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RESOURCE UPDATE FS-74

Forests of Delaware, 2015

This publication provides an overview of forest resources in Delaware based on inventories conducted by the U.S. Forest Service, Forest Inventory and Analysis (FIA) program of the Northern Research Station. From 2004-2013, FIA employed an annual inventory with a cycle length of 5 years, measuring data on 20 percent of all sample plots each year in Delaware. Beginning in 2014, FIA is on a 7-year cycle, inventorying 14.3 percent of all plots annually. For the 2015 inventory, estimates for current variables such as area, volume, and biomass are based on 396 plots collected from 2010-2015. Change variables such as net growth, removals, and mortality are based on 374 samples collected in 2006-2010 and resampled in 2010-2015. Estimates from earlier annual and periodic inventories are shown for comparison. See Bechtold and Patterson (2005) and O'Connell et al. (2013) for definitions and technical details.

Overview

Delaware is home to an estimated 361,000 acres of forest land (Table 1). Since 2010 there has been little change in forest land area, however long-term data show decreases in the amount of forest land since the 1986 FIA inventory (Fig. 1). According to the 2015 results, there are approximately 229 million trees on Delaware's forest land containing an all live tree aboveground biomass of 26 million tons and a net volume of 954 million cubic feet. Estimates of aboveground biomass and net volume on forest land have increased since 2010. Total annual growth of all live trees on timberland outpaced total removals by a ratio (growth:removals) of 1.9:1 and annual mortality averaged 1 percent on timberland when calculated as a percentage of current volume.

Table 1.—Delaware forest statistics, 2015 and 2010. Volumes are for trees 5-inch diameter and larger. Number of trees and biomass are for trees 1-inch diameter and larger. Sampling errors in this and other tables represent 68 percent confidence intervals. Growth, removals, and mortality data from 2010 are not available (NA) because there are limited annual remeasurement data for this year and estimates have a high degree of uncertainty.

	2015 Estimate	Sampling error (percent)	2010 Estimate	Sampling error (percent)	Change since 2010 (percent)
Forest Land					
Area (thousand acres)	361	3.9	341	4.4	5.9
Number of live trees (million trees)	229	9.9	239	9.5	-4.2
Aboveground biomass of live trees (thousand oven-dry tons)	26,181	5.1	23,362	5.4	12.1
Net volume of live trees (million ft^3)	954	5.6	857	5.9	11.4
Annual net growth of live trees (thousand ft^3/yr)	19,353	11.3	NA	NA	NA
Annual mortality of trees (thousand ft^3/yr)	9,313	17.0	NA	NA	NA
Annual harvest removals of live trees (thousand ft^3/yr)	8,932	35.8	NA	NA	NA
Timberland					
Area (thousand acres)	346	4.2	327	4.9	5.7
Number of live trees (million trees)	224	10.1	230	9.9	-2.7
Aboveground biomass of live trees (thousand oven-dry tons)	24,794	5.5	22,198	5.9	11.7
Net volume of live trees (million ft^3)	894	6.0	809	6.2	10.5
Net volume of growing stock trees (million ft^3)	818	6.3	766	6.2	6.8
Annual net growth of growing stock trees (thousand ft^3/yr)	16,022	11.5	NA	NA	NA
Annual mortality of growing stock trees (thousand ft^3/yr)	7,130	18.4	NA	NA	NA
Annual harvest removals of growing stock trees (thousand ft^3/yr)	7,513	36.5	NA	NA	NA

Forest Area

Successive inventories since the mid-1980s in Delaware have shown forest land area decreasing. However, since 2008, forest land estimates have been relatively stable. The 2015 estimate of 361,000 acres of forest land is 6 percent larger than the 2010 estimate, which may be an indication of a stabilizing forest land base (Fig. 1). Timberland accounts for 96 percent of this forest land or 346,000 acres. Slightly more than 3 percent of forest land is reserved from timber production and less than 1 percent of the forest land does not meet minimum productivity standards.

Seventy-seven percent of Delaware's forests (278,000 acres) are privately owned (Fig. 2). Private owners include individuals, families, corporations, and other private entities. The remaining 23 percent (82,000 acres) is in public ownership. The largest public owner is the State of Delaware, which holds 58,000 acres of timberland and 9,000 acres of reserved forest.

Delaware's forests have been maturing as is illustrated by the distribution of timberland by stand-size class (Fig. 3). Since the 1973 inventory, there has been a general trend of increasing acreage in large diameter stands and decreasing acreage in medium- and small-diameter stands. Acreage in large-diameter stands now accounts for 76 percent of timberland whereas the area in small-diameter stands is 12 percent. Even within each major forest-type group, most forest land is classified in the large-diameter stand-size class (Fig. 4).

Oak/hickory is the dominant forest-type group in Delaware, covering 54 percent of forest land. The oak/hickory forest-type group is most prevalent in all but the southern most part of the State where the loblolly pine/shortleaf pine forest-type group dominates. Loblolly pine/short leaf pine is the most abundant softwood forest-type group within the State, accounting for 16 percent of the forest land.

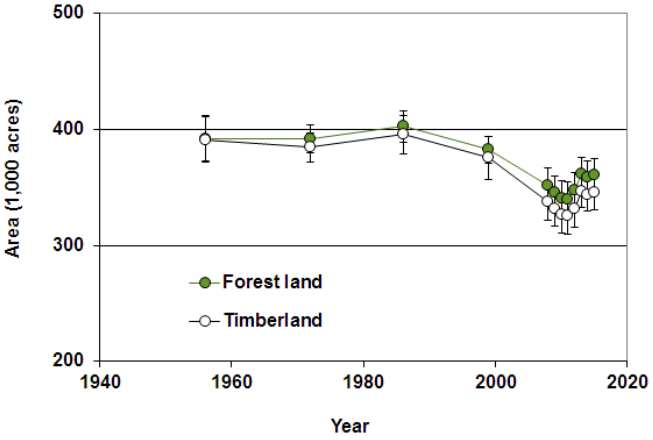


Figure 1.—Forest land and timberland area by year, Delaware, 1957-2015. Error bars shown in figures in this report represent 68 percent confidence interval.

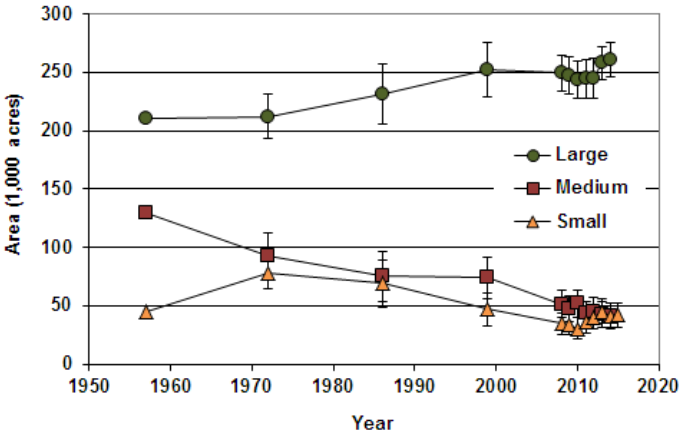


Figure 3.—Timberland area by stand-size class and year, Delaware, 1957-2015.

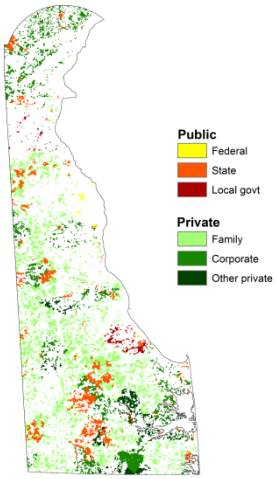


Figure 2.—Distribution of forest land by major owner group, Delaware, 2015.

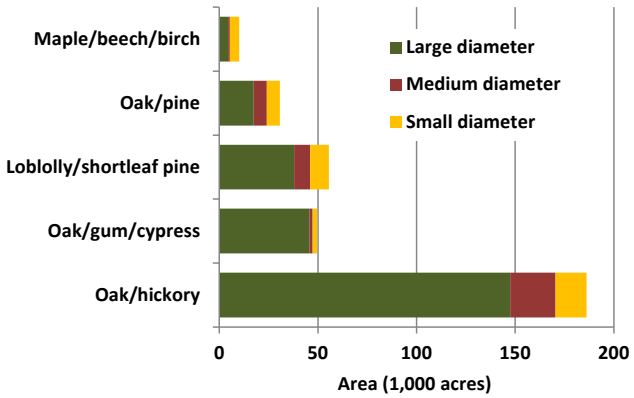


Figure 4.—Area of timberland by selected forest-type groups and stand-size classes, Delaware, 2015.

Volume, Biomass, and Trends

The net volume of trees on forest land increased by 11.4 percent to 954 million cubic feet since 2010 (Table1). Red maple continues to be the most voluminous species followed by yellow-poplar, sweetgum, and loblolly pine (Table 2). Changes in live volume since 2010 varied across species and interpretation is difficult given the high sampling errors for most species. Yellow-poplar and scarlet oak showed the highest percentage increases since 2010.

The sawtimber volume on timberland increased by 15.1 percent to 3 billion board feet since 2010. Red maple was the leading sawtimber species by volume, followed by yellow-poplar and loblolly pine. Sawtimber volume estimates for yellow-poplar and scarlet oak showed the greatest increases from 2010.

Aboveground biomass on forest land totaled 26 million dry tons. Ninety-five percent of biomass is contained in trees on timberland. Aboveground biomass on timberland averaged 76 dry tons per acre.

In terms of average annual growth and removals on timberland, loblolly pine had the highest growth rate and also the highest estimated removals of all tree species (Fig. 5). Loblolly pine and red maple combined account for 45 percent of the total growth and 35 percent of all removals.

Total annual growth outpaced total removals by a ratio (G:R) of 1.9:1 in 2015, although ratios varied considerably among species (Fig. 5). Among the five most voluminous species, yellow-poplar had the largest growth to removals ratio (6.9:1) and white oak had the smallest (1.0:1). As a percentage of current volume, annual mortality averaged 1 percent on timberland. Of the prominent species, sweetgum had the highest mortality rate (1.3 percent per year).

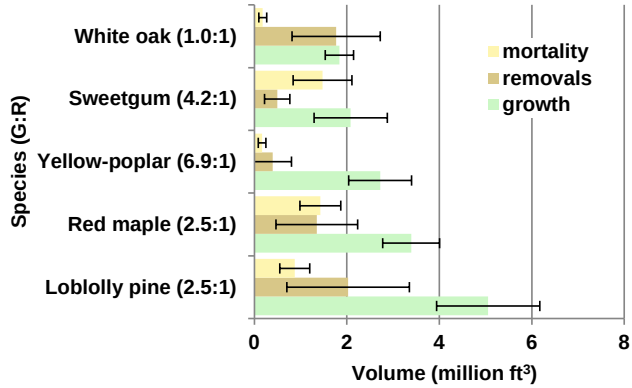


Figure 5.—Average annual net growth, removals, and mortality of net volume on timberland, and growth to removals ratio (G:R) for select species, Delaware, 2015.

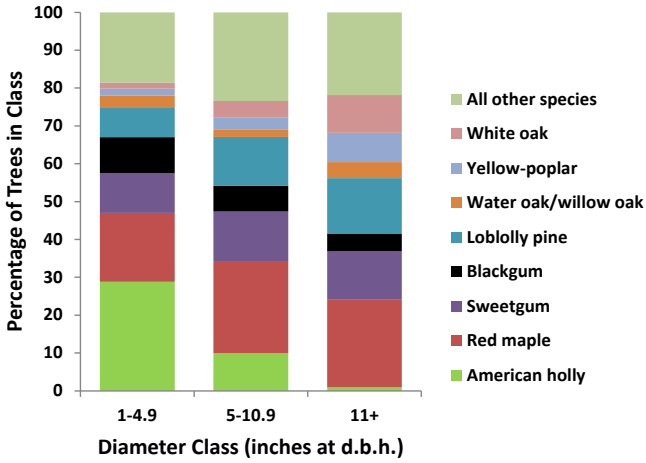
Table 2.—Top 10 species by net volume and percentage change since 2010 on forest land; sawtimber volume and percentage change since 2010 on timberland; and biomass on forest land, Delaware, 2015.

	Volume of live trees on forest land (million ft³)	Sampling error (percent)	Percent change since 2010	Volume of sawtimber trees on timberland (million board feet)	Sampling error (percent)	Percent change since 2010	Aboveground biomass on forest land (thousand tons)	Sampling error (percent)
Red maple	205	11.7	6.6	598	15.6	7.5	5,640	11.0
Yellow-poplar	138	23.9	37.6	440	25.2	44.1	2,821	23.4
Sweetgum	118	13.9	13.4	390	18.1	26.2	2,993	13.3
Loblolly pine	109	18.7	-7.9	408	20.2	2.5	2,460	18.0
White oak	77	17.5	22.8	317	20.3	23.9	2,481	17.3
Willow oak	51	32.5	29.0	263	33.8	32.6	1,509	32.3
Blackgum	38	18.5	26.2	111	25.3	39.7	1,050	17.0
Southern red oak	35	24.0	35.1	126	27.6	36.8	1,079	23.7
Scarlet oak	22	33.1	44.0	80	37.4	52.4	775	31.7
Black cherry	21	28.9	-4.9	40	59.9	0.0	605	26.0
Total of all species	954	5.6	11.4	3,177	7.8	15.1	26,181	5.1

Factors Affecting Species Composition in Delaware's Forests

One factor affecting species composition in Delaware is the successional stage of the forest. Many of the species that are thriving in the understory are tolerant of shaded conditions. As Delaware's forest matures, shade-tolerant species will likely replace the more shade-intolerant species now growing in the overstory. A comparison of species composition by diameter class shows that white oak, yellow-poplar, and the water oak/willow oak species are better represented in diameters 11 inches and larger than they are in smaller diameter classes (Fig. 6). White oak comprises 10 percent of trees 11 inches in diameter and larger and 2 percent of trees 1 to 4.9 inches (saplings). Yellow-poplar comprises 8 percent of trees 11 inches in diameter and larger and 2 percent of saplings. These contrast with American holly and blackgum. American holly comprises 29 percent of saplings and only 1 percent of trees 11 inches and larger, and blackgum comprises 10 percent of saplings and 5 percent of trees 11 inches and larger.

Both yellow-poplar and white oak are intolerant of shade. In the smaller size classes these species occur less than they do in sawtimber-size class, suggesting that these species will be replaced by other species, and that their current occurrence in the overstory may not be sustainable. American holly and blackgum are both very tolerant of shade. The larger occurrence of American holly and blackgum species in the seedling (trees less than 1-inch diameter) and sapling size classes, when compared to their presence in sawtimber-size trees, indicates that these species may play a larger role in Delaware's transitioning and future forest. Red maple, sweetgum, and loblolly pine are numerous across all diameter classes, suggesting that they appear to have adequate regeneration and that they will continue to dominate in the larger size classes.



Figure—6. Species composition as a percent of all trees by in each diameter class on forest land, Delaware, 2015.

In addition to shade tolerance, browse by white-tailed deer (*Odocoileus virginianus*) is also a contributing factor in determining which species regenerate successfully in Delaware. Blackgum, sweetgum, sweetbay magnolia, American holly, and loblolly pine are not preferred browse for white-tailed deer and are common in the seedling and sapling-size classes, whereas species of oaks, which are more favored browse, are poorly represented in seedling and sapling-size classes. Currently, successional stage, soil moisture, and browse by white-tailed deer appear to be driving trends in species composition in Delaware.

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More information on Delaware Forests

Lister, T.W.; Gladders, G.; Barnett, C.J.; et al. 2012. **Delaware's Forests 2008**. Resour. Bull. NRS-62. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 56 p. [DVD included]

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