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RESOURCE UPDATE FS-143

Forests of Delaware, 2016

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 2016 inventory, estimates for current variables such as area, volume, and biomass are based on 394 plots (138 forested) collected from 2011-2016. Change variables such as net growth, removals, and mortality are based on 374 samples (122 forested) collected in 2006-2010 and resampled in 2011-2016. Estimates from earlier annual and periodic inventories are shown for comparison. See Bechtold and Patterson (2005), O'Connell et al. (2013), and Gormanson et al. (2017) for definitions and technical details. A complete set of inventory tables is available at https://doi.org/10.2737/FS-RU-143.

Overview

Delaware is home to an estimated 355,000 acres of forest land (Table 1). Since 2011 there has been little statistical 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 2016 results, there are approximately 242 million trees on Delaware's forest land containing an all live tree aboveground biomass of 26 million tons and a net volume of 949 million cubic feet. Estimates of aboveground biomass and net volume on forest land have increased since 2011. Annual net growth of growing stock trees on timberland outpaced annual harvest removals of growing stock trees by a ratio (growth:removals or G:R) of 2.2:1 and annual mortality of growing stock trees averaged 0.8 percent on timberland when calculated as a percentage of the net volume of growing stock trees.

Table 1.—Delaware forest statistics, 2016 and 2011. Volumes are for trees 5 inches in diameter and larger. Number of trees and biomass are for trees 1 inch in diameter and larger. Sampling errors in this and other tables represent 68 percent confidence intervals.

	2016 Estimate	Sampling error (percent)	2011 Estimate	Sampling error (percent)	Change since 2011 (percent)
Forest Land					
Area (thousand acres)	355	3.8	340	4.5	4.5
Number of live trees (million trees)	242	10.8	232	10.1	4.3
Aboveground biomass of live trees (thousand oven-dry tons)	25,953	5.1	23,570	5.8	10.1
Net volume of live trees (million ft^3)	949	5.7	861	6.1	10.3
Annual net growth live trees (thousand ft^3/yr)	20,425	11.4	18,410	13.5	10.9
Annual mortality of live trees (thousand ft^3/yr)	9,255	17.2	7,192	25.5	28.7
Annual harvest removals of live trees (thousand ft^3/yr)	9,330	35.3	6,441	56.3	44.8
Timberland					
Area (thousand acres)	340	4.2	326	5.0	4.4
Number of live trees (million trees)	237	11.0	222	10.5	6.8
Aboveground biomass of live trees (thousand oven-dry tons)	24,626	5.6	22,404	6.2	9.9
Net volume of live trees (million ft^3)	891	6.0	814	6.5	9.5
Net volume of growing stock trees (million ft^3)	816	6.5	755	6.6	8.1
Annual net growth of growing stock trees (thousand ft^3/yr)	17,215	11.6	15,004	13.1	14.7
Annual mortality of growing stock trees (thousand ft^3/yr)	6,719	19.6	5,269	27.5	27.5
Annual harvest removals of growing stock trees (thousand ft^3/yr)	7,732	36.6	5,405	57.0	43.1

Forest Area

Successive inventories since the mid-1980s in Delaware have shown forest land area decreasing. However, since 2008, forest land estimates have increased by less than 1 percent. The 2016 estimate of 355,000 acres of forest land is 5 percent larger than the 2011 estimate, which is an indication of a stabilizing forest land base (Fig. 1). Timberland accounts for 96 percent of this forest land or 340,000 acres. Nearly 4 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-eight percent of Delaware's forests (277,000 acres) are privately owned (Fig. 2). Private owners include individuals, families, corporations, and other private entities. The remaining 22 percent (78,000 acres) is in public ownership. The largest public owner is the State of Delaware, which holds 54,000 acres of timberland and 9,000 acres of reserved forest.

Delaware's forests steadily matured between the 1972 and 2011 inventories, as is illustrated by the distribution of timberland by stand-size class (Fig. 3). Stand size ratios have remained relatively constant since the 2011 inventory. Acreage in large-diameter stands now accounts for 77 percent of timberland whereas the area in small-diameter stands is 11 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 53 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 17 percent of the forest land.

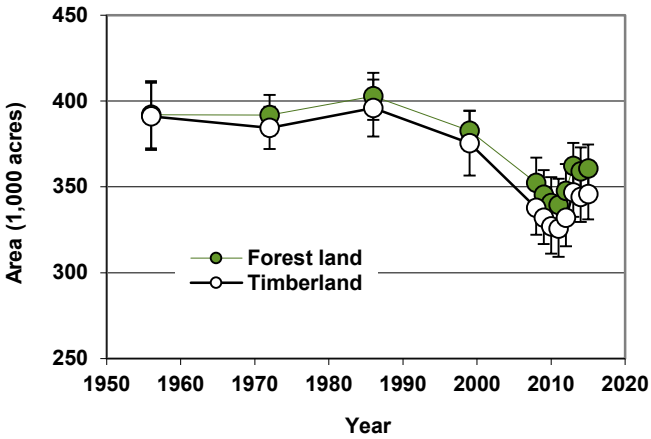

Figure 1.—Forest land and timberland area by year, Delaware, 1957-2016. Error bars shown in figures in this report represent 68 percent confidence interval.

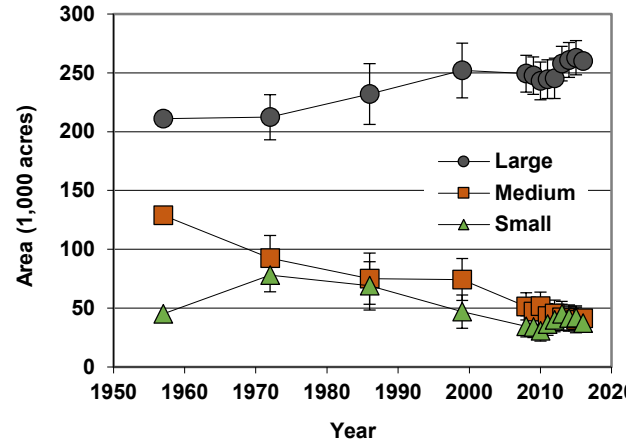

Figure 3.—Timberland area by stand-size class and year, Delaware, 1957-2016.

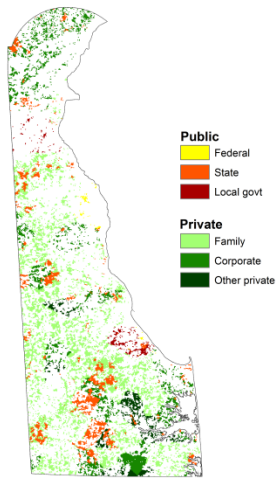

Figure 2.—Distribution of forest land by major owner group, Delaware, 2014.

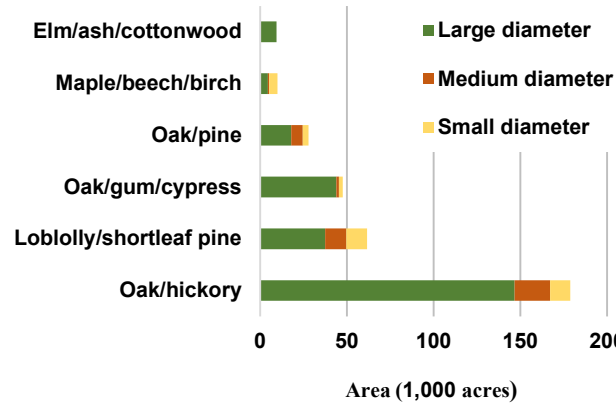

Figure 4.—Area of timberland by selected forest-type groups and stand-size classes, Delaware, 2016.

Volume, Biomass, and Trends

The net volume of trees on forest land increased by 10.3 percent to 949 million cubic feet since 2011 (Table 1). Red maple continues to be the most voluminous species followed by yellow-poplar, loblolly pine, and sweetgum (Table 2). Changes in live volume since 2011 varied across species and interpretation is difficult given the high sampling errors for most species. Yellow-poplar, scarlet oak, and blackgum showed the highest percentage increases since 2011.

The sawtimber volume on timberland increased by 12.4 percent to 3 billion board feet since 2011. Red maple was the leading sawtimber species by volume, followed by yellow-poplar and loblolly pine. Sawtimber volume estimates for blackgum, yellow-poplar, and scarlet oak showed the greatest increases from 2011.

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 72 dry tons per acre.

In terms of average annual net growth and removals on timberland, loblolly pine had the highest net growth rate and also the highest estimated removals of all tree species (Fig. 5). Loblolly pine, red maple, and yellow-poplar combined account for 61 percent of the total net growth and 35 percent of all removals.

Total annual net growth outpaced total removals by a ratio (G:R) of 2.3:1 in 2016, although ratios varied considerably among species (Fig. 5). Among the five most voluminous species, yellow-poplar had the largest net growth to removals ratio (3.7:1) and white oak had the smallest (1.1:1). As a percentage of current net volume, annual mortality averaged slightly less than 1 percent on timberland. Of the prominent species, sweetgum had the highest mortality rate (0.9 percent per year) (Fig. 5).

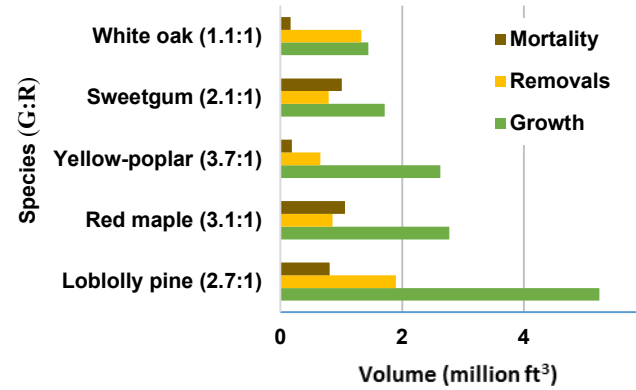

Figure 5.—Average annual net growth, removals, and mortality of net volume on timberland, and net growth to removals ratio (G:R) for select species, Delaware, 2016.

Table 2.—Top 10 species by net volume and percentage change since 2011 on forest land; sawtimber volume and percentage change since 2011 on timberland; and biomass on forest land, Delaware, 2016.

	Volume of live trees on forest land (million ft3)	Sampling error (percent)	Percent change since 2011	Volume of sawtimber trees on timberland (million board feet)	Sampling error (percent)	Percent change since 2011	Aboveground biomass on forest land (thousand tons)	sampling error (percent)
Red maple	197	12.0	8.6	590	15.7	13.6	5,366	11.4
Yellow-poplar	138	23.5	31.2	452	25.2	36.0	2,823	23.1
Loblolly pine	117	18.4	- 3.5	405	20.3	- 6.2	2,637	17.7
Sweetgum	113	14.4	12.9	378	18.9	22.9	2,881	13.8
White oak	75	17.3	21.5	308	20.1	24.6	2,436	17.0
Willow oak	52	32.7	22.5	274	34.1	24.9	1,558	32.4
Blackgum	38	18.6	29.2	111	25.6	39.2	1,050	17.1
Southern red oak	35	24.1	3.0	131	26.8	4.8	1,086	23.7
Scarlet oak	22	32.9	29.9	81	37.0	35.6	776	31.4
Black cherry	20	28.4	-12.8	35	60.3	-15.5	576	25.7
Total of all species	949	5.7	10.3	3,159	8.0	12.4	25,953	5.1

Bacterial Leaf Scorch

Bacterial leaf scorch is an often deadly disease affecting many tree species in Delaware. The bacteria (*Xylella fastidiosa)* restricts the flow of water throughout the tree by colonizing its water transportation system (xylem). Infected trees decline over several years before death. Drought stress can increase the severity of the disease. Infected trees are also more prone to secondary injuries, such as cankers, fungi, and wood boring insects.

Symptoms of infection usually appear during late summer months and can be very similar in appearance to drought stress. Leaves die from the tips towards the base and often have a yellow band separating the green and brown tissue. The red oak group contains many of the most commonly infected species. Many other species are also infected by the disease, such as maples, sweetgum and members of the white oak group. The average annual mortality rate on forest land of the red oak group for 2016 was 2.1 percent of its net volume, twice the average annual mortality rate of all species at 1 percent. Sweetgum had the second highest annual mortality rate of susceptible species at 1.2 percent. Other susceptible species did not have a large enough sample size to be included. Mortality rates listed in Figure 6 are from all causes and are not solely representative of mortality from bacterial leaf scorch. However, bacterial leaf scorch is a known issue in the state that could be affecting mortality. Continued monitoring of susceptible species will be necessary to determine long-term impacts.

Bacterial leaf scorch (*Xylella fastidiosa*) damage. Photo by Nancy Gregory, University of Delaware, from Bugwood.org.

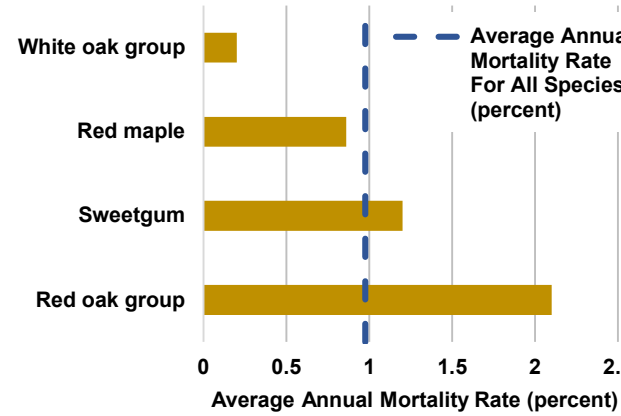

Figure 6. — Average annual mortality rate for species susceptible to bacterial leaf scorch (calculated as the proportion of annual mortality volume to net live volume on forest land), Delaware, 2016.

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More information on Delaware Forests

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