USDA
United States Department of Agriculture

RESOURCE UPDATE FS-92

Forests of Pennsylvania, 2015

This resource update provides an overview of the forest resources in Pennsylvania based on inventories conducted by the U.S. Forest Service, Forest Inventory and Analysis (FIA) program of the Northern Research Station (NRS). Estimates are based on field data collected using the FIA annualized sample design and are updated yearly[1] (see footnote 1, page 2). Information about the national and regional FIA program is available online at http://fia.fs.fed.us. Since 2000, FIA has implemented an annual inventory in Pennsylvania. For the 2015 inventory, estimates for current variables, such as area, volume, and biomass, are based on 4,550 (3,036 forested) plot samples collected from 2010-2015. Change variables, such as net growth, removals, and mortality, are based on 4,178 samples collected in 2005-2010 and in 2010-2015. Estimates from earlier annual and periodic inventories are shown for comparison. See Bechtold and Patterson (2005) and O'Connell et al. (2014) for definitions and technical details.

Overview

Pennsylvania's forest land area totals 16.9 million acres and occupies 58 percent of the State's land area (Table 1). Ninety-seven percent of Pennsylvania's forest land, 16.3 million acres, is classified as timberland. Three percent is in public reserve status (572,000 acres), where the commercial harvesting of trees is restricted by law or public policy. All reserved forest land is in public ownerships. Less than one-tenth of a percent is other forest land (14,000 acres). Other forest land consists of forest land with low productivity. The most recent inventory shows the net volume of trees on forest land and timberland continues to increase, and annual growth continues to outpace annual removals. Annual mortality on forest land averaged 21 cubic feet per acre or 0.9 percent of the current inventory.

Table 1.—Pennsylvania forest statistics, 2015 and 2010. Volume estimates are for trees 5 inches and larger in diameter. Numbers of trees and biomass estimates are for trees 1 inch and larger in diameter. Sampling errors and error bars shown in tables in this report represent 68 percent confidence intervals.

	2015 Estimate	Sampling error (percent)	2010 Estimate	Sampling error (percent)	Change since 2010
Forest Land					
Area (thousand acres)	16,899	0.6	16,763	0.7	0.8
Number of live trees (million trees)	8,185	1.7	8,237	1.7	-0.6
Aboveground biomass of live trees (thousand oven-dry tons)	1,096,112	1.0	1,034,274	1.0	6.0
Net volume of live trees (million ft^3)	38,476	1.0	36,202	1.1	6.3
Annual net growth of live trees (thousand ft^3/yr)	808,358	2.8	869,961	2.9	-7.1
Annual mortality of live trees (thousand ft^3/yr)	351,584	3.8	336,057	3.9	4.6
Annual harvest removals of live trees (thousand ft^3/yr)	337,464	8.0	380,271	7.2	-11.3
Annual other removals of live trees (thousand ft^3/yr)	10,585	28.2	24,384	31.7	-56.6
Timberland					
Area (thousand acres)	16,312	0.7	16,136	0.8	1.1
Number of live trees (million trees)	7,935	1.7	7,985	1.7	-0.6
Aboveground biomass of live trees (thousand oven-dry tons)	1,051,488	1.0	992,234	1.1	6.0
Net volume of live trees (million ft^3)	36,907	1.1	34,736	1.2	6.2
Net volume of growing-stock trees (million ft^3)	33,674	1.2	32,246	1.3	4.4
Annual net growth of growing-stock (thousand ft^3/yr)	669,401	2.7	729,829	2.6	-8.3
Annual mortality of growing-stock trees (thousand ft^3/yr)	249,926	4.4	242,648	4.3	3.0
Annual harvest removals of growing-stock trees (thousand ft^3/yr)	285,069	8.2	322,137	7.3	-11.5
Annual other removals of growing-stock trees (thousand ft^3/yr)	10,474	42.4	28,392	27.0	-63.1

Forest Area

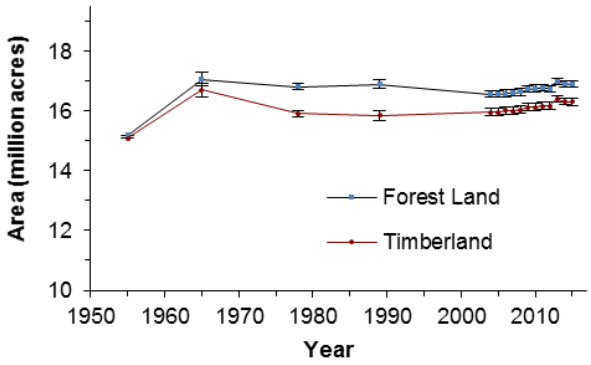

Figure 1.—Area of forest land and timberland by year, Pennsylvania. Error bars in this and other graphs represent a 68 percent confidence interval around the estimated mean.

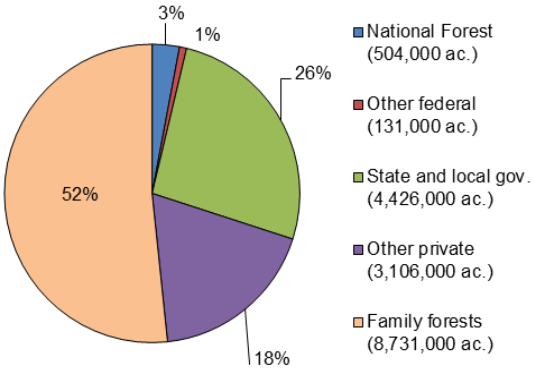

Figure 2.—Area of forest land ownership, Pennsylvania, 2015.

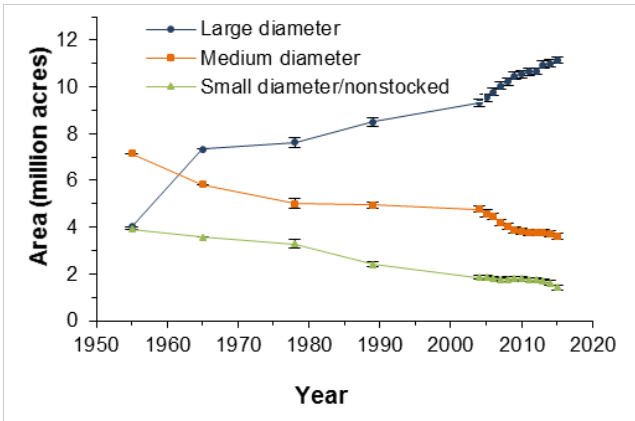

Figure 3.—Area of timberland by stand-size class and inventory year, Pennsylvania.

[1]One-fifth of the plots was measured annually from 2007 thru 2013 resulting in a complete set of samples for every 5 years of data collection. In 2014, this 5-year cycle was changed to 7 years, wherein 1/7th (14.3 percent) of the plots are measured annually.

Pennsylvania's forest land area has been very stable since 1965, with small changes over the last 50 years within the range of sampling error (Fig. 1). Over this period, losses of forest land to development and other nonforest uses have been about equal to that of agricultural and other nonforest land reverting to forest. The 2015 inventory shows that over the last remeaurement period, 365,000 acres of forest land were converted to nonforest land uses and 367,000 acres of nonforest land reverting to forest land. Public ownerships hold 30 percent of the Commonwealth's forest land. Seventy percent is in private ownerships that include family, corporate, club, and other entities (Fig. 2).

The area of timberland in large diameter stands[2] has steadily increased since the 1950s (Fig. 3). Currently, 69 percent of the Commonwealth's forest land is in large diameter stands and 9 percent of forest land is in small diameter stands. Forest types dominated by oak species have even lower percentages in small diameter stands than other types (Fig. 4). The northern red oak, chestnut oak/black oak/scarlet oak and the chestnut oak types each have less than 1 percent of their area in small diameter stands, whereas the cherry/white ash/yellow-poplar and black cherry types each have over 10 percent of their area in small diameter stands. The lack of small diameter stands in oak forest types illustrates the difficulty in regenerating oak forest types in Pennsylvania.

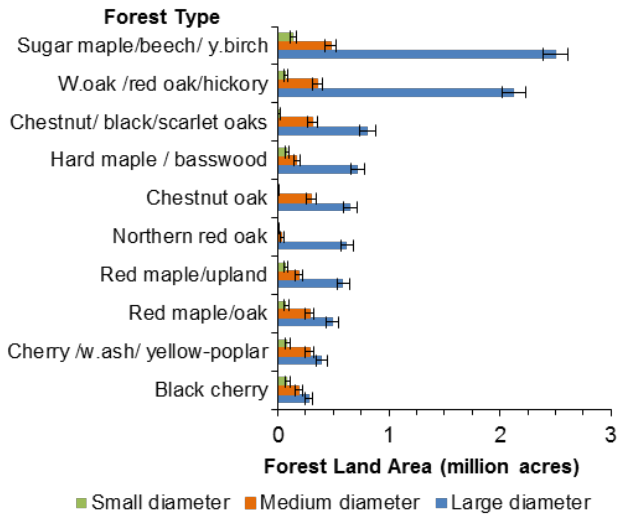

Figure 4.—Area of forest land by stand-size class[2] (based on small, medium, and large trees) for the top 10 forest types ranked by area, Pennsylvania, 2015.

[2] Small diameter stands: dominated by trees less than 5.0 inches d.b.h.; Medium: 5.0 to 8.9 inches d.b.h. for softwoods and 5.0 to 10.9 inches d.b.h. for hardwoods; Large:≥ 9.0 inches for softwoods and 11.0 d.b.h. for hardwoods.

Volume, Biomass, and Trends

Across all forest land, the net volume of trees increased by 6.3 percent, since 2010, to 38.5 billion cubic feet. Red maple continued to be the most voluminous species followed by black cherry, northern red oak, and sugar maple (Table 2). Changes in volume since 2010 were inconsistent across species. All the top 10 species ranked by volume exhibited increases in net volume, although beech, ranked eleventh by volume, decreased by 2 percent. Of the top 10 species, sweet birch had the largest percentage increase in volume, 10.9 percent, and white oak the smallest, 1.5 percent.

Sawtimber volume on timberland increased by 10.4 percent to 117.1 billion board feet. Red maple is the leading sawtimber species by volume, followed by northern red oak, black cherry, and sugar maple. Since 2010, hemlock, northern red oak, and yellow-poplar had the largest increases in board-foot volume, 13.4, 12.5, and 10.5 percent, respectively.

Aboveground biomass on forest land totaled 1.1 billion dry tons. This was a 6.0 percent increase since 2010. On timberland, aboveground biomass averaged 65 dry tons per acre for all live trees 1 inch and larger in diameter.

In terms of average annual growth and removals of net volume on timberland, red maple had the largest annual volume of both net growth and removals expressed as cubic foot volume (Fig. 5).

Red maple accounts for 18 percent of total annual net growth and 16 percent of removals, although the oaks combined accounted for 23 percent of growth and 25 percent of removals. Statewide, net growth outpaced removals by a ratio of 2.3 to 1. Beech was the only major species with a growth to removals ratio of less the 1.0.

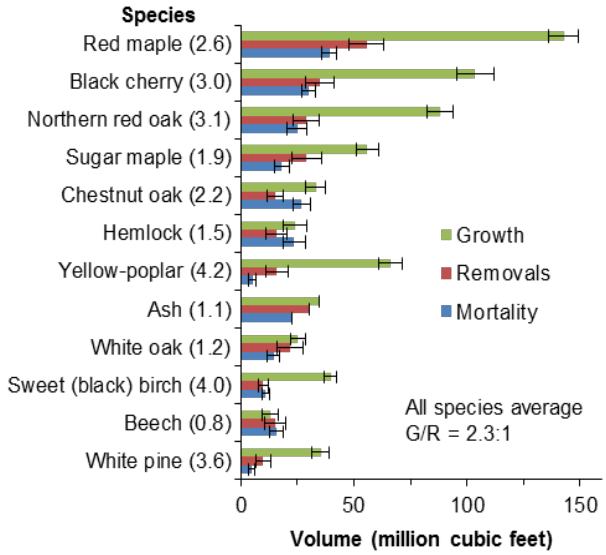

Figure 5.—Average annual net growth, removals, and mortality of net volume on timberland over 5-year remeasurement period, and growth to removals ratios (G/R) in parentheses, for the top 12 species ranked by total net volume, Pennsylvania, 2015.

Table 2.—Net volume, and percent change in net volume on forest land; sawtimber volume and percent change on timberland, and biomass on forest land, Pennsylvania, 2015, (top 10 species by net volume)

Species	Volume of live trees on forest land (million ft^3)	Sampling error (pecent)	Percent change since 2010	Volume of sawtimber trees on timberland (million bd.ft.)	Sampling error (percent)	Percent change since 2010	Aboveground biomass on forest land (million tons)	Sampling error (percent)
Red maple	7,101	2.5	5.3	17,869	3.7	9.9	193	2.4
Black cherry	4,082	3.9	6.7	13,247	5.1	9.1	105	3.7
Northern red oak	3,798	3.8	9.1	15,035	4.4	12.5	121	3.7
Sugar maple	2,806	4.7	6.9	8,475	5.9	10.2	89	4.6
Chestnut oak	2,643	4.3	3.7	7,356	5.1	7.6	86	4.3
Hemlock	1,960	5.8	8.7	5,802	6.6	13.4	37	5.7
Yellow-poplar	1,869	7.6	9.3	8,030	8.5	10.5	39	7.4
White ash	1,759	5.1	3.6	5,610	6.8	8.4	53	5.0
Sweet (black) birch	1,695	4.4	10.9	3,121	6.3	9.1	61	4.0
White oak	1,657	5.2	1.5	5,756	6.5	7.9	54	5.2
Other softwoods	1,758	6.6	7.5	5,912	7.6	13.7	33	6.6
Other hardwoods	7,348	2.3	5.4	20,883	3.2	10.8	225	2.3
All Species	38,476	1.0	6.3	117,094	1.6	10.4	1,096	1.0

Are Pennsylvania's Forests Being Managed Sustainably?

Changes in net volume on timberland can be explained by examining growth, removals and mortality of trees. Comparing net growth to removals addresses one aspect of forest sustainability; when net growth exceeds removals, total volume increases. Timberland removals include trees harvested on land that remain in timberland, trees on timberland that has been reclassified to reserved forest land, and trees lost because the forest was developed for a nonforest use. The volume of trees that die from natural causes, such as insects, diseases, wind, and suppression from other trees, is reported as mortality. The data presented in Figure 6 are estimates of annual change in net volume on private land and unreserved public timberland in Pennsylvania. These data are based on the changes that occurred over the most recent 5 to 6 year remeasurement period. Analysis of these individual components can help us better understand what is influencing net change in volume.

The growth of trees has greatly outpaced their mortality and removals. The most recent inventory revealed that as a percentage of the current total inventory, gross growth was 3.1 percent; mortality: 0.9 percent, net growth: 2.2 percent; and removals: 1.0 percent.

These result in an overall net change of 1.2 percent annually. This implies that the current level of removals is sustainable and that increases in volume will continue, although the 13 percent of removals due to land-use change is a concern and may impact growth in the future.

As the total volume of trees continues to increase, some species are fairing better than others, indicating a shift in the species composition of the forest resource (Table 2, Fig. 5). Illustrating this shift, sweet birch and yellow-poplar had large increases in volume and high ratios of growth to removals. These species will likely play a bigger role in Pennsylvania's future forest, while white oak and ash had small increases in volume and low ratios of growth to removals, and will likely be a smaller part of the future forest.

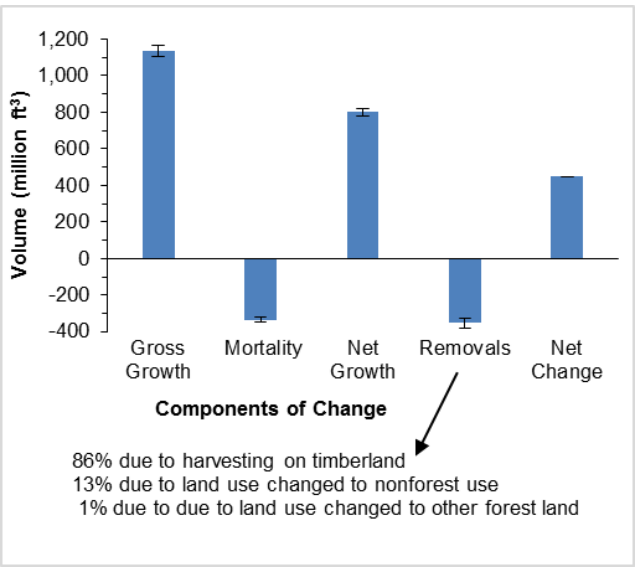

Figure 6.—Average annual components of change in net volume on timberland, Pennsylvania, 2015.

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