were higher than increases in growing-stock cubic-foot volume (+2.3 percent). As trees grow into sawtimber size, the value can increase abruptly because they can be used for higher value timber products. Despite the substantial increase in sawtimber volume, trends in tree quality and species composition raise concern for the sustainability of some high value species.

Since 2007, sound wood volume increased by 4.9 percent, or more than twice the increase of growing-stock volume, even though these two measures both refer to bole volume between a 1-foot stump and a 4-inch top diameter. The difference is that measurements of sound wood exclude only rotten and missing wood, whereas measures of growing-stock volume also take deductions for rough cull, i.e., sweep, crook, and forks, and excludes trees classified as cull or of noncommercial species. While some of these volume deductions may be subjective when applied in the field and collected inconsistently over time, these measures indicate that low value wood is increasing faster than the higher quality timber.

Additionally, within growing-stock volume, volume realized a greater increase in the tie/local use class (8 percent or 1.6 billion board feet) than in grades 1 and 2 combined (4 percent or 1.0 billion board feet), although the portions of total board-foot volume by grade remained nearly unchanged. The larger increase in lower quality sawtimber can be attributed to a combination of timber harvest methods that remove higher value trees and leave residual trees of lower grades, and ingrowth of trees species that typically make up the poorer grade timber, such as beech and red maple.

Overall tree quality is affected by changes in species composition, though other factors are also involved. Since 2007, ash and northern red oak, which typically grade higher than other species, had the largest increases in board-foot volume of the major species, but increases in these two species may not be sustainable A decrease in the number of sapling-size northern red oak trees indicates problems with regeneration. Ash species are the most numerous seedling-size trees and fourth most numerous sapling in New York (Table 2), but long-term survival of these trees is doubtful because of the emerald ash borer.

Beech, red maple, and aspen represent a fifth of the sawtimber resource but typically are of a poor grade. Beech has experienced smaller increases in board-foot volume than many other major species since 1993, but it is also the most numerous sapling species. The numerous beech saplings should be a concern to forest managers.

Red maple is the leading species by growing-stock volume, it has had the largest increase in volume since 1993, and is the second most numerous sapling. This suggests that large amounts of red maple volume will continue to grow to sawtimber size. Increases in volumes in low grade saw timber negatively affects the value of the resource for producing timber products. The lower grade trees occupy space that could be used to grow higher value trees.

There is a large amount of sound volume in the cull sections of growing-stock trees and trees classified as rough and rotten cull. This wood could present opportunities for increased utilization of low value wood, much of which is now left in the woods during harvesting operations either in standing live trees or as logging residue. Although cull trees have low value for wood products, they are often of high value for wildlife habitat. Many of the same features that decrease the value for wood products increase these species value for wildlife, such as bole cavities, large amounts of rot, and broken tops. Cull trees and portions of growing-stock trees left in the woods as logging residues provide habitat for wildlife and provide for nutrient recycling.

In New York, 40 percent of hardwood sawtimber volume is in trees less than 15.0 inches diameter. These trees are too small to be rated grade 1 and are given a low grade in many cases because of size alone. Forest land owners can receive better financial returns by practicing sustainable forestry and thinning around trees with potential to grow into quality grade 1 and 2 trees. By using silvicultural tools that promote high value species and increase tree quality, landowners can improve the financial compensation from their harvest and make the residual forest healthier. Having markets for small trees and lower grade wood products, such as pallets, wood pellets, and biomass energy, promotes best management practices and improves overall stand quality.

In each of the eight FIA units, the top five species by volume represent about 60 percent of the total volume, with no single species representing more than a quarter of the total volume in any unit. There are few areas in New York where any one species dominates. This diverse mix of species reduces the impact of insects and diseases that affect a single species.

Ash species represent the largest portion of volume in the Lake Plain and Southwestern Highlands units, 13.6 and 11.1 percent, respectively. Since the impact of EAB will be proportional to the ash volume, these units will be impacted the most, although the EAB is likely to cause decreases in ash volume throughout the State.

Biomass Volume of Live Trees

Background

Trees play an important role in the world's carbon cycle. They act as a sink for carbon by removing it from the atmosphere in the form of carbon dioxide (a greenhouse gas) and storing it as cellulose. In this role, forests help mitigate the effect of burning fossil fuels and the resulting increase of carbon dioxide in the atmosphere. New York's forests contribute greatly to the sequestration of carbon dioxide due to increases in tree biomass.

Tree biomass, a measure of how much carbon is being stored in trees on forest land, is the total weight of both live and dead trees, including branches, roots, and stumps. Typically the carbon content of biomass is equal to half the biomass weight measured in dry tons. Estimates of biomass are important for knowing not only the amount of carbon storages but also the potential amount of biomass available for energy uses.

What we found

Aboveground biomass of all live trees in New York's forests is 1.1 billion dry tons, a 4 percent increase since 2007, and averages 59 tons per acre. Fifty-one percent is found in the merchantable boles of commercially important trees represented by growing-stock volume (Fig. 42). It is this component that can be converted to high value wood products, although the potential for using the portion in the lowest grade tree (also referred to as tie and local use grade) for high value products is low. Other portions of tree biomass on timberland are underutilized and can be considered as potential sources of fuel for commercial power generation, home heating, and as wood for producing fuel pellets.

The highest volumes of biomass per acre are associated with New York's reserved forest land. Statewide biomass averaged 70 dry tons per acre on reserved forest land and 57 tons on timberland (Fig. 43). Since 2007, average biomass increased by 3.8 percent on timberland and 2.2 percent on reserved forest land. Differences between timberland and reserve forest land are especially noticeable in the Southwestern Highlands unit where the Allegany State Park accounts for most of the reserved forest land. Biomass on reserved forest land, though not available for use for products, serves as a carbon sink.

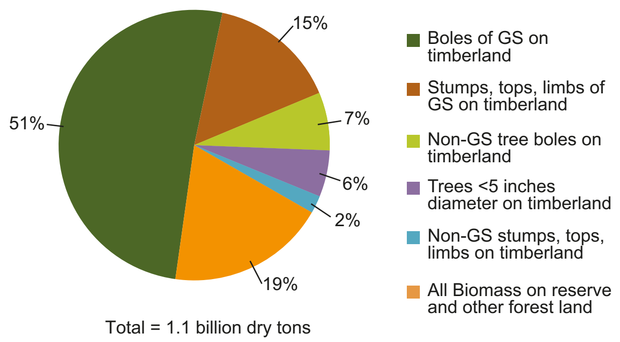


Figure 42.—Components of tree biomass on forest land, New York, 2012.

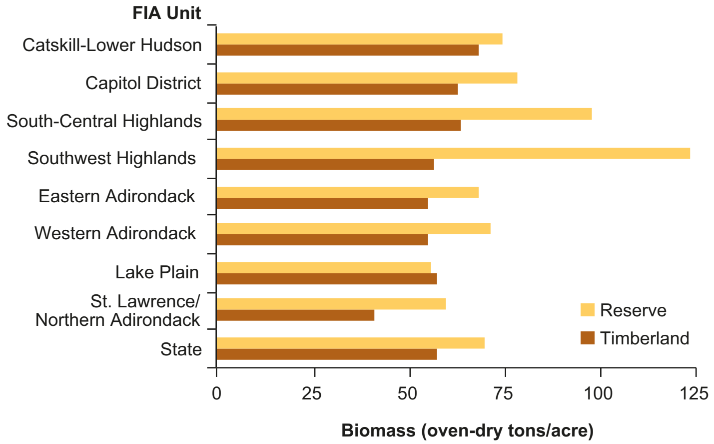


Figure 43.—Average per-acre biomass on timberland and reserved forest land by FIA unit, New York, 2012.

What this means

New York's forests are accumulating substantial biomass. This will receive increasing attention as the Nation seeks sources of renewable energy and ways to offset carbon dioxide emissions. Because biomass is a renewable source of energy, it can help reduce the Nation's dependence on fossil fuels. Using biomass for fuel provides markets for low grade and underutilized wood. As biomass markets develop, forest managers will have the opportunity to integrate the harvesting of biomass into their management plans.

Carbon Stocks

Background

Forest ecosystems represent the largest terrestrial carbon sink on earth. The accumulation of carbon in forests through sequestration helps mitigate emissions of carbon dioxide to the atmosphere from sources such as burning of fossil fuels and forest fires. 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 York's forest carbon. Estimation procedures are detailed by Smith et al. (2006).

What we found

Carbon sequestered on New York forest land is 1.6 billion tons or 83 tons per acre, and a 2.2 percent increase from the 2007 estimate. Of the various carbon pools, the largest carbon stocks are found in live trees and saplings (43 percent), and soil (39 percent) (Fig. 44). Within the live tree and sapling pool, the bulk of carbon is contained in the merchantable boles of trees. Carbon in living trees can increase relatively quickly in young stands (Fig. 45), then slows, and after 100 years, nearly stops, whereas carbon in the soil changes slowly as stands age. Sixty-one percent of New York's live tree carbon is contained in stands 41 to 80 years old stands.

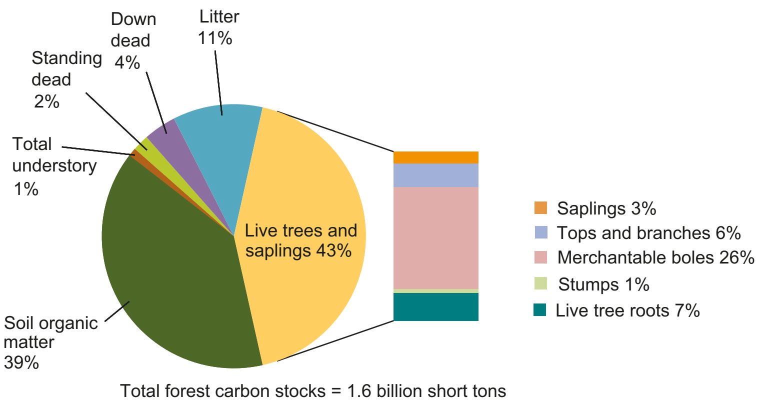


Figure 44.—Estimated carbon stocks on forest land by forest ecosystem component, New York, 2012.

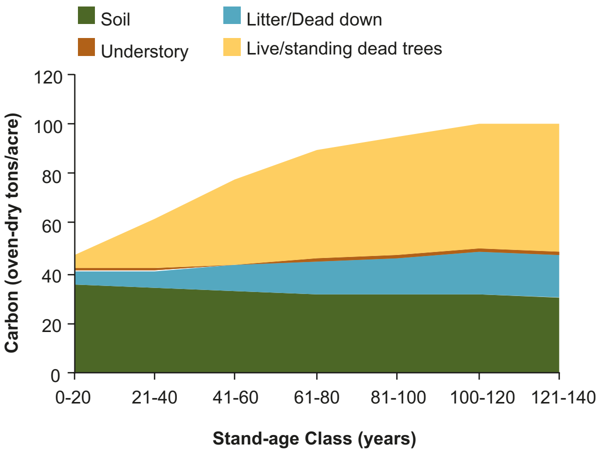


Figure 45.—Average per-acre carbon stocks on forest land by component group and stand-age class, New York, 2012.

What this means

The largest pool, aboveground carbon in live trees and saplings, is influenced by timber harvesting and other disturbances. It is this pool that can be most affected by forest management. Because nearly three-fourths of New York's forests are less than 80 years old and dominated by relatively long-lived species, it can be expected that they will continue to accumulate aboveground carbon at a fairly rapid pace. The rate of increase will slow as stands grow older. Thinning stands can keep them growing at optimal rates, while the removed wood is stored in products or is used as fuel, offsetting the burning of fossil fuels. Soil carbon, the second largest pool, is important to long-term carbon sequestration, but because changes to it are slow, there are few opportunities to manage for it in the near term. Managing forests for carbon in combination with other land management objectives will require careful planning and creative silviculture beyond simply managing to maximize growth and timber yield.

New York participates in the Regional Greenhouse Gas Initiative (RGGI). Forest management projects have not been accepted to date for RGGI in New York, and though power producers cannot currently buy credits from forest management activities (projects), they can get credit for using wood. In the future RGGI could support forestry projects that increase carbon sequestration and enhance wildlife habitats. Currently, few forest landowners are financially compensated for the contributions their trees make in absorbing carbon dioxide and storing carbon. However, this may change if the use of trees to offset the release of greenhouse gases becomes a higher priority. Improvements in how carbon is measured and accounted for would likely help promote this as a new income source for landowners.

Components of Annual Volume Change: Growth, Removals, and Mortality

Background

Well-tended forests supply a continuous flow of products and services without impairing long-term productivity or the ecological integrity of the forest. One way to judge the sustainability of a forest is to examine the components of annual change in inventory volume: growth, removals, and mortality. Net growth includes growth (accretion) on trees measured previously, ingrowth[3] of trees over the 5-inch threshold for volume measurement, deductions for mortality due to natural causes, and volume of trees on lands reverting to forest. Removals include trees harvested and trees no longer counted as part of the inventory because the forest land was developed for a nonforest use. Timberland removals also include trees on land that has been reclassified as reserved. Analysis of these individual components can help us better understand what is influencing net change in volume.

What we found

The growth of trees has greatly outpaced mortality and removals during the past 50 years. The most recent inventory revealed that since 2007, the gross growth in the net volume of live trees on timberland is more than 1 billion cubic feet annually (Fig. 46). Annual mortality averages 358 million cubic feet, resulting in a net growth of 699 million cubic feet per year. The annual removals of trees due to harvesting and land-use change averaged 327 million cubic feet, leaving an annual surplus or net increase of 372 million cubic feet on New York's timberland (Fig. 46). As a percentage of the current inventory, gross growth was 3.2 percent; mortality, 1.1 percent; net growth, 2.1 percent; and removals, 1.0 percent. These result in an average annual net increase in total volume of 1.1 percent (Table 7).

On land classified as timberland in both 2007 and 2012, 85 percent of net growth was on trees previously in the 6-inch diameter class and larger (accretion) and the remaining 15 percent was from trees growing into diameter classes 6-inches and larger (ingrowth). Fifty-four percent of the accretion was on trees that were in the 6, 8, and 10 inch diameter classes in the 2007 inventory (Fig. 47).

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[3] Ingrowth on timberland refers to the estimated net volume of trees that became 5.0 inches d.b.h. or larger during the period between inventories. Also, the estimated net volume of trees 5.0 inches d.b.h. and larger that are growing on land that was reclassified from nonforest land to timberland.

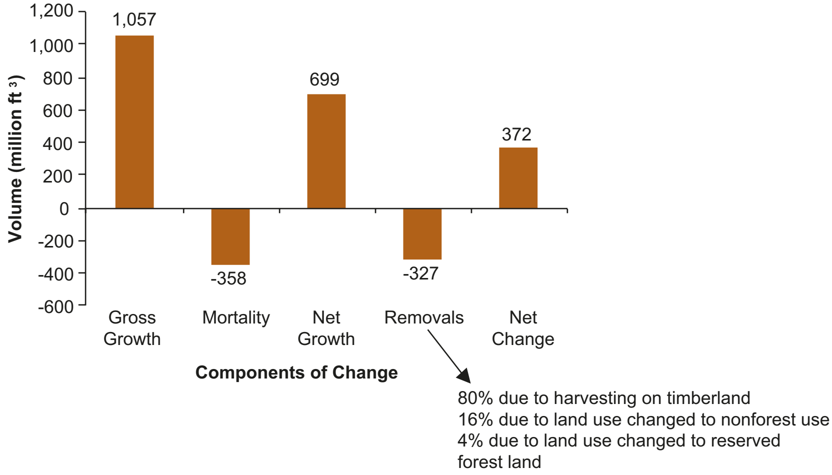

Figure 46.—Average annual components of change in net volume on timberland, New York, 2008-2012.

Figure 47.—Average annual net growth (volume) on live trees (known as accretion) by 2007 diameter class on timberland, New York, 2008-2012.

Table 7.—Average annual components of change in net volume as a percentage of current volume on timberland, by FIA unit, New York, 2008-2012

FIA Unit	Gross growth	Mortality	Net growth	Removals	Net change
	percent				
St. Lawrence/Northern Adirondack	3.6	1.8	1.8	1.4	0.4
Lake Plain	3.5	1.0	2.5	1.0	1.5
Western Adirondack	2.9	1.3	1.7	0.9	0.8
Eastern Adirondack	2.9	1.4	1.5	2.1	-0.6
Southwest Highlands	3.3	0.8	2.6	1.2	1.4
South-Central Highlands	2.9	1.0	1.9	0.7	1.2
Capitol District	3.2	0.7	2.5	1.1	1.3
Catskill-Lower Hudson	3.1	0.9	2.2	0.4	1.8
State	3.2	1.1	2.1	1.0	1.1

Statewide, 80 percent of the removals were from the harvesting of trees on land that remained in timberland, 16 percent was due to timberland being diverted to nonforest land, and 4 percent from timberland being reclassified as reserved or other forest land. The units with the highest percentage of removals due to land-use change were the Catskill-Lower Hudson (41 percent), Lake Plain (24 percent), and Capitol District (22 percent) units. On land that was timberland in both 2007 and 2012, removals were concentrated on the trees that were in the 14- to 18-inch diameter classes in the 2007 inventory. These classes account for nearly half of these harvest removals by volume (Fig. 48).

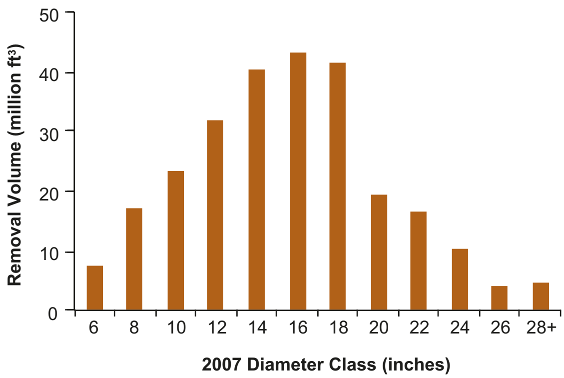

Figure 48.—Average annual removals (volume) by 2007 diameter class on timberland, New York, 2008-2012. Data excludes removals due to forest land being diverted to nonforest uses, New York.

Harvests were primarily from high volume stands. Ninety-three percent of harvest removals came from stands that previously had a live-tree basal area greater than 81 square feet per acre. The 2012 inventory recorded evidence of harvest on 1.2 million acres during the 5-year period. A fairly high density of trees was retained on most of these harvested acres. Thirty-five percent of the harvested areas currently has a basal area per acre between 81 and 120 square feet per acre, and 30 percent currently has a basal area of at least 120 square feet. Only 5 percent of the harvested area currently has a basal area of less than 40 square feet. On timberland with evidence of harvesting over the last 5 years, volume currently averages 1,966 cubic feet of sound wood per acre. This is equivalent to 94 percent of the average volume on timberland that had no evidence of harvesting over the same time period. Trees that were previously classified as growing stock had a higher rate of removal, 1.0 percent, than trees that were classified as cull, 0.8 percent.

On timberland, the ratio of total net growth-to-removals (G/R) averaged 2.1:1 from 2007 to 2012. If growth and removals due to land-use change are excluded, this ratio is

2.3:1. The ratio was lowest in the Eastern Adirondack unit where removals were greater than net growth, resulting in a ratio of less than one (0.8 to 1), while in the Catskill-Lower Hudson unit, growth outpaced removals by a ratio of 6.4 to 1 (Fig. 49).

In terms of growth and removals by species, red maple experienced the largest net growth in volume since 2007 and accounted for 18 percent of total growth (Fig. 50). Sugar maple accounted for 20 percent of removals, the greatest amount for any species. G/R ratios varied considerably between these species, from red maple with a G/R ratio of 2.9:1, to sugar maple with a G/R ratio of 1.3:1.

Ash species had the third largest amount of growth and the highest G/R ratio of the major species group, 3.5:1. Statewide net growth exceeded removals for all major species, with the exceptions American basswood where removals outpace growth by a ratio of 0.8:1.

What this means

Today's well-stocked forests are a product of growth consistently outpacing removals during the last half century and the surplus of timber accumulating in the forest. Since 2007, net growth has been twice that of removals, with the net change amounting to an annual increase of 1.1 percent in inventory volume. This implies that the current level of removals is sustainable and that increases in volume will continue at the State level and all the FIA units, except for Eastern Adirondack. The G/R ratios indicate that harvesting pressure is greatest in the Eastern Adirondack and St. Lawrence/Northern Adirondack units, although high mortality in these units lowered growth which contributed to low G/R ratios. Harvesting pressure was least in the Catskill-Lower Hudson unit.

Comparing the G/R ratios of individual species to the average ratio for all species (2.1:1) reveals which species are increasing in importance and which are decreasing. The high G/R ratios for red maple, northern red oak, and black birch indicate these species will increase in importance in New York's forests. However, most northern red oak growth can be attributed to accretion on large trees and because of low ingrowth into the 5-inch diameter class; future growth of northern red oak may decrease. Hemlock and ash also have high ratios of G/R but their futures are being threatened by exotic pests. Currently, ash species account for 12 percent of net growth in New York. This amount of growth is unlikely to continue as the EAB spreads across the State, slowing ash growth and increasing mortality.

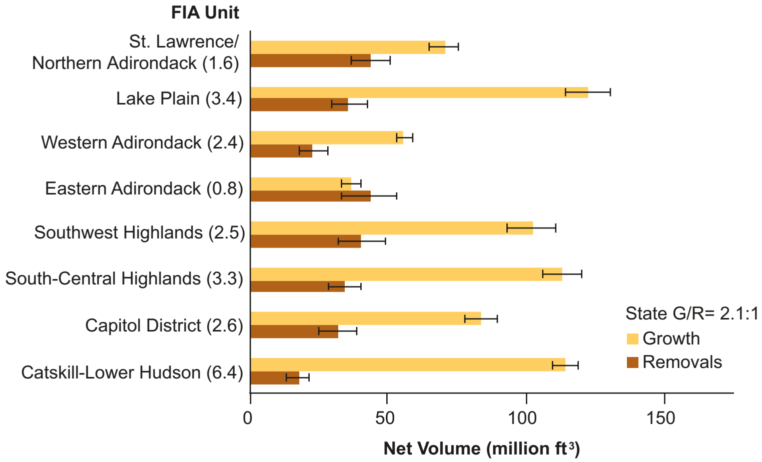

Figure 49.—Average annual growth and removals of net volume on timberland by FIA unit, New York, 2008-2012. Growth-to-removals ratio is in parentheses. Error bars represent 68 percent confidence intervals around the estimated mean.

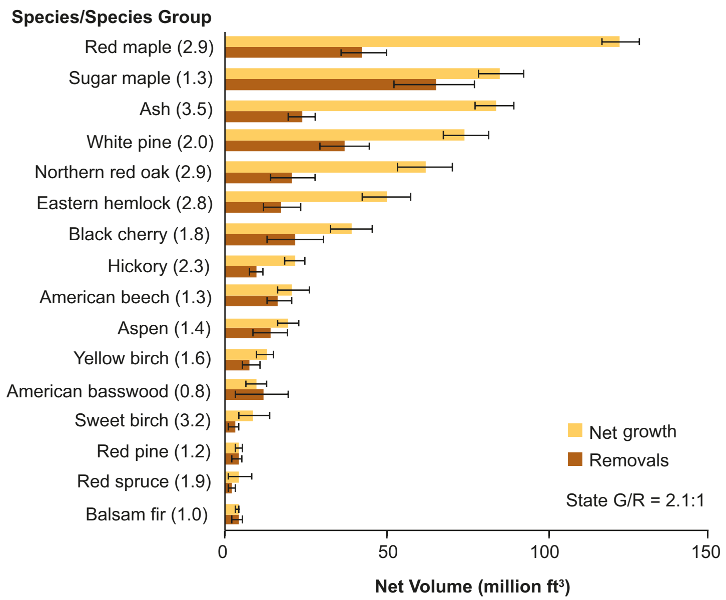

Figure 50.—Average annual growth and removals of net volume on timberland by species, New York, 2008-2012. Growth-to-removals ratio is shown in parentheses. Error bars represent 68 percent confidence intervals around the estimated mean.

Of the major species, sugar maple has one of the lowest ratios of G/R, and though not indicated by its G/R ratio greater than 1, it has had a small decrease in volume since 2007 (Figs. 37, 38) (because estimates of growth and removals are based on a slightly different set of plots than estimates of total inventory volume, some discrepancies can occur between them). This indicates that this species remains under intense harvesting pressure. Also future ingrowth of this species may be less than what it has been traditionally because of poor regeneration and heavy deer browse. Sugar maple comprises 14 percent of total volume and 20 percent of removals. The harvest composition will need to be adjusted to produce sustainable sugar maple levels, i.e., less sugar maple harvested in the future.

Areas where harvesting has occurred show that most harvests are light and retain a fairly high volume of residual trees. These light harvests influence the future growth and species composition of the New York's forests. Future growth will tend to occur on residual trees rather than ingrowth, and the reproduction that does occur will favor more shade-tolerant species at the expensive of shade intolerant species.

Mortality

Background

The volume of trees that die from natural causes, such as insects, diseases, fire, wind, and suppression by other trees, is reported as mortality; harvested trees are not included in mortality estimates. Tree mortality is a natural process that occurs in a functioning ecosystem. Dramatic increases in mortality can indicate forest health problems, such as invasions by exotic insects and diseases.

What we found

In New York, the average annual rate of mortality for live trees on timberland was 1.1 percent between 2007 and 2012. If only growing-stock trees are considered, the morality rate for this period is 0.9 percent, the same growing-stock mortality rate as occurred during 1993 to 2007.

The mortality rate of live trees in New York tends to be higher than that in the neighboring states of Pennsylvania (0.9 percent), New Jersey (1.0 percent), Connecticut (0.6 percent), Massachusetts (0.8 percent), and Vermont (1.0 percent) and the same as that in Ohio (1.1 percent). Rates were highest in the Adirondack units: St. Lawrence/Northern Adirondack (1.8 percent), Eastern Adirondack (1.4 percent), and Western Adirondack (1.3 percent). Lowest rates were in the Capitol District (0.7 percent) and Southwest Highlands units, (0.8) (Fig. 51).

Mortality rates were higher for smaller diameter trees than for larger ones, although rates do rise in diameter classes larger than 26 inches (Fig. 52). The mortality rate in the 6-inch class was 1.7 percent per year, 50 percent higher than the rate across all diameter classes. The 20-inch diameter class had the lowest mortality rate at 0.7 percent. Trees less than 11.0 inches in diameter accounted for 41 percent of the total mortality, by volume, even though they represent only 32 percent of total tree volume.

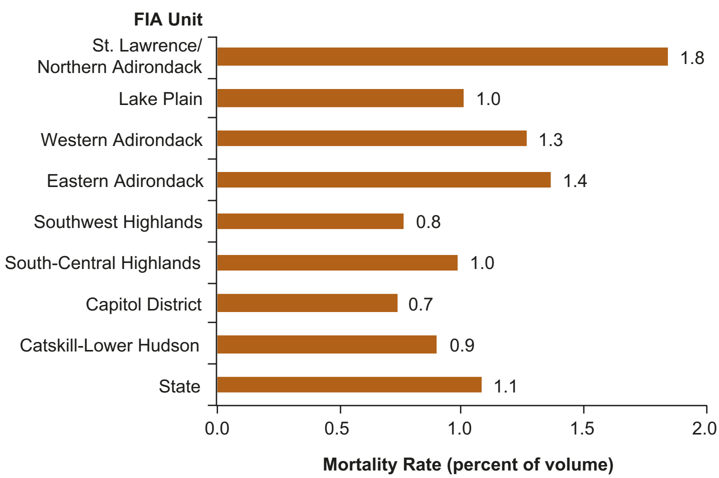

Figure 51.—Average annual mortality as a percent of current live tree volume on timberland by FIA unit, New York, 2008-2012.

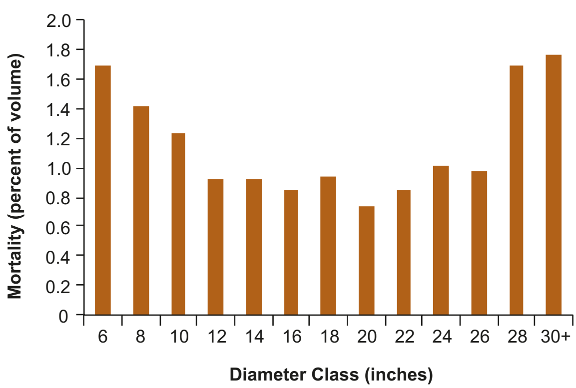

Figure 52.—Average annual mortality as a percent of current live tree volume on timberland by 2007 diameter class, New York, 2008-2012.

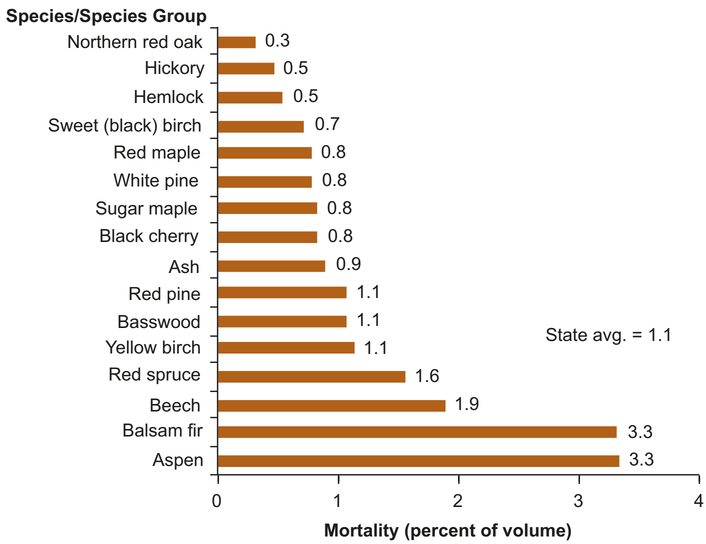

Figure 53.—Average annual mortality as a percent of current live tree volume for major species on timberland, New York, 2008-2012.

Species groups with highest annual mortality rates were aspen (3.3 percent), balsam fir (3.3 percent), and beech (1.9 percent) (Fig. 53). The three leading species by volume in the State, red maple, sugar maple, and white pine, each had an annual mortality rate of 0.8 percent—less than the State average for all species. Other species with high mortality rates, though not shown on Figure 53, are butternut (11.5 percent), gray birch (8.8 percent), American elm (6.9 percent), paper birch (4.0 percent), and hawthorn species (2.4 percent).

What this means

Mortality rates in New York are higher than some surrounding states. Much of this mortality can be explained by stand dynamics or insects and diseases that target specific species. The maturing of New York's forests has resulted in more crowded growing conditions. As trees compete for light and growing space, some fall behind their neighbors, lose vigor, and eventually succumb to insects and diseases. This is evident in the higher mortality rates in small-diameter classes. Species that are classified as early successional, such as aspen, gray birch, paper birch, and hawthorn species, should be expected to decline in importance as stands age, as is the case in New York.

Field crews attributed most beech mortality to disease. Though they did not specifically identify the disease, beech bark disease (BBD) has caused heavy mortality of beech throughout the Adirondack region (See separate section on this disease on page 102). Other species with high mortality rates likely due to nonnative insects or diseases are butternut and American elm.

On New York timberland, 94 percent of the balsam fir and 86 percent of the red spruce volume grows in the three Adirondack units. Field crews attributed 54 percent of fir mortality and 37 percent of red spruce mortality to weather. Because balsam fir and red spruce are shallow rooted, they are more susceptible to wind damage than associated species (Blum 1990). Along with crowding and suppression from surrounding trees, high morality of balsam fir and red spruce may be due to storm events including hurricane Irene in August 2011. Balsam fir, red spruce, and beech are primarily responsible for elevated mortality rates on timberland in the Adirondack units. In the Eastern Adirondack unit, high mortality lowered net growth and, in combination with high removals, resulted in a volume decrease since 2007.

Mortality rates vary between species with many species deviating substantially from the State average. Having a large diversity of species contributes to the overall resiliency of New York's forest to the impacts of insects and diseases that attack individual species.

Reserved Forest Land

Background

Reserved forest land is land in public ownership where the commercial harvesting of trees is prohibited. Reserved forest land includes State, county, and municipal parks; State owned "unique areas"; State owned historic sites; and forests managed by the National Park Service or the U.S. Fish and Wildlife Service. These forests are managed differently than timberland where various intensities of harvesting often are practiced. Although harvesting is prohibited on reserve forest land, much of it was harvested prior to public ownership. Trees on these lands contribute to watershed protection, recreational enjoyment, habitat for certain wildlife, and carbon storage. Therefore forest health and changes in species composition are of interest to forest managers, and though natural processes for the most part are allowed to function without interference, these forests can be threatened by exotic insect pests and diseases introduced by man, air pollution, and climate change, as well as natural disturbances such as wildfire, and wind, and ice storms. In New York, most reserved forest land is classified as Forest Preserve in the State owned portion of the Adirondack State Park. The 2012 inventory completed the remeasurement of plots first measured during the 2007 inventory cycle. Prior to the 2007 inventory cycle, plots were not established on reserve forest land in the Catskill-Lower Hudson and three Adirondack units.

What we found

There are 3.1 million acres of reserved forest land in New York and 97 percent is owned by the State. These forests are composed of stands of larger size and higher stocking levels than that on timberland in the State. On reserved forest land, 79 percent of stands are sawtimber size and only 3 percent are in seedling/sapling and nonstocked stands. This compares to timberland where 60 percent are in sawtimber-size stands and 13 percent in seedling/sapling nonstocked stands. On reserved forest land, only 3 percent of stands are classified as poorly stocked or nonstocked whereas on timberland 13 percent are so classified.

Seventy-seven percent of the reserved forest land acreage is made up of the 2.4 million acres (does not include the area covered by water) that comprise the state-owned Adirondack Forest Preserve in the Adirondack Park. Since 2007, the net volume of trees on these acres increased by 2.6 percent. This is less than the 4.4 percent increase on timberland in the State, but higher than the 1 percent increase on timberland in the Adirondack units in which the Park is located (Table 8, Fig. 1). Volume increases on Adirondack reserved forest land were impacted by high mortality rates. Mortality averages 1.6 percent annually, resulting in a net growth rate of 0.4 percent.

On a per-acre basis, the volume of live trees on Adirondack Park reserved forest land averaged 2,536 cubic feet per acre. This compares to an average of 1,901 cubic feet per acre on timberland inside the Adirondack Park boundary. Inside the Park, annual mortality averaged 39.8 cubic feet per acre and net growth averaged 8.5 cubic feet per acre on reserved forest land compared to that on timberland inside the Park of 27.5 cubic feet per acre (mortality) and 27.3 cubic feet per acre (net growth).

On reserved forest land in the Adirondack units, there are substantial differences between the species composition of trees in the smaller diameter classes and those in the larger diameter classes (Fig. 54). In diameter classes 18 inches and larger, yellow birch, sugar maple, red maple, and white pine represent 71 percent of the trees, whereas they only comprise 10 percent of saplings (trees 1 to 4.9 inches d.b.h.). Most saplings are beech, balsam fir, and red maple. Together these three species comprise 75 percent

Table 8.—Net volume, annual mortality rate, and annual net growth rate of top 10 species by net volume on State owned reserved forest land in the Adirondack units, New York, 2008-2012

	Volume (ft^3 millions)	Sampling error (percent)	Pecent change in volume 2007-2012*	Annual mortality rate (percent)	Annual net growth rate (percent)
Sugar maple	1,188	7.8	4.2	1.2	0.3
Yellow birch	973	7.2	-0.1	1.6	-0.4
Red maple	841	7.1	1.6	1.4	0.4
American beech	694	7.1	10.2	2.1	1.0
Red spruce	651	9.2	1.1	1.2	0.7
Eastern hemlock	429	14.0	6.8	0.5	1.2
Eastern white pine	333	22.4	5.0	0.5	1.6
Balsam fir	260	13.9	2.4	4.0	0.4
Paper birch	190	15.2	-13.5	4.2	-3.1
Black cherry	147	26.7	4.3	0.8	1.4
Ash	119	20.0	-2.1	2.2	-0.4
Aspen	41	30.8	-7.5	8.0	-7.2
Total all species	6,087	2.5	2.6	1.6	0.4

*Includes additions to reserve area

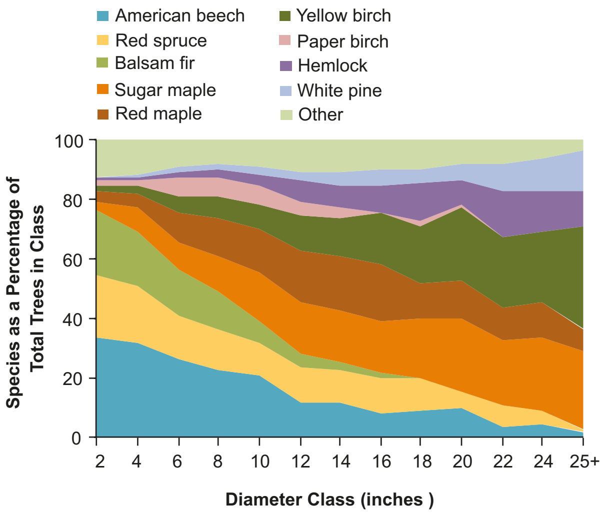

Figure 54.—Species composition by diameter class on State owned reserved forest land in the Adirondack units, New York, 2012. See Figure 1 for unit boundaries.

of the saplings (Fig. 55). Of the major species, beech had the largest increase in number of trees 5 inches and larger, whereas paper birch and white pine had decreases in trees 5-inches d.b.h. and larger (Fig. 56). Numbers of standing dead trees 5-inches d.b.h. and larger average 37 trees per acre on Adirondack Park reserved forest land, compared to 26 trees per acre on private timberland within Adirondack Park (Fig. 57).

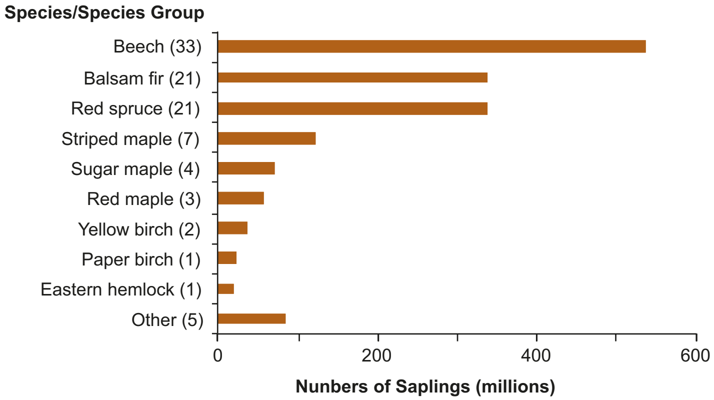

Figure 55.—Numbers of saplings by selected species on State owned reserved forest land in the Adirondack units, New York, 2012. Species number as a percent of all saplings shown in parentheses.

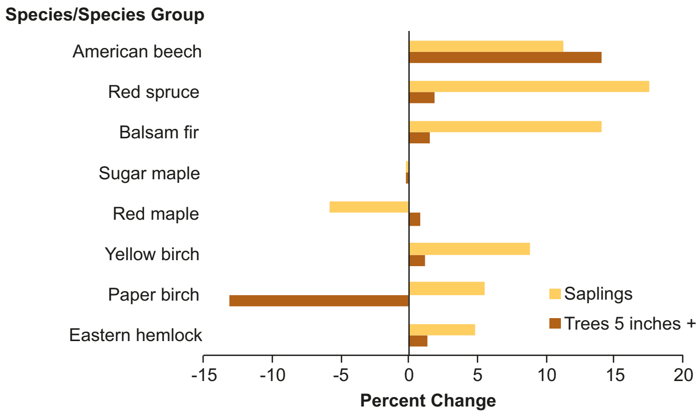

Figure 56.—Percentage change in numbers of trees of selected species for saplings and trees 5 inches d.b.h. and larger, on State owned reserved forest land in the Adirondack units, New York, 2007 to 2012.

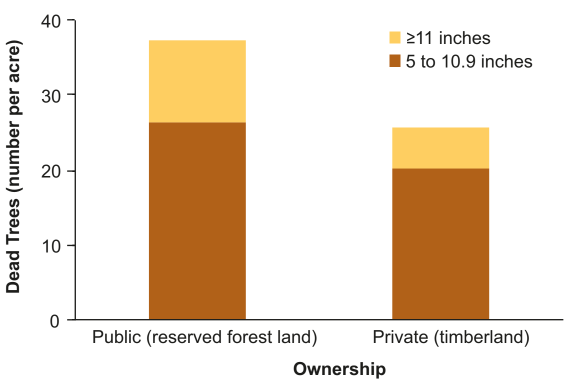

Figure 57.—Number of dead trees per acre on forest land inside the New York's Adirondack Park, by ownership, New York, 2012.

What this means

All reserved acreage is in public ownership (except a small area of private land where timber harvesting is prohibited by deed), and with few exceptions, most is available for public use for outdoor recreation. State and other public forests provide opportunities for activities such as hiking, hunting, fishing, and other outdoor activities that aren't easily accessed by the general public on private land. Reserved forest land also provides unique interior forest habitat for wildlife that differs in attributes such as species composition, stand size, stand density, and numbers of standing dead trees.

The 2.4 million acres of reserved forest land owned by the State and located in the three Adirondack units have greater per-acre volume and higher mortality than that on timberland, and though the volume of live trees will likely continue to increase, net growth is lower because of high mortality. Higher mortality rates on reserved forest land are not unexpected as harvesting is prohibited and mature trees are allowed to succumb to natural senescence and death. Growth rates in the Adirondack units are also lower because they generally have poorer soils and a colder climate than the rest of the State.

The species composition of reserved forests in the Adirondacks is changing. Red spruce, balsam fir, and beech are now the dominate sapling-size tree species. As these grow into the overstory, which is now predominantly yellow birch, sugar maple, and red maple, the composition of the overstory will transition to these species. Despite high mortality of balsam fir, it will likely continue to increase in importance because of the large number of saplings. These balsam fir saplings are well distributed in that half grow in stands other than the spruce/fir forest type they are typically associated with. Sugar maple is now the leading species in terms of inventory volume, and will likely continue to lead in volume for some time, but will eventually give way to other more prolific species. Beech saplings in the understory are likely interfering with the reproduction of other species, particularly sugar maple that it grows in association with. Declines in the numbers of paper birch, 5-inches in diameter and larger, are occurring rapidly as this species has the highest morality rate and few sapling size trees to replace those that die due to lack of widespread disturbance. Many of the changes occurring on reserved forest land in the Adirondacks are consistent with what would be expected in a maturing forest, although low numbers of small diameter hemlock trees seem to be inconsistent with this maturation.

Forest Indicators of Health and Sustainability

Beech bark disease commonly causes beech trees to breakoff above the ground—“beech snap”. Notice large numbers of beech trees in the understory—“beech brush”. Photo by Richard Widmann, U.S. Forest Service.

Tree Damage

Background

Tree damage is assessed for trees at least 5.0 inches d.b.h. Up to two damages can be recorded. If more than two damage agents are observed, decisions about which two are recorded are based on the relative abundance of the damaging agents (U.S. Forest Service 2012). The types of damage that are recorded include defoliation, foliage disease, cankers, decay, rot, fire, animal damage, weather, and logging damage.

What we found

Damage was recorded on approximately 29 percent of the trees in New York, but there is considerable variation between species (Table 9). The most frequent damage on all species was decay (16 percent of trees). Decay ranged from 6 percent or less on conifer species to up to 25 percent on red maple. Notably, branch or shoot damage from insects was present on 62 percent of white pine trees (Fig. 58) and cankers were present on 55 percent of American beech trees. The occurrence of all other injury types was very low.

What this means

Decay was the most commonly observed damage which is not unusual given that the majority of New York's forests are composed of mature trees. The high incidence of white pine damage is due to the accumulation of deformed stems caused by the native white pine weevil (*Pissodes strobe*). Although the weevil damage does not typically kill trees, the form and quality of saw logs is impacted as evidenced by the increasing

Table 9.—Percentage of trees with damage by species on forest land, New York, 2012

	Damage Type						
Species	None	Insect damage	Cankers	Decay	Animal	Weather	Logging/ human
American beech	26	0	55	17	1	1	1
Eastern white pine	30	62	0	6	1	1	1
Sugar maple	68	7	1	20	0	1	2
Red maple	70	0	1	25	0	2	1
Black cherry	70	1	2	23	0	2	1
Yellow birch	75	0	2	19	0	2	1
White ash	82	0	1	14	0	2	1
Northern red oak	88	0	0	10	0	1	1
Eastern hemlock	88	0	0	5	2	2	1
Red spruce	94	0	0	4	0	2	1
All	71	4	6	16	1	2	1

proportion of damaged trees that fall into the poorer quality trees, in grades 3, 4, and 5 (Fig. 58). The high frequency of cankers on American beech is due to the long history of beech bark disease in the region.

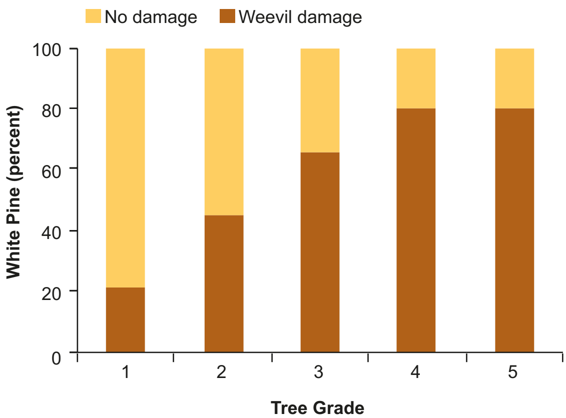

Figure 58.—Percentage of sawtimber size white pine trees by tree grade with or without weevil damage on forest land, New York, 2012.

Crown Health

Background

The crown condition of trees is influenced by various biotic and abiotic stressors. Abiotic stressors include drought, flooding, cold temperatures or freeze injury, nutrient deficiencies, soil physical properties affecting soil moisture and aeration, or toxic pollutants. Biotic stressors include native or introduced insects, diseases, invasive plant species, and animals.

Invasions by exotic diseases and insects are one of the most important threats to the productivity and stability of forest ecosystems around the world (Liebhold et al. 1995, Pimentel et al. 2000, Vitousek et al. 1996). Over the last century, New York's forests have suffered the effects of native insect pests such as forest tent caterpillar (*Malacosoma disstria*) and well-known exotic invasive agents such as Dutch elm disease (*Ophiostoma ulmi*), chestnut blight (*Cryphonectria parasitica*), European gypsy moth (*Lymantria dispar*), hemlock woolly adelgid, and the beech bark disease complex. More recent invasions include emerald ash borer, Asian longhorned beetle (*Anoplophora glabripennis*), and Sirex wood wasp (*Sirex noctilio*).

Tree-level crown dieback is collected on a subset of Phase 2 (P2) plots. Crown dieback is defined as recent mortality of branches with fine twigs and reflects the severity of recent stresses on a tree. A crown was labeled as 'poor' if crown dieback was greater than 20 percent. This threshold is based on findings by Steinman (2000) that associated crown ratings with tree mortality. Additionally, crown dieback has been shown to be the best crown variable to use for predicting tree survival (Morin et al. 2012).

What we found

The incidence of poor crown condition is very low in New York (Fig. 59). The only species with more than 2 percent of live basal area containing poor crowns is white ash (Table 10). Additionally, the proportion of basal area with poor crowns has dropped for nearly all species since 2007.

Mean dieback ranged from 1 percent for eastern white pine to 4 percent for black cherry (Table 11). An analysis of the trees from the 2007 inventory that were remeasured in the 2012 inventory revealed that the proportion of the trees that die increases with increasing crown dieback (Fig. 60). Over 50 percent of trees with crown dieback above 20 percent during the 2007 inventory were dead when visited again during the 2012 inventory.

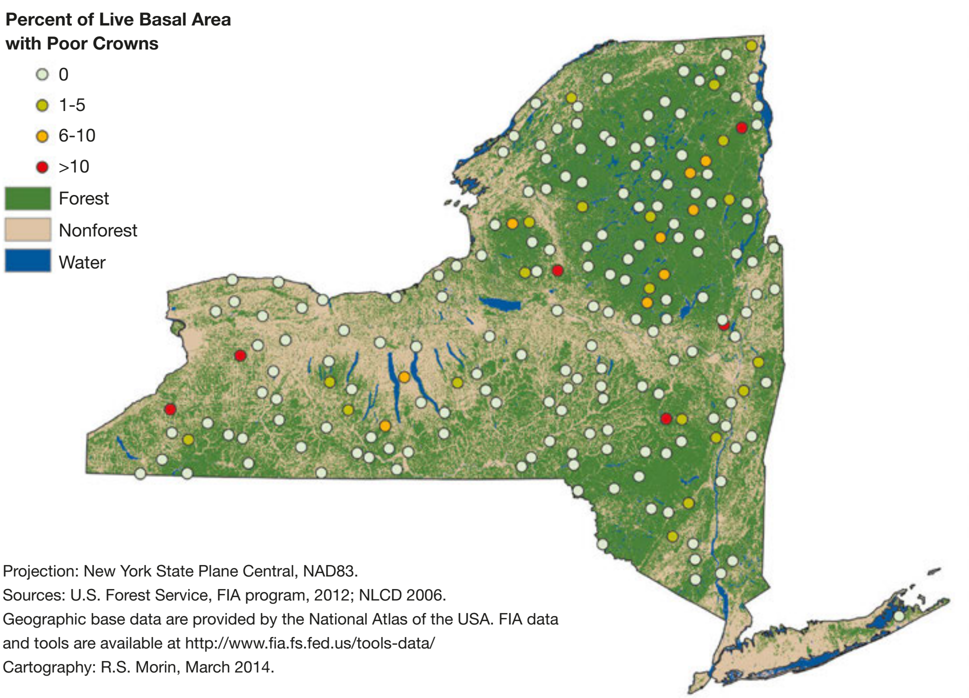

Figure 59.—Plot location and percentage of live basal area for trees with poor crowns, New York, 2012. Approximate plot locations depicted.

Table 10.—Percent of live basal area with poor crowns, New York, 2007 and 2012

Species	Basal Area with Poor Crowns 2007	2012
	percent	
White ash	4.5	3.3
American beech	9.0	1.7
Sugar maple	1.3	1.6
Red maple	1.2	1.4
Yellow birch	0.3	1.0
Black cherry	3.3	0.9
Eastern hemlock	0.4	0.4
Eastern white pine	0.2	0.0
Red spruce	0.2	0.0
Northern red oak	0.3	0.0

Table 11.—Mean crown dieback and other statistics for live trees (>5 inches d.b.h.) on forest land by species, New York, 2012

Species	Trees	Mean	SE
	number	*percent*	
Black cherry	124	3.5	0.7
American beech	439	3.3	0.2
White ash	280	3.2	0.6
Sugar maple	547	2.8	0.3
Red maple	873	2.7	0.2
Yellow birch	168	2.1	0.3
Northern red oak	144	1.8	0.2
Red spruce	224	1.2	0.2
Eastern hemlock	362	1.0	0.3
Eastern white pine	277	0.8	0.1

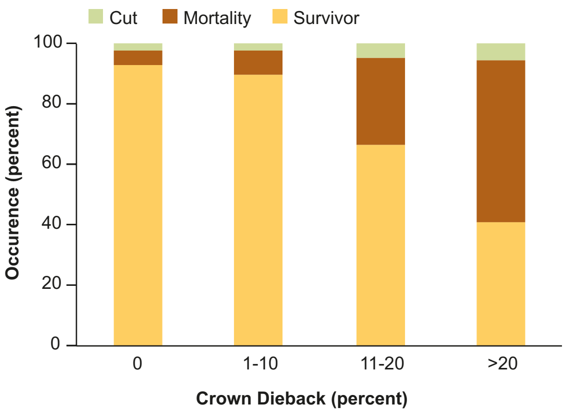

Figure 60.—Crown dieback distribution by tree survivorship for remeasured trees, New York, 2007 to 2012.

What this means

The trees in the forests of New York are generally in good health indicating that none of the aforementioned damaging agents are causing widespread declines. However, the health of trees should continue to be monitored in order to quantify the impacts of hemlock woolly adelgid and beech bark disease as well as the potential impacts of emerald ash borer and Asian longhorned beetle.

Vegetation Diversity

Background

The diversity of plant life is an essential foundation of terrestrial forest ecosystems. Plants convert the sun's energy into cellulose/carbon, provide food for animals (including humans), and are a fuel source. Some animals are species-specific and require the presence of a certain plant for survival (e.g., various butterfly larvae). Plants also help filter pollutants, stabilize soil, and increase nitrogen availability. A survey of the plant community can provide information about disturbance, nutrient availability, and water table depth. In New York, vegetation data was collected on about 6 percent of the Phase 3 (P3) field plots from 2008 to 2010. This resulted in a survey of 117 plots which describe the vegetation structure of the forest.

What we found

New York's forests support a diverse mix of flora. Crews found 695 identifiable species with an additional 67 that were identified at the genus level. After analyzing the 50 most commonly observed identifiable species (species found on 26 or more plots), we found 52 percent were classified as forbs/herbs (Fig. 61) (NRCS 2014). Trees and shrubs also made up a large portion of the species observed each representing 20 percent of the top 50 identifiable species. Of these 50 identifiable species, 86 percent were native species of the lower 48 states, 10 percent were introduced, and 4 percent were native and introduced, a category where some, below the level of species, are native and others are introduced (Fig. 62) (NRCS 2014). The presence of nonnative plant species in the forest community is a concern when they interfere with the growth of native species and how ecosystems function. Differing from invasive plant species, which can be native or nonnative and are discussed in the next section of this report, the list of nonnative plant species contains only species that have been

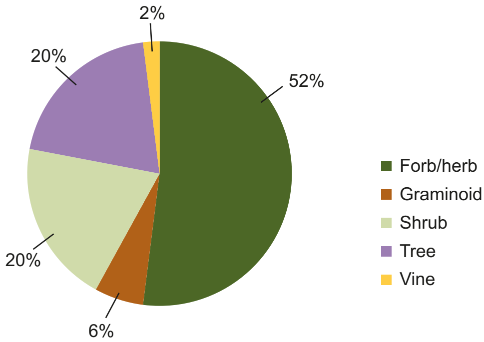

Figure 61.—Growth forms of the top 50 identifiable species on New York P3 plots, 2008-2010.

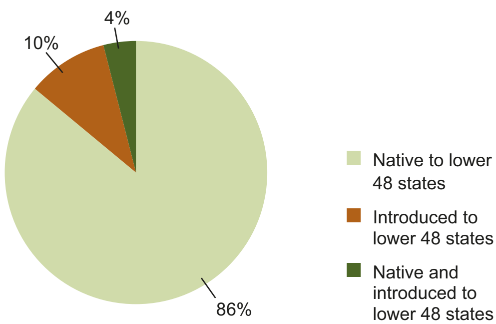

Figure 62.—Origin of the top 50 identifiable species on New York P3 plots, 2008-2010.

introduced to the lower 48 states. The nonnative species most commonly observed in New York was American red raspberry (*Rubus idaeus*) (origin: native and introduced below the species level), which was found on 42 percent of the P3 plots.

The 20 most frequently observed species are listed in Table 12. Included on the list are eight species of trees and six species of ferns. The three most common identifiable species were trees. Red maple, the most commonly observed species, was found on nearly 80 percent of the inventory plots. Since the previous 2007 inventory, beech has moved from being the fourth most frequent species to being the third. It is important to monitor these changes and trends in the future as our forests face threats from insects and disease, climate, and fragmentation.

Table 12.—The 20 most commonly occurring identifiable plant species found on P3 plots, the number and percentage of plots on which each species was observed, New York, 2008-2010

Species	Latin name	Number of plots	Percentage of plots	Sampling error
Red maple	*Acer rubrum*	93	79	3.7
Sugar maple	*Acer saccharum*	82	70	4.2
American beech	*Fagus grandifolia*	74	63	4.5
Canada mayflower	*Maianthemum canadense*	69	59	4.6
White ash	*Fraxinus americana*	68	58	4.6
Black cherry	*Prunus serotina*	61	52	4.6
Striped maple	*Acer pensylvanicum*	56	48	4.6
Intermediate woodfern	*Dryopteris intermedia*	50	43	4.6
American red raspberry	*Rubus idaeus*	49	42	4.6
Starflower	*Trientalis borealis*	49	42	4.6
Sensitive fern	*Onoclea sensibilis*	46	39	4.5
Common yellow oxalis	*Oxalis stricta*	44	38	4.5
Wrinkleleaf goldenrod	*Solidago rugosa*	44	38	4.5
Eastern hemlock	*Tsuga canadensis*	44	38	4.5
Common gypsyweed	*Veronica officinalis*	44	38	4.5
Yellow birch	*Betula alleghaniensis*	43	37	4.5
Eastern hayscented fern	*Dennstaedtia punctilobula*	43	37	4.5
New York fern	*Thelypteris noveboracensis*	43	37	4.5
Spinulose woodfern	*Dryopteris carthusiana*	41	35	4.4
Chokecherry	*Prunus virginiana*	41	35	4.4

What this means

New York's forests support a diverse plant community that supports a diverse mix of forbs/herbs, graminoids, shrubs, trees, and vines. Gathering data on vegetation communities provides key information on site and habitat quality and species distribution. Obtaining future survey data will help us improve our understanding of forest plant communities and increase our knowledge of the factors that influence the presence of various species groups. There were 695 identifiable plant species that were observed on P3 plots and consist of both native and nonnative species. The presence of nonnative and invasive plants within the forest community is problematic because they can displace the native plants that flora depend on. Invasive plants are a widespread concern because they have characteristics, such as high seed production and rapid growth, which allow them to quickly spread through the forest understory.

Invasive Plant Species

Background

Invasive plant species (IPS) are a concern throughout the world. Some invasive plants are alternate hosts for insects and diseases and can cause severe agricultural impacts. Their presence also affects forest structure, health, and diversity. These invaders often form very dense colonies that limit light, nutrient, and water availability. These plants may have beneficial characteristics, such as providing habitat or aesthetics. Autumn olive and Russian olive were widely planted to restore degraded lands and for wildlife habitat as they fix nitrogen in the soil and produce abundant fruit. Norway maple and Japanese barberry are commonly used for landscaping material. The negative impacts to our ecosystems are worrisome. Annually, these intruders cost billions of dollars through monitoring and removal. Because of the vast implications caused by these IPS, it is important to increase awareness through informing and educating individuals.

What we found

From 2008 to 2012, 606 P2 invasive plots were monitored in New York for the presence of 43 IPS and one undifferentiated genus (*Lonicera*; nonnative bush honeysuckles) (Table 13). Three hundred and nine of the plots had IPS present (51 percent) and 33 different invasive species were observed (Table 14). The most commonly observed IPS was multiflora rose (*Rosa multiflora*), which was found in the central and southern part of the State (Fig. 63) and Morrrow's honeysuckle (*Lonicera morrowii*) (Fig. 64), which was observed throughout the State with the exception of the heavily forested northern part of the State. Multifora rose was found on 178 plots (29 percent) and Morrow's honeysuckle was found on 160 plots (26 percent). The greatest number of invasive plant species observed on a plot was 10 (Fig. 65). The data suggest that when invasive plants were present, there are fewer seedlings and saplings (Fig. 66) and a lower tree basal area is observed (Fig. 67) compared to plots without invasive species. However, this may not necessarily mean that the IPS are reducing regeneration but may instead be due to the plants establishing in areas where there is less competition and more light available. Also, most IPS are not preferred browse for white-tailed deer whereas many tree species are heavily browsed.

In the previous report for New York, which covered the 2007-2008 P2 invasive plot data (Widmann et al. 2013), 27 of the invasive species monitored were observed. In the 2012 inventory, the number of IPS observed on P2 Invasive plots increased to 33, however the 2007 survey for invasive plants did not include the genus *Lonicera* (nonnative bush honeysuckles). The four most commonly observed IPS remained the same: multiflora rose, Morrow's honeysuckle, common buckthorn, and garlic mustard.

What this means

Nearly 51 percent of the plots in New York had one or more of the monitored IPS. In the nearby states of Vermont and New Hampshire, Morin et al. (2015) reported the presence of invasive plants in 24.5 percent of Vermont plots and 11.2 percent of New Hampshire plots. The relatively high number of IPS across New York is a concern as these invaders can cause detrimental forest changes. These plants can change hydrology, displace native species, and reduce the visual aesthetics of an area.

Table 13.—The list of 43 invasive plant species and one undifferentiated genus monitored on FIA P2 invasive plots, 2007 to present

Tree Species
Black locust *(Robinia pseudoacacia)*
Chinaberry *(Melia azedarach)*
Norway maple *(Acer platanoides)*
Russian olive *(Elaeagnus angustifolia)*
Princesstree *(Paulownia tomentosa)*
Punktree *(Melaleuca quinquenervia)*
Saltcedar *(Tamarix ramosissima)*
Siberian elm *(Ulmus pumila)*
Silktree *(Albizia julibrissin)*
Tallow tree *(Triadica sebifera)*
Tree of heaven *(Ailanthus altissima)*

Woody Species
Amur honeysuckle *(Lonicera maackii)*
Autumn olive *(Elaeagnus umbellata)*
Common barberry *(Berberis vulgaris)*
Common buckthorn *(Rhamnus cathartica)*
European cranberrybush *(Viburnum opulus)*
European privet *(Ligustrum vulgare)*
Glossy buckthorn *(Frangula alnus)*
Japanese barberry *(Berberis thunbergii)*
Japanese meadowsweet *(Spiraea japonica)*
Morrow's honeysuckle *(Lonicera morrowii)*
Multiflora rose *(Rosa multiflora)*
Nonnative bush honeysuckle (*Lonicera* spp.)
Showy fly honeysuckle (*Lonicera x bella*)
Tatarian honeysuckle (*Lonicera tatarica*)

Vine Species
English ivy *(Hedera helix)*
Japanese honeysuckle *(Lonicera japonica)*
Oriental bittersweet *(Celastrus orbiculatus)*

Herbaceous Species
Black swallow-wort *(Cynanchum louiseae)*
Bull thistle *(Cirsium vulgare)*
Canada thistle *(Cirsium arvense)*
Creeping jenny *(Lysimachia nummularia)*
Dames rocket *(Hesperis matronalis)*
European swallow-wort *(Cynanchum rossicum)*
Garlic mustard *(Alliaria petiolata)*
Giant knotweed *(Polygonum sachalinense)*
Japanese knotweed *(Polygonum cuspidatum)*
Leafy spurge *(Euphorbia esula)*
Bohemian knotweed *(Polygonum x bohemicum)*
Purple loosestrife *(Lythrum salicaria)*
Spotted knapweed (*Centaurea stoebe* ssp. *micranthos*)

Grass Species
Common reed *(Phragmites australis)*
Japanese siltgrass *(Microstegium vimineum)*
Reed canarygrass *(Phalaris arundinacea)*

Heavily infested areas may result in a reduction in wildlife habitat and invasives such as Japanese siltgrass (*Microstgium vimineum*), which thrive after disturbances, can interfere with tree regeneration. Invasive plants can make timber management more difficult, as it may necessitate measures to control invasives before trees species can be re-established after timber harvesting. Once established, IPS can rapidly spread and impact co-occurring native plant species. With the increased occurrence of IPS in this inventory, it is important that the presence and spread of these species are monitored. Through continual monitoring of invasive species, managers will be aware of the presence of these aggressive species and be able to make more informed management decisions.

Table 14.—Invasive plant species observed on FIA P2 invasive plots, New York, 2012

Species	Number of plots	Percentage of plots
Multiflora rose	178	29.4
Morrow's honeysuckle	160	26.4
Common buckthorn	107	17.7
Garlic mustard	79	13
Nonnative bush honeysuckles	46	7.6
Japanese barberry	43	7.1
Creeping jenny	36	5.9
Reed canarygrass	25	4.1
Black locust	24	4
Autumn olive	20	3.3
Glossy buckthorn	17	2.8
Dames rocket	16	2.6
Oriental bittersweet	16	2.6
Norway maple	11	1.8
European privet	11	1.8
Tatarian honeysuckle	9	1.5
Common reed	9	1.5
Bull thistle	8	1.3
Amur honeysuckle	8	1.3
Purple loosestrife	7	1.2
Japanese knotweed	7	1.2
Nepalese browntop	6	1
Tree of heaven	5	0.8
Canada thistle	7	1.2
Common barberry	7	1.2
Showy fly honeysuckle	7	1.2
European cranberrybush	2	0.3
Japanese honeysuckle	2	0.3
Louise's swallow-wort	2	0.3
Spotted knapweed	1	0.2
Leafy spurge	1	0.2
Chinaberry	1	0.2
European swallow-wort	1	0.2

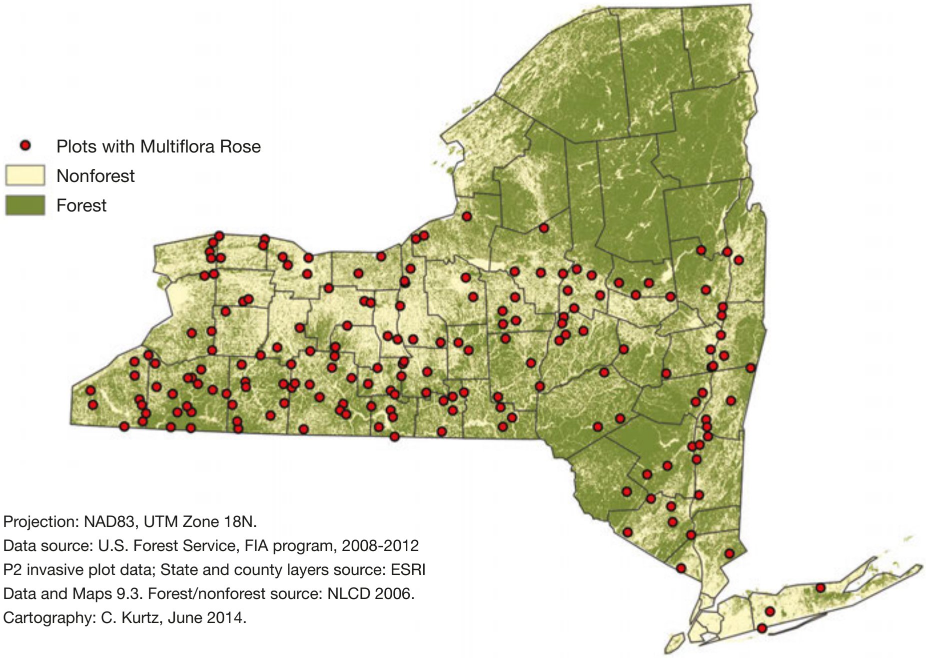

Figure 63.—Distribution of multiflora rose on FIA P2 invasive plots, New York, 2012. Approximate plot locations depicted.

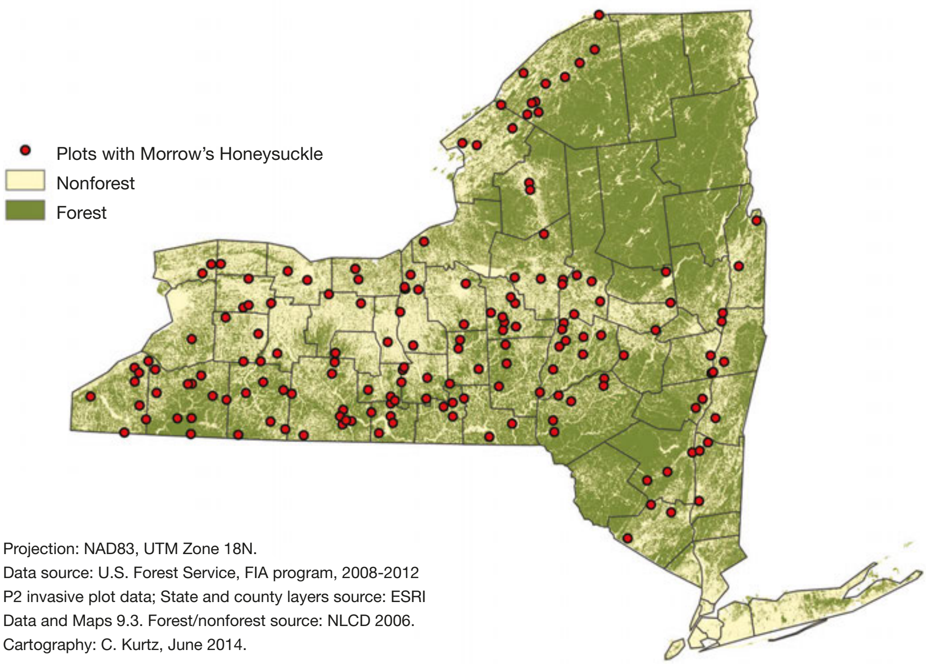

Figure 64.—Distribution of Morrow's honeysuckle on FIA P2 invasive plots, New York, 2012. Approximate plot locations depicted.

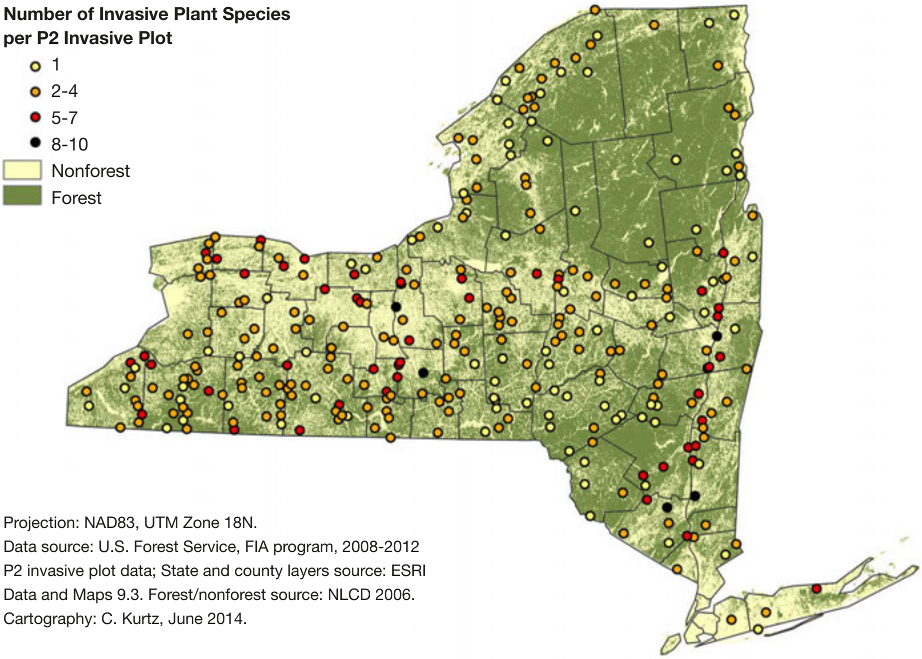

Figure 65.—Number of invasive plant species observed on FIA P2 invasive plots, New York, 2012. Approximate plot locations depicted.

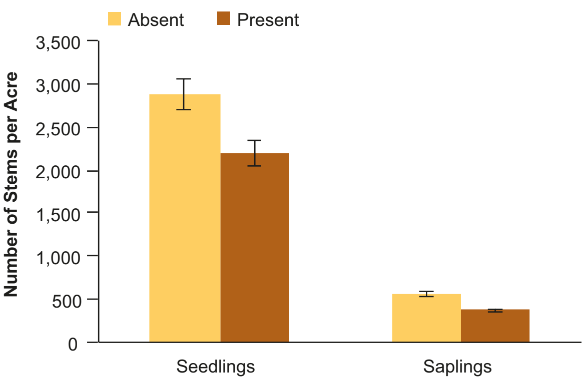

Figure 66.—Number of seedlings and saplings per acre on FIA P2 invasive plots with invasive plant species present and absent, New York, 2012. Error bars represent 68 percent confidence intervals around the estimated mean.

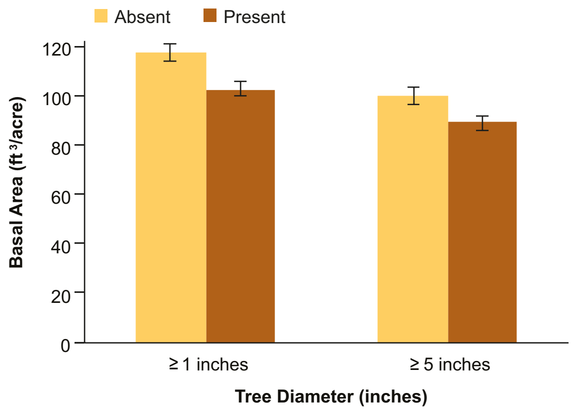

Figure 67.—Basal area on FIA P2 invasive plots with invasive plant species present and absent, New York, 2012. Error bars represent 68 percent confidence intervals around the estimated mean.

Wildlife Habitats

Forests provide habitats for many species of New York birds (163), mammals (49), and amphibians and reptiles (40) (NatureServe, n.d.). Different forest types at different structural stages provide natural communities (habitats) at a "coarse filter" scale of conservation. Rare, imperiled, or wide-ranging wildlife species may not be fully served at this scale, so a "fine filter" approach is used to identify species-specific conservation needs. Representing an intermediate or "meso-filter" scale of conservation are specific habitat features (e.g., snags, riparian forest strips), which may serve particular habitat requirements for multiple species. This report characterizes habitats at the coarse-filter scale (forest age/size) and meso-filter scale (standing dead trees).

Like all states, New York has developed a State wildlife action plan (SWAP). The plan (NY DEC, n.d.a) identifies species of greatest conservation need (SGCN), and focal habitats. SGCN species include early successional forest and shrubland breeding birds, and boreal forest species. The SGCN list contains few species dependent on mid-successional forests, but several that require early- or late-successional habitats. We report on the condition and trends in forest attributes of forest age and size. One of the fine scale conservation issues associated with forest habitats is the presence and abundance of snags and nest cavities. We report on the quantity and distribution of standing dead trees.

Forest Age and Size

Background

Some species of wildlife depend on early successional forests comprised of smaller, younger trees, while other species require older, interior forests containing large trees with complex canopy structure. Yet other species inhabit the ecotone (edge) between different forest stages, and many require multiple structural stages of forests to meet the needs during different phases of their life. Boreal forest bird SGCN are represented by spruce grouse (*Falcipennis canadensis*) and olive-sided flycatcher (*Contopus cooperi*). Spruce grouse prefer a mixture of older and younger coniferous forest. Maturation of forest is attributed as a cause of declines for these species. Similarly, the New England cottontail (*Sylvilagus transitionalis*) is a SGCN dependent on early successional habitat resulting from natural- and human-based forest canopy disturbances, as are American woodcock, (*Scolopax minor*) golden-winged warbler (*Vermivora chrysoptera*), and other bird species. American marten (*Martes americana*) is a mammal SGCN that relies on northern coniferous and mixed deciduous/coniferous forests of New York. The SWAP states that "Since marten and their prey consume beechnuts, changes in forest health (e.g., the spread of beech bark disease) may have long-term negative consequences on marten populations." Abundance and trends in structural and successional stages serve as indicators of population carrying capacity for wildlife species (Hunter et al. 2001). Historical trends in New York's forest habitats are reported for timberland, which comprises about 84 percent of all forest land in the state. For current habitat conditions, estimates are reported for all forest land.

What we found

Abundance of large diameter stands has increased steadily in New York during the past several decades (with the exception of 1968) comprising 42 percent of timberland in 1953, and nearly 60 percent today. Apart from a sharp decrease in 1968 and corresponding increase in 1980, the medium diameter stand-size class remained stable. Small diameter size stands increased substantially between 1953 and 1968, then declined during each of the next several decades (Fig. 68). Since 1993, timberland area younger than 20 year years has decreased by half (Fig. 69). Area in other age classes changed moderately, increasing in some classes while decreasing in others. Timberland older than 100 years comprised the smallest area of any age class, a pattern that has been consistent over the past two decades.

In New York, all three stand-size classes contain forests of multiple ages. The medium stand-size class is predominated by forests of 41 to 80 years of age, with lower amounts of both younger and older forest. The most abundant age classes in small diameter forest are 0 to 20 and 21 to 40 year class, with decreasing abundance as stand age increases (Fig. 70). The opposite trend is not true for large diameter stand-size class, where forest of 61 to 100 years stand age predominates over both younger and older forests.

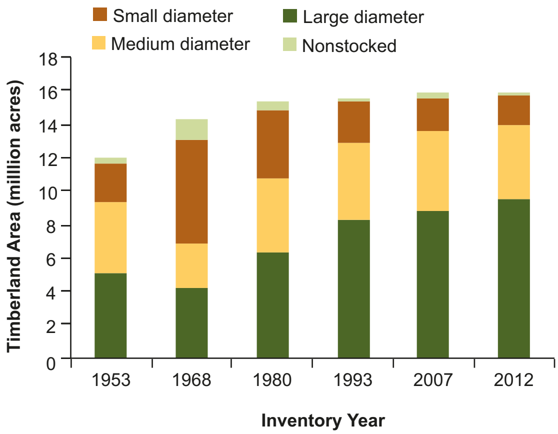

Figure 68.—Area of timberland by stand-size class and inventory year, New York.

Figure 69.—Area of timberland by stand-age class and inventory year, New York.

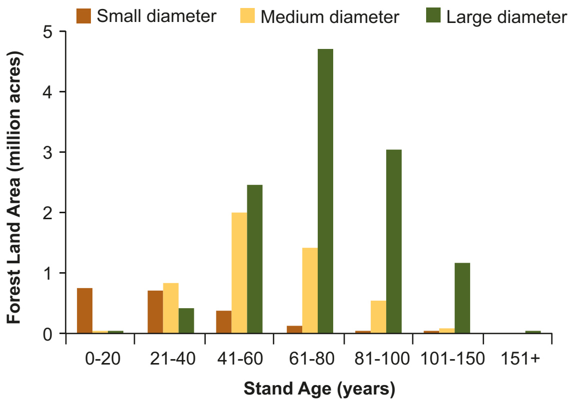

Figure 70.—Area of forest land by age class and stand-size class, New York, 2012.

What this means

Although the large diameter stand-size class has increased markedly over the past six decades, timberland area over 100 years of age has actually decreased slightly during the past two decades, and comprises only 4 percent of all forest land; only 6 percent of large diameter stands are older than 100 years. The selective harvesting of large diameter trees from stands has likely slowed increases in the area of stands older than 100 years, that otherwise would be expected over time. The small diameter stand-size class comprises slightly more area than during the 1950s, but only a fraction of the peak of 1968. Both stand-size class and stand-age class are indicators of forest structural/successional stage. Forests between 21 and 100 years of age contain at least some fraction of all three stand-size classes. There is virtually no small diameter forest in the oldest stand-age classes, and very little large diameter forest in the youngest stand age. Two age classes with most size heterogeneity are 21 to 40 and 41 to 60 year classes. Such mixtures of differently aged or sized trees provide a vertical diversity of vegetation structure that can enhance habitat conditions for some species. Though seemingly contradictory, there is a need to maintain forest conditions in both smaller and larger structural stages to maintain both early and late successional habitats for all forest-associated species. Managing forest composition and structure in a variety of conditions should conserve habitat and viable populations of many forest-associated wildlife species.

Standing Dead Trees

Background

Specific habitat features like nesting cavities and standing dead trees provide critical habitat components for many forest-associated wildlife species. Standing dead trees that are large enough to meet habitat requirements for wildlife are referred to as 'snags'. According to one definition, "for wildlife habitat purposes, a snag is sometimes regarded as being at least 10 inches in diameter at breast height and at least 6 feet tall" (Society of American Foresters, n.d.). Within openings in conifer stands, olive-sided flycatchers (*Contopus cooperi*) use residual standing snags for singing perches. Standing dead trees serve as important indicators not only of wildlife habitat, but also for past mortality events and carbon storage. They also serve as sources of down woody material that also provide habitat features for wildlife. The number and density of standing dead trees, together with decay classes, species, and sizes, define important wildlife habitat features across New York's forests.

What we found

FIA collects data on standing dead trees (at least 5 inches d.b.h.) of numerous species and sizes in varying stages of decay. More than 412 million standing dead trees were found on New York forest land. This equates to an overall density of 21.7 standing dead trees per acre of forest land, with higher densities on public (33.7) than on private (19.4) forest land. Three species contributed more than 30 million standing dead trees. Red maple contributed the most, with more than 50 million (Fig. 71). Relative to the total number of live trees in each species, nine species exceeded 20 standing dead trees per 100 live trees (at least 5 inch d.b.h.), with gray birch and American elm topping the list with standing dead trees about half the number of live trees (at least 5 inch d.b.h.) (Fig. 72). Seventy-nine percent of standing dead trees were smaller than 11 inches d.b.h., 39 percent were between 5 and 6.9 inches d.b.h., and less than 5 percent over 17 inches (Fig. 73). Only 2 percent of standing dead trees were in the class of most decay (no evidence of branches remain); the remaining four decay classes were fairly evenly distributed, ranging from 17 to 33 percent of all standing dead trees.

What this means

Snags and smaller standing dead trees result from a variety of potential causes, including diseases and insects, weather damage, fire, flooding, drought, and

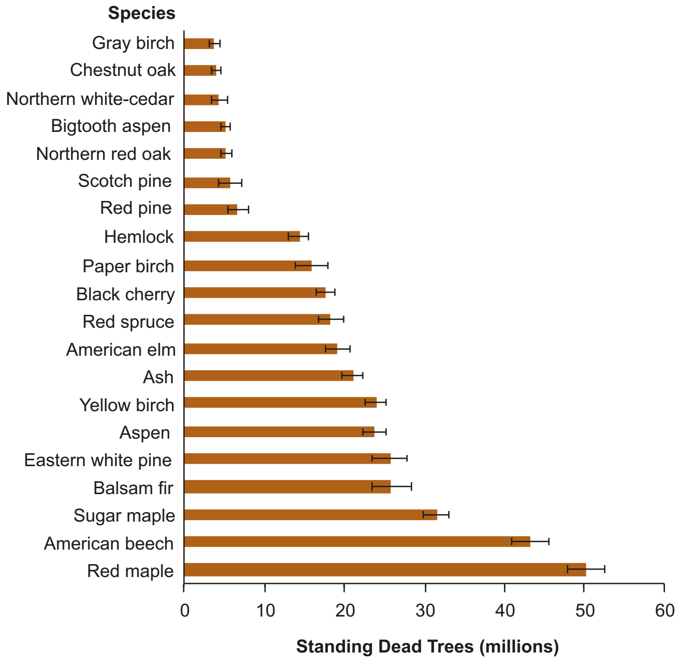

Figure 71.—Number of standing dead trees, 5 inches d.b.h. and larger, by species, New York, 2012. Error bars represent 68 percent confidence intervals around the estimated mean.

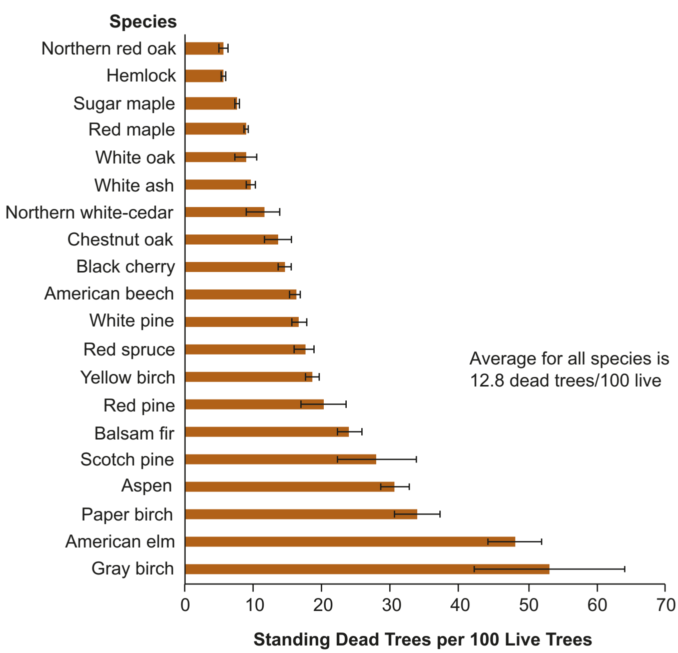

Figure 72.—Number of standing dead trees, 5 inches d.b.h. and larger, per 100 live trees by species, New York, 2012. Error bars represent 68 percent confidence intervals around the estimated mean.

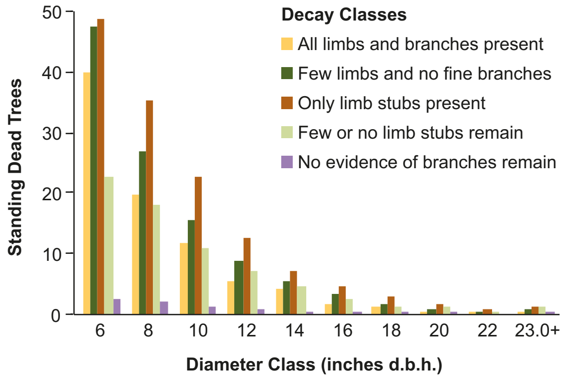

Figure 73.—Distribution of standing dead trees by decay and diameter class for all dead trees, New York, 2012.

competition, and other factors. Relative to total number of live trees, the number of standing dead trees is small, but dead trees may contain substantially more cavities per tree than occur in live trees (Fan et al. 2003). Standing dead trees provide areas for foraging, nesting, roosting, hunting perches, and cavity excavation for wildlife, from primary colonizers such as insects, bacteria, and fungi to birds, mammals, and reptiles. Most cavity nesting birds are insectivores which help to control insect populations. The availability of very large snags may be a limiting meso-scale habitat feature for some species of wildlife. Providing a variety of forest structural stages and retaining specific features like snags on both private and public lands are ways that forest managers maintain the abundance and quality of habitat for forest-associated wildlife species in New York.

Tree Species of Concern in New York

The harvesting of trees has become more mechanized in New York. Photo courtesy of New York Department of Environment and Conservation, used with permission.

American Beech and Beech Bark Disease

Background

American beech is a major component of the maple/beech/birch forest-type group, which makes up 56 percent of the forests in the State. New York has more beech volume than any other state. Forests with the highest proportion of American beech volume are found in the most mountainous portions of the State (Fig. 74). American beech is used for forest products and is important to wildlife due to the hard mast that it produces. Beech bark disease (BBD) is an insect-fungus complex involving the beech scale insect (*Cryptococcus fagisuga*) and the exotic canker fungus *Neonectria coccinea* var. *faginata.* or the native *Neonectria galligena* that kills or injures American beech. BBD was inadvertently introduced via ornamental beech trees into North America at Halifax, Nova Scotia, in 1890 and then began spreading across New England. By 1960, eastern New York was infested and by 1975 the entire state was infested. Three phases of BBD are generally recognized: (1) the “advancing front”, which corresponds to areas recently invaded by scale populations; (2) the “killing front”, which represents areas where fungal invasion has occurred (typically 3 to 5 years after the scale insects appear, but sometimes as long as 20 years) and tree mortality begins; (3) the “aftermath forest”, which are areas where the disease is endemic (Houston 1994, Shigo 1972).

What we found

Currently, the annual mortality rate for American beech (1.9 percent) is substantially higher than that for all trees (1.1 percent) in New York (Fig. 53). The impacts of BBD on mortality of large diameter beech have steadily skewed the diameter distribution of beech toward smaller trees since 1983 (Fig. 75). Beech trees larger than 15 inches d.b.h. have become increasingly rare in New York, and beech trees larger than 29 inches d.b.h. have been completely eliminated.

What this means

Since New York’s forests have been infested by BBD for over 35 years, beech forests are in the aftermath phase of BBD. Aftermath forests are often characterized by a dearth of large beech trees due to past BBD mortality which is associated with large amounts of beech seedlings and saplings. This condition, often referred to as “beech brush,” can interfere with regeneration of other hardwood species such as sugar maple (Hane 2003) and is made up of trees with low vigor, slow growth, and often consisting of root suckers that in many instances succumb to the disease before growing into the overstory.

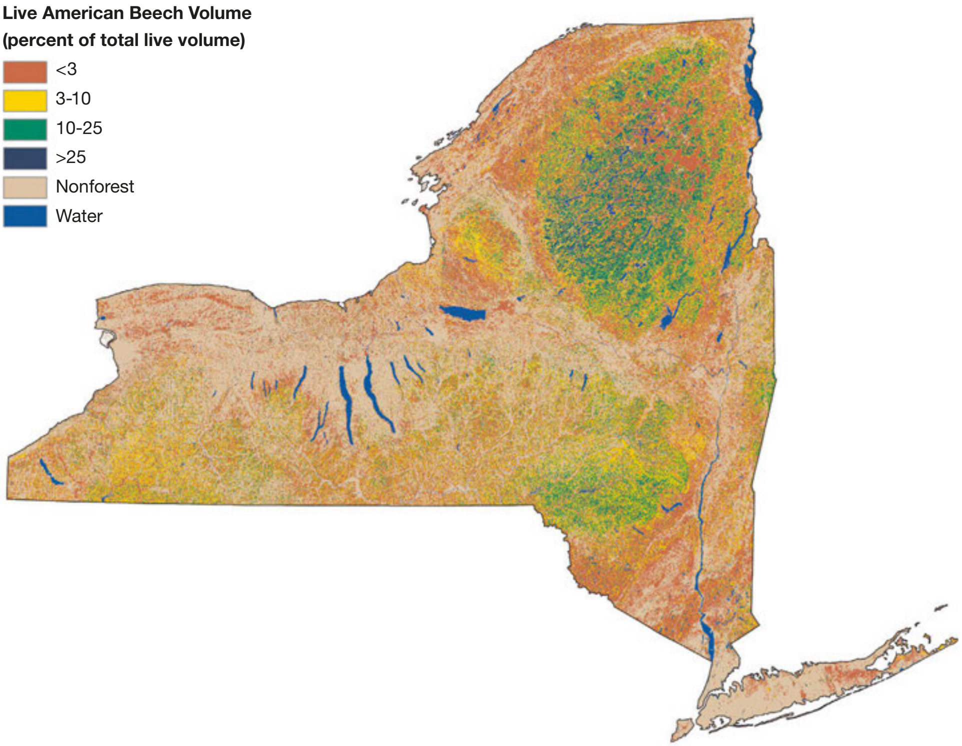

Figure 74.—American beech volume as a percentage of total live volume, New York, 2012.

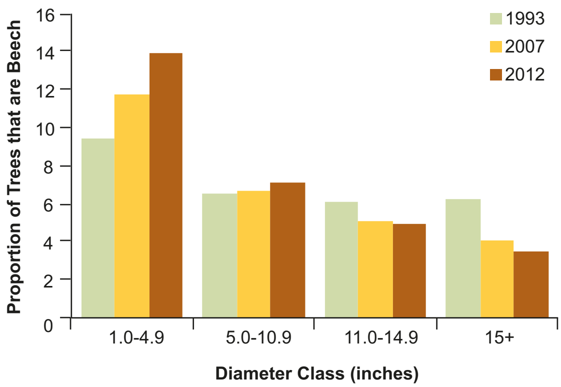

Figure 75.—Proportion of all trees that are American beech by diameter class and inventory year on timberland, New York.

Eastern Hemlock and Hemlock Woolly Adelgid

Background

Eastern hemlock is a major component of the forest resource in New York. It is ranked fifth in volume in New York, and the State has more hemlock volume than any other state in the Nation. Eastern hemlock is valued for wildlife habitat and the unique niche it fills. In riparian areas it is an ecologically important species and is also extensively used for pulpwood. Forests with the highest proportion of hemlock basal area occur in the foothills of more mountainous areas of the State. Hemlock woolly adelgid (*Adelges tsugae;* HWA) is native to East Asia and was first noticed in the eastern United States in the 1950s (Ward et al. 2004). Since then, it has slowly expanded its range; in areas where populations have established, they often reach high densities, causing widespread defoliation and sometimes mortality of hosts, eastern hemlock (McClure et al. 2001, Orwig et al. 2002).

What we found

HWA was first observed in New York on Long Island in 1984. By 2012, the insect had been discovered in 35 counties including most of southeast and south-central New York (Fig. 76). Unlike in many other states that have been impacted by HWA, hemlock annual mortality rate (0.5, see Fig. 53), the incidence of insect damage (Table 9), and crown health (Tables 11, 10), have seemingly been unaffected in New York. Additional analysis reveals that the annual mortality rate of hemlock increases with years of HWA infestation but the differences are fairly small (Fig. 77). Additionally, there is no difference between the hemlock mortality rate in the counties infested longest by HWA and the statewide mortality rate for hemlock; likewise no differences in hemlock crown health were detected.

What this means

HWA has not yet spread into the forests of New York where hemlock is the most abundant. Morin et al. (2009) estimated that HWA is spreading at a rate of between 6.0 and 9.0 miles/year in the northwest and north directions. However, cold winter temperatures can cause considerable mortality and trigger dramatic population declines (Skinner et al. 2003). Therefore the rate of spread of HWA into the rest of New York may be impacted by temperature. As HWA continues to spreading north and west from the Catskill-Lower Hudson unit into the rest of the State (likely over the next two decades), it will move into forests where densities of eastern hemlock are considerably higher than

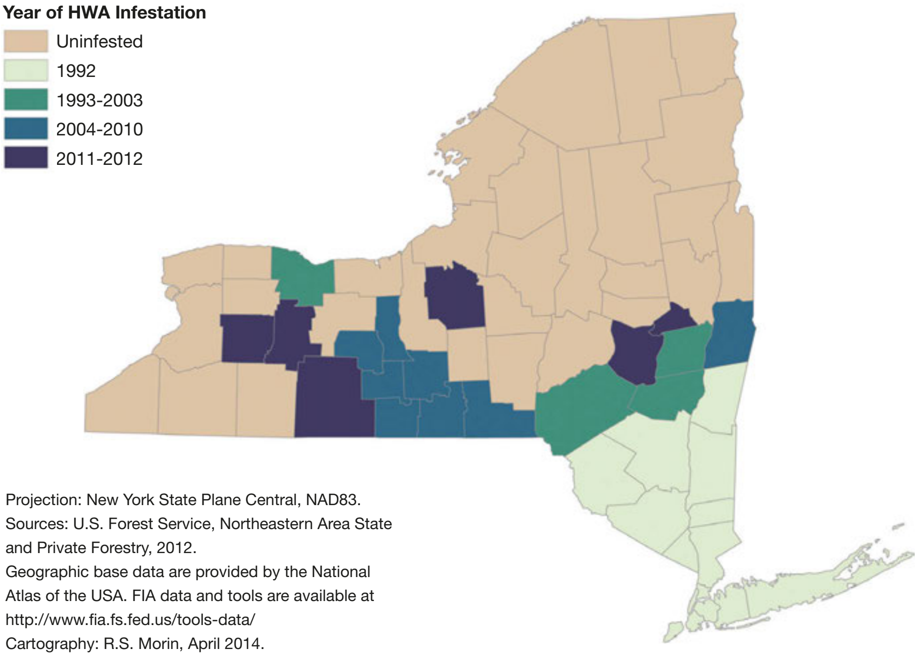

Figure 76.—Year of first detection of hemlock woolly adelgid by county, New York.

Figure 77.—Annual hemlock mortality rate based on county level HWA infestation duration categories. Error bars represent 68 percent confidence intervals around the estimated mean.

where it has already been. It will be important to continue monitoring for increased mortality in the high density eastern hemlock forests over the coming decade. It also will be important to continue monitoring crown health, though the health of eastern hemlock in the forests of New York does not appear to have been impacted by HWA yet. A previous study reported that hemlock mortality increases were not substantial until HWA had infested counties for more than 20 years (Morin et al. 2011).

Ash and Emerald Ash Borer

Background

The emerald ash borer (EAB) is a wood-boring beetle native to Asia. It was discovered in Detroit, Michigan, in 2002 (Kovacs 2010) and since that time, EAB has spread and killed millions of ash trees in the north-central region of the United States. It was first identified in Cattaraugus County, New York, in 2009. In North America, EAB has only been identified as a pest of ash and all native ash species appear to be susceptible, regardless of tree size or vigor (Poland and McCullough 2006). Tree mortality is rapid, occurring within 1 to 4 years of infestation, depending on tree size and beetle intensity. It is especially dangerous because there are no practical treatments available for EAB infested forests other than harvesting ash. EAB has the potential to eliminate ash as a commercial timber species in the State. Currently isolated pockets of EAB infested trees have been found in counties across the State, excluding the Adirondack region.

What we found

Ash species are common and well-distributed throughout the State, though stands dominated by ash are rare. There is an average of 12 ash trees 5 inches and larger d.b.h per acre of forest land, which represents an average 7.2 percent of the total volume or 156 cubic feet of wood per acre (Fig. 78). Ash is most prevalent in the Lake Plain unit where it represents nearly 14 percent of volume and averages 286 cubic feet per acre. Ash is least abundant in the three Adirondack units. Currently, about 66 million board feet of ash are removed annually for all purposes in the State (7 percent of the total removals). Ash produces abundant seeds, has the highest number of seedling-size trees across the State, and is ranked fourth in numbers of saplings (Fig. 28, Table 5). Currently annual mortality rates for ash average 0.9 percent of volume, which is lower than the State average for all species (Fig. 53). Not included here, but also at risk, are ash shade trees in urban areas.

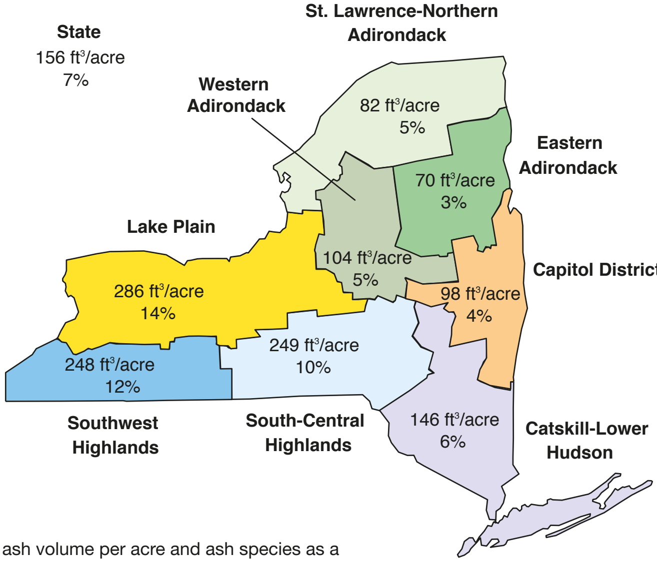

Figure 78.—Average ash volume per acre and ash species as a percentage of total live volume by FIA geographic unit, 2012.

What this means

EAB represents a significant threat to the forested and urban ash resource in New York. The loss of ash in forested ecosystems will affect species composition, alter community dynamics, and will likely eliminate ash a commercial species in the State. The consequences of ash loss will ripple through forest ecosystems, affecting other plants and animals. Pockets of EAB infestation have been identified in areas of the State with the highest densities of ash. Although ash mortality is not currently substantially higher than other species, it will likely increase as EAB spreads, as it has done in other states. EAB will likely have significant financial impacts to municipalities, property owners, and the forest products industries in the State. Continued monitoring of ash resources will help to identify the long-term impacts of EAB in forested settings.

To limit the spread of EAB through human behavior, a quarantine is in effect for most of New York. It restricts the export of ash products out of the quarantine area. Because the movement of firewood is a major cause of the spread of EAB and other tree diseases, regulations have been established that restrict the movement firewood of all tree species throughout the State. It is hoped that by slowing the spread of EAB, it will be contained until biological controls are found.

Current information on the EAB quarantine area, regulations, and restrictions on the movement of firewood can be found at: http://www.dec.ny.gov/ and http://www.dec.ny.gov/animals/28722.htm.

Timber Products

Background

The harvesting and processing of timber products produces a stream of income shared by timber owners, managers, marketers, loggers, truckers, and processors. The wood products and paper manufacturing industries in New York employs more than 43,000 people with an average annual payroll of more than $1.9 billion per year and a total value of shipments of $9.9 billion per year (North East State Foresters Association 2014). These economic benefits have a large impact on rural communities where unemployment is prevalent. The sale of timber products in New York provide forest owners with around $250 million of revenue annually (North East State Foresters Association 2014). To better manage the State's forests, it is important to know the species and amounts of timber being harvested. The State annually surveys wood-processing mills to estimate the wood volume that is processed into products in the State (NY DEC, n.d.c); this publication reports on data from the 2012 state survey.

What we found

The production of industrial wood in 2012 was 147 million cubic feet, a 9 percent decrease since 2007. The decrease was due to a 20 percent decrease in log production (Fig. 79). Over this same period, production of pulpwood and chips used for pulp, industrial fuelwood, and other products increased by 4 percent. Since 1997, declines in log production have been fairly steady, although production increased slightly in 2012. Current production of pulpwood and chips is about the same as in 2004. Historically the volume of wood used for logs has outpaced that for pulpwood, but the trend began to change in 2008. Logs now comprise 45 percent of industrial wood production with pulpwood and chips accounting for 55 percent.

In 2012, log production was 508 million board feet. Six species represent 80 percent of the log harvest (Fig. 80): sugar maple, white ash, red maple, white pine, black cherry, and northern red oak. Pulpwood and chips production were made up of 59 percent hardwood species and 41 percent softwood species.

Most logs were processed at mills in the State. Of the 147 million cubic feet of industrial wood harvested from the State, about 111 million cubic feet (76 percent) was processed at in-state mills and the remainder was shipped to either Canada or surrounding states. Of the 36 million cubic feet exported, a little over half went to Canada. Imports of wood from surrounding states to New York mills were about 13 million cubic feet. In 2012,

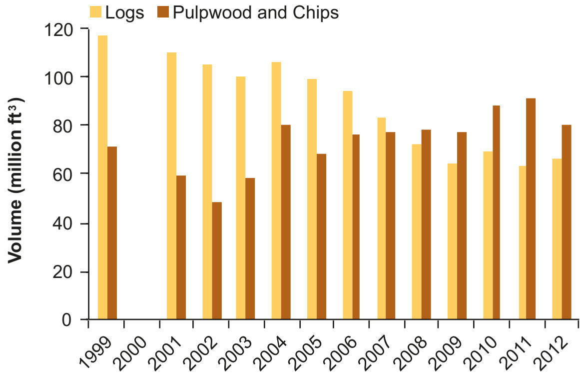

Figure 79.—Industrial roundwood production by year and major product, New York, 2012. Logs are used for lumber, veneer, pallets, and poles. Pulpwood and chips are used for pulp, industrial fuel, and wood pellet production.

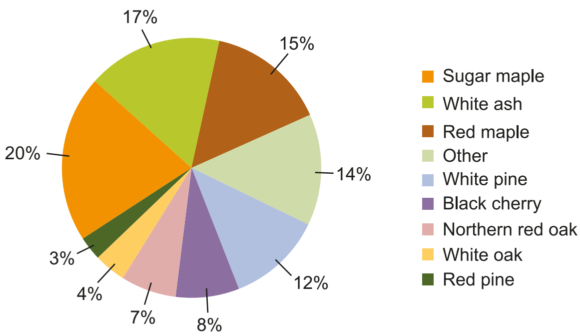

Figure 80.—Species composition of logs harvested in New York, 2012.

there were about 160 mills operating in the State, about 40 fewer than in 2007. These numbers exclude many very small capacity mills, mostly portable sawmills, that are not operated full time. It is estimated that there could be as many as 1,800 of these portable mills that may account for an additional 60 million board feet (equivalent to 7.9 million cubic feet) of log processing in the State (NY DEC, n.d.c).

What this means

A decrease in log production in recent years is most likely due to an overall decline in the economy and not because of a lack of timber. Previous to the recent downturn in the economy, the number of sawmills was declining, but at the same time other mills were adding capacity, resulting in little change in the overall milling capacity in the State. This contrasts with more recent changes that likely resulted in the net loss of milling capacity. To some extent, small mills have emerged to fill the role of processing logs into lumber for local use. Small mills can more easily shutdown and startup than larger mills that employ a full-time labor force.

The shift to a larger portion of the total harvest going to pulpwood and chips during the recent economic downturn may have been caused by several factors. Decreases in sawmill output results in less sawmill residues and hence less available for use as pulp. Traditionally pulpmills get a portion of their wood from slabs and edgings produced by sawmills in the production of lumber. If fewer sawmill residues are available, pulpmills have to rely more heavily on wood coming directly from the forest. Also, within the pulpwood and chip category there is a shift to using more chips for industrial fuelwood and the manufacturing of wood pellets for home heating. Pulpwood and chip production is not only important for its contribution to the State's economy, but it also provides markets for trees of poor quality and low value. Low value trees are abundant in New York and having markets for them is important for landowners wishing to manage their stands.

New York's wood processors provide woodland owners with an outlet to sell timber and provide jobs in rural areas. Having markets for wood is essential to forest management and for landowners to achieve many of their stewardship objectives. Despite the loss of sawmills, New York's mills continue to provide landowners a competitive market for their timber. The income landowners receive from selling timber is an incentive to keep land as forest. Income also helps pay property taxes and fund forest management activities such as wildlife habitat improvements, regeneration, and control of invasive species.

New York's Future Forest

Background

This section focuses on anticipated changes to the forests of New York between 2010 and 2060. The analysis is derived entirely from the Northern Forest Futures study (Shifley and Moser, in press). A large component of future forest change will be the result of normal forest growth, aging, natural regeneration, and species succession. In addition, the following external forces will drive forest change:

- Growth of urban areas will increase the portion of total forest land in urban areas from 3.7 percent in 2000 to 12.3 percent in 2050 (Nowak 2005).
- Economic conditions will affect forest products consumption, production, and harvest rates.
- Emerald ash borer will spread and affect forest change.
- Changes in population, the economy, energy consumption, and energy production will affect future climate change.
- Climate change will affect patterns of forest growth and species succession.

The Northern Forest Futures study utilized several alternative scenarios that cover a range of different assumptions about the economy, population, climate and other driving forces. The assumptions were incorporated into analytical models that estimated how northern forests are likely to change under each alternative scenario. The seven scenarios (A1B-C, A1B-BIO, A2-C, A2-BIO, A2-EAB, B2-C, and B2-BIO) are based on a storyline and storyline variation. They are identified by their storyline identifier (A1B, A2, or B2) followed by a hyphen and then their storyline variation (C, BIO, or EAB).

The three storylines use the following scenarios:

1) A1B—Rapid economic globalization. International mobility of people, ideas, and technology. Strong commitment to market-based solutions. Strong commitment to education. High rates of investment and innovation in education, technology, and institutions at the national and international levels. A balanced energy portfolio including fossil intensive and renewable energy sources. Uses the CGCM3.1 climate model (Canadian Centre for Climate Modelling and Analysis, n.d.b).

2) A2—Consolidation into economic regions. Self-reliance in terms of resources and less emphasis on economic, social, and cultural interactions between regions.

Technology diffuses more slowly than in the other scenarios. International disparities in productivity, and hence income per capita, are largely maintained or increased in absolute terms. Utilizes the CGCM3.1 climate model.

3) B2—A trend toward local self-reliance and stronger communities. Community-based solutions to social problems. Energy systems differ from region to region, depending on the availability of natural resources. The need to use energy and other resources more efficiently spurs the development of less carbon-intensive technology in some regions. Uses the CGCM2 Coupled Global Climate Model (Canadian Centre for Climate Modelling and Analysis, n.d.a).

The three storyline variations:

1) C—Standard variation—available for all three storylines (A1B, A2, and B2) storylines.

2) BIO—Increased harvest and utilization of woody biomass for energy variation—available for all three storylines (A1B, A2, and B2).

3) EAB—Potential impact of continued spread of the emerald ash borer (EAB) with associated mortality of all ash trees in the affected areas—available for only one scenario (A2).

What we found

The anticipated declines in forest land, which total in the hundreds of thousands of acres, reverse the century-long trend of increasing forest area in New York (Fig. 81). Specifically, over the next 50 years forest land area is projected to decline from an estimated 18.951 million acres in 2010 to 18.219 million acres (-3.1 percent) in 2060 under scenario A1B-C; to 18.312 million acres (-2.7 percent) under scenario A2-C; and 18.591 million acres (-1.2 percent) under scenario B2-C. Only three scenarios are represented in Figure 82 as the climate model and variations on the storylines do not impact the area of forest land under this model. Only the storylines (developed around differing demographics and levels of economic activity) alter the area of forest land in the model. Scenarios with increasing population and economic activity have less forest land over the time period. The projected losses of forest land from 2010 to 2060 are relatively small compared to the cumulative increase in forest area since start of the 20th century. In 2010, 63 percent of New York was forested. Forests are projected to remain a significant land cover in New York in 2060 (with projections varying from 60 to 62 percent).

EAB was first detected in New York in June of 2009. Ash species comprise 7 percent of the total live tree volume on forest land in New York and 19 percent of the volume in the elm/ash/cottonwood type. Under scenario A2-EAB ash species volume is projected to decline from 2.851 billion cubic feet in 2010 to zero cubic feet by 2030. Under scenario A2-C ash volume is expected to decrease from 2.851 billion cubic feet in 2010 to 2.439 billion cubic feet by 2060. There is a decrease in the area of elm/ash/cottonwood group from 2010 to 2060 under both scenario A2-C (79 percent) and A2-EAB (78 percent) (Fig. 82). The loss of the ash component in the elm/ash/cottonwood group in scenarios A2-C and A2-EAB is partially offset by increases in other associated species in the elm/ash/cottonwood group. The area in the oak/hickory type is expected to increase over the next 50 years.

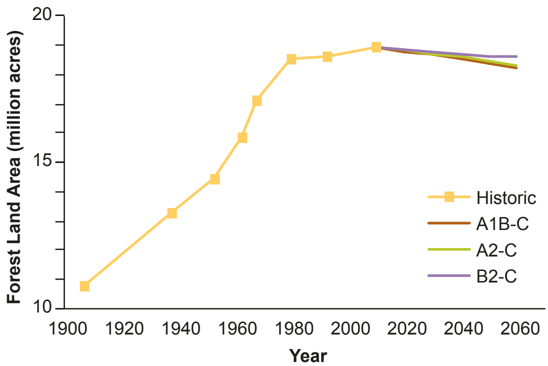

Figure 81.—Projected forest land area (million acres) for New York by scenario, 2010 to 2060.

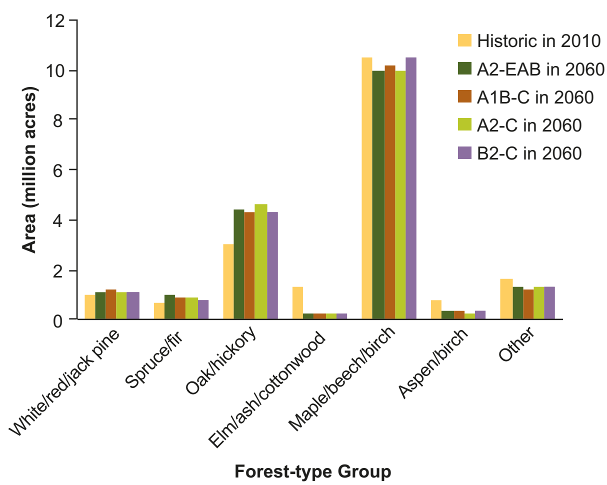

Figure 82.—Forest land area (million acres) by forest-type group, 2010 and by scenario in 2060.

The negative impacts of EAB are more apparent in Figure 83, which illustrates the volume under scenario A2-EAB is projected to be 4 percent less than the volume under scenario A2-C in 2060.

All seven scenarios result in higher levels of live tree volume in 2060 than in 2010. The largest increase occurs in the standard storyline scenarios. The A1B-BIO storyline increases in volume until 2030 whereupon it begins a steady decline through 2050 before a steep decline to 2060. This is due to much higher harvesting rates under the A1B-BIO storyline. Average annual removals of growing-stock on timberland, for each of the seven scenarios, are depicted in Figure 84.

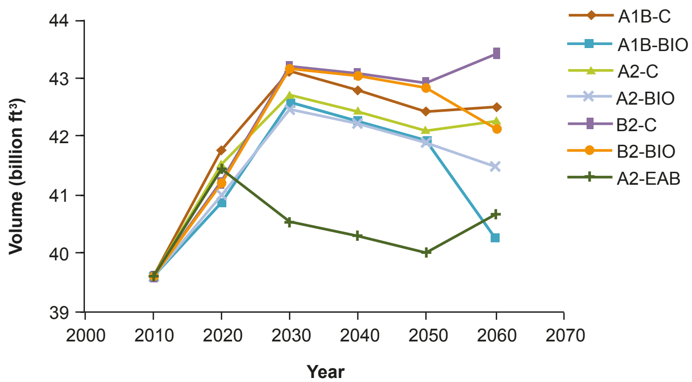

Figure 83.—Live tree volume (billion cubic feet) on forest land in New York by scenario, 2010 to 2060.

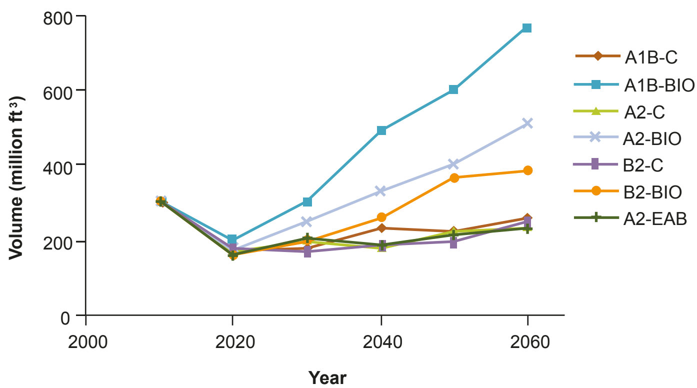

Figure 84.—Average annual growing-stock removals on timberland in New York by scenario, 2010 to 2060.

What this means

The projected losses of forest land are still relatively small compared to the cumulative increase in forest area since the start of the 20th century. Only three scenarios are represented in Figure 82 as the climate model and variations on the storylines do not impact the area of forest land under this model. Only the storylines (developed around differing demographics and levels of economic activity) alter the area of forest land in the model. Under all scenarios, increases in population and economic activity cause forest land to decrease.

Some losses of forest area in the elm/ash/cottonwood forest-type group and a 100 percent loss of ash tree volume are expected under the A2-EAB scenario. Ash species comprise 7 percent of the total live tree volume in New York and 230 million ash trees at least 5 inches in d.b.h. are likely to be lost. The oak/hickory group is expected to increase under these scenarios. The area of forest land is expected to decrease but the tree volume per acre is expected to increase as forests continue to mature.

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Appendix—List of tree species, greater than or equal to five inches in diameter, found on FIA inventory plots, New York, 2008-2012

Common name	Genus	Species
Balsam fir	*Abies*	*balsamea*
Redcedar/juniper spp.	*Juniperus*	spp.
Eastern redcedar	*Juniperus*	*virginiana*
Larch spp.	*Larix*	spp.
Tamarack (native)	*Larix*	*laricina*
Norway spruce	*Picea*	*abies*
White spruce	*Picea*	*glauca*
Black spruce	*Picea*	*mariana*
Blue spruce	*Picea*	*pungens*
Red spruce	*Picea*	*rubens*
Jack pine	*Pinus*	*banksiana*
Table Mountain pine	*Pinus*	*pungens*
Red pine	*Pinus*	*resinosa*
Pitch pine	*Pinus*	*rigida*
Eastern white pine	*Pinus*	*strobus*
Scotch pine	*Pinus*	*sylvestris*
Douglas-fir	*Pseudotsuga*	*menziesii*
Northern white-cedar	*Thuja*	*occidentalis*
Eastern hemlock	*Tsuga*	*canadensis*
Boxelder	*Acer*	*negundo*
Striped maple	*Acer*	*pensylvanicum*
Red maple	*Acer*	*rubrum*
Silver maple	*Acer*	*saccharinum*
Sugar maple	*Acer*	*saccharum*
Mountain maple	*Acer*	*spicatum*
Norway maple	*Acer*	*platanoides*
Ailanthus	*Ailanthus*	*altissima*
European alder	*Alnus*	*glutinosa*
Serviceberry spp.	*Amelanchier*	spp.
Yellow birch	*Betula*	*alleghaniensis*
Sweet (black) birch	*Betula*	*lenta*
River birch	*Betula*	*nigra*
Paper birch	*Betula*	*papyrifera*
Gray birch	*Betula*	*populifolia*
American hornbeam (musclewood)	*Carpinus*	*caroliniana*
Hickory spp.	*Carya*	spp.
Bitternut hickory	*Carya*	*cordiformis*
Pignut hickory	*Carya*	*glabra*
Shellbark hickory	*Carya*	*laciniosa*
Shagbark hickory	*Carya*	*ovata*
Mockernut hickory	*Carya*	*alba*

(Appendix continued on next page.)

(Appendix Continued)

American chestnut	*Castanea*	*dentata*
Catalpa spp.	*Catalpa*	spp.
Northern catalpa	*Catalpa*	*speciosa*
Hackberry spp.	*Celtis*	spp.
Hackberry	*Celtis*	*occidentalis*
Flowering dogwood	*Cornus*	*florida*
Hawthorn spp.	*Crataegus*	spp.
American beech	*Fagus*	*grandifolia*
White ash	*Fraxinus*	*americana*
Black ash	*Fraxinus*	*nigra*
Green ash	*Fraxinus*	*pennsylvanica*
Butternut	*Juglans*	*cinerea*
Black walnut	*Juglans*	*nigra*
Sweetgum	*Liquidambar*	*styraciflua*
Yellow-poplar	*Liriodendron*	*tulipifera*
Cucumbertree	*Magnolia*	*acuminata*
Apple spp.	*Malus*	spp.
Sweet crab apple	*Malus*	*coronaria*
White mulberry	*Morus*	*alba*
Blackgum	*Nyssa*	*sylvatica*
Eastern hophornbeam	*Ostrya*	*virginiana*
American sycamore	*Platanus*	*occidentalis*
Balsam poplar	*Populus*	*balsamifera*
Eastern cottonwood	*Populus*	*deltoides*
Bigtooth aspen	*Populus*	*grandidentata*
Quaking aspen	*Populus*	*tremuloides*
Cherry and plum spp.	*Prunus*	spp.
Pin cherry	*Prunus*	*pensylvanica*
Black cherry	*Prunus*	*serotina*
Chokecherry	*Prunus*	*virginiana*
American plum	*Prunus*	*americana*
Sweet cherry	*Prunus*	*avium*
White oak	*Quercus*	*alba*
Swamp white oak	*Quercus*	*bicolor*
Scarlet oak	*Quercus*	*coccinea*
Northern pin oak	*Quercus*	*ellipsoidalis*
Scrub oak	*Quercus*	*ilicifolia*
Bur oak	*Quercus*	*macrocarpa*
Chinkapin oak	*Quercus*	*muehlenbergii*
Pin oak	*Quercus*	*palustris*
Chestnut oak	*Quercus*	*prinus*
Northern red oak	*Quercus*	*rubra*
Post oak	*Quercus*	*stellata*

(Appendix continued on next page.)

(Appendix Continued)

Black oak	*Quercus*	*velutina*
Black locust	*Robinia*	*pseudoacacia*
Willow spp.	*Salix*	spp.
Peachleaf willow	*Salix*	*amygdaloides*
Black willow	*Salix*	*nigra*
Bebb willow	*Salix*	*bebbiana*
Balsam willow	*Salix*	*pyrifolia*
White willow	*Salix*	*alba*
Weeping willow	*Salix*	*sepulcralis*
Sassafras	*Sassafras*	*albidum*
Mountain-ash spp.	*Sorbus*	spp.
American mountain-ash	*Sorbus*	*americana*
European mountain-ash	*Sorbus*	*aucuparia*
northern mountain-ash	*Sorbus*	*decora*
American basswood	*Tilia*	*americana*
American elm	*Ulmus*	*americana*
Slippery elm	*Ulmus*	*rubra*
Rock elm	*Ulmus*	*thomasii*

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This report summarizes the second annual inventory of New York's forests, conducted in 2008-2012. New York's forests cover 19.0 million acres; 15.9 million acres are classified as timberland and 3.1 million acres as reserved and other forest land. Forest land is dominated by the maple/beech/birch forest-type group that occupies more than half of the forest land. The sound wood volume on timberland has been rising and is currently 37.4 billion cubic feet, enough to produce saw logs equivalent to 93.7 billion board feet. On timberland, the average annual growth in volume of live trees outpaced removals by a ratio of 2.1:1. The net change in volume averaged 1.1 percent per year. This report includes additional information on forest attributes, land use, forest fragmentation, forest ownership, forest health indicators, timber products, statistics, and quality assurance of data collection. Detailed information on forest inventory methods and data quality are available online at http://dx.doi.org/10.2737/NRS-RB-98.

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