



# Forests of Pennsylvania, 2013

This publication provides an overview of the forest resources in Pennsylvania based upon inventories conducted by the USDA Forest Service, Forest Inventory and Analysis (FIA) program of the Northern Research Station. Information about the national and regional FIA program is available online at <http://fia.fs.fed.us>.

Since 1999, FIA has implemented an annual inventory measuring data on 20 percent of sample plots each year. For the 2013 inventory, estimates for current variables such as area, volume, and biomass are based on 3,015 forested plots inventoried from 2009-2013. Change variables such as net growth, removals, and mortality are based on 2,750 samples collected in 2004-2008 and resampled in 2009-2013. There are additional tables available online (<http://www.nrs.fs.fed.us/fia/data-tools/state-reports/PA/default.asp>). See Bechtold and Patterson (2005) and O'Connell et al. (2014) for definitions and technical details.

## Overview

It is estimated that Pennsylvania contains almost 17 million acres of forest land (Table 1). The acreage of forest land has been quite stable since 1965, covering 59 percent of the total area of the Commonwealth (Ferguson 1968). The number of live trees greater than 1-inch in diameter at breast height (d.b.h.) is approaching 8.3 billion trees.

The estimate for aboveground biomass of all live trees has increased almost 7 percent since 2008. Over the same period, the average annual volume for tree growth has been unchanged, with a slight increase in tree mortality. Tree harvest levels have decreased since 2008 (McCaskill et al. 2011).

**Table 1.—Pennsylvania forest statistics, 2013 and 2008. Volumes are for 5-inch and larger diameter trees. Number of trees and biomass are for 1-inch and larger diameter trees. Sampling errors represent 68-percent confidence intervals**

	2013 Estimate	Sampling error (percent)	2008 Estimate	Sampling error (percent)	Change since 2008 (percent)
<b>Forest Land</b>					
Area (thousand acres)	16,999	0.6	16,652	0.7	2.1
Number of live trees (million trees)	8,289	1.7	8,349	1.7	-0.7
Aboveground biomass of live trees (thousand oven-dry tons)	1,085,127	1.0	1,014,784	1.0	6.9
Net volume of live trees (million ft <sup>3</sup> )	38,021	1.0	35,386	1.1	7.4
Annual net growth of live trees (thousand ft <sup>3</sup> /yr)	846,548	3.0	843,899	3.0	0.3
Annual mortality of live trees (thousand ft <sup>3</sup> /yr)	336,706	4.0	316,549	4.7	6.4
Annual harvest removals of live trees (thousand ft <sup>3</sup> /yr)	344,692	7.8	421,475	7.9	-18.2
Annual other removals of live trees (thousand ft <sup>3</sup> /yr)	12,045	27.9	22,014	43.3	-45.3
<b>Timberland</b>					
Area (thousand acres)	16,419	0.7	16,048	0.8	2.3
Number of live trees (million trees)	8,046	1.7	8,103	1.7	-0.7
Aboveground biomass of live trees (thousand oven-dry tons)	1,041,418	1.0	975,943	1.1	6.7
Net volume of live trees (million ft <sup>3</sup> )	36,482	1.1	34,035	1.2	7.2
Net volume of growing stock trees (million ft <sup>3</sup> )	33,331	1.2	31,897	1.2	4.5
Annual net growth of growing stock trees (thousand ft <sup>3</sup> /yr)	699,581	2.7	734,529	2.8	-4.8
Annual mortality of growing stock trees (thousand ft <sup>3</sup> /yr)	246,209	4.5	233,169	5.2	5.6
Annual harvest removals of growing stock trees (thousand ft <sup>3</sup> /yr)	292,374	7.9	356,723	7.9	-18.0
Annual other removals of growing stock trees (thousand ft <sup>3</sup> /yr)	15,557	30.3	20,424	41.2	-23.8



# Forest Area

Pennsylvania’s forest land area has been very stable since 1965, with a small upturn since the annual inventory was initiated (Fig. 1). Commercial timberland makes up 97 percent of this total forested area. Public ownership represents 30 percent of the Commonwealth’s forested area while 70 percent is in private (family, corporate, club) ownerships (Fig. 2). The stand-size classes representing the stocking for statewide timberlands are out of balance. Acreage in the large-diameter stands has continued to increase since the early 1980s while the area in small-diameter stands has decreased (Fig. 3).

Currently, the proportions of timberland in large- and small-diameter stands are at their highest (67 percent) and lowest (10 percent) levels, respectively, for any FIA inventory.

Individually, the area of forest land in the major oak and oak-hickory forest types illustrates this unbalanced statewide distribution with less than 3 percent of their acreages dominated with small-diameter stands. The extensive maple-beech-birch forest type has 4.5 percent of its acreage in small-diameter stands, while the black cherry and the cherry-ash-yellow-poplar forest types have greater balance with small-diameter stands representing 18.3 and 13.5 percent, respectively (Fig. 4).

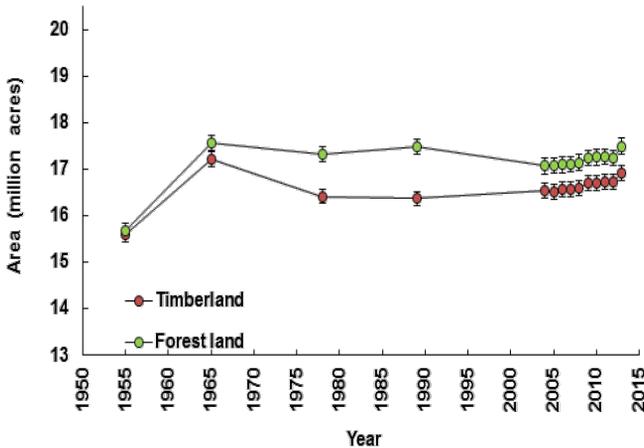


Figure 1. —Forest land and timberland by year, Pennsylvania, 1955-2013. Error bars represent 68-percent confidence intervals.

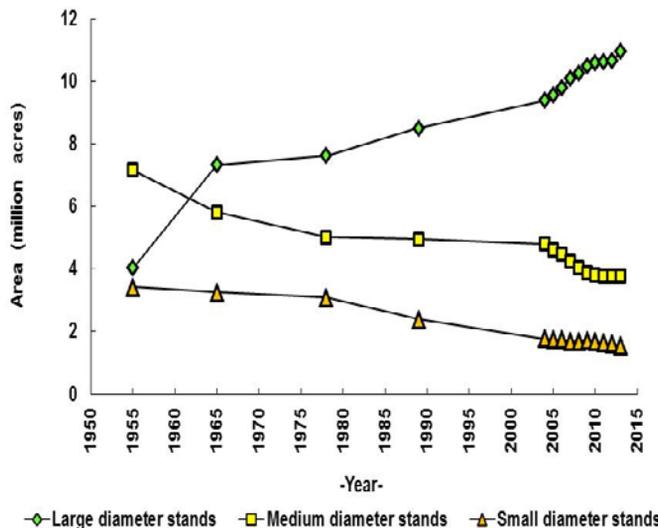


Figure 3. — Timberland by stand-size class\* and survey year, Pennsylvania, 1955-2013.

\*Small: dominated by saplings <5.0 inches d.b.h.; Medium: dominated by poletimber trees 5.0 to 8.9 inches d.b.h. for softwoods and 5.0 to 10.9 inches d.b.h. for hardwoods; Large: dominated by sawtimber trees ≥9.0 inches for softwoods and 11.0 inches d.b.h. for hardwoods.

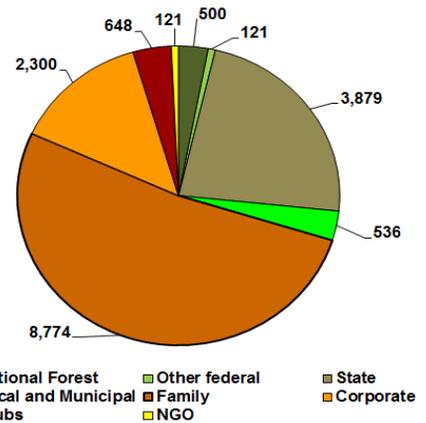


Figure 2. — Ownership groups on forest land (1,000 acres), Pennsylvania, 2013.

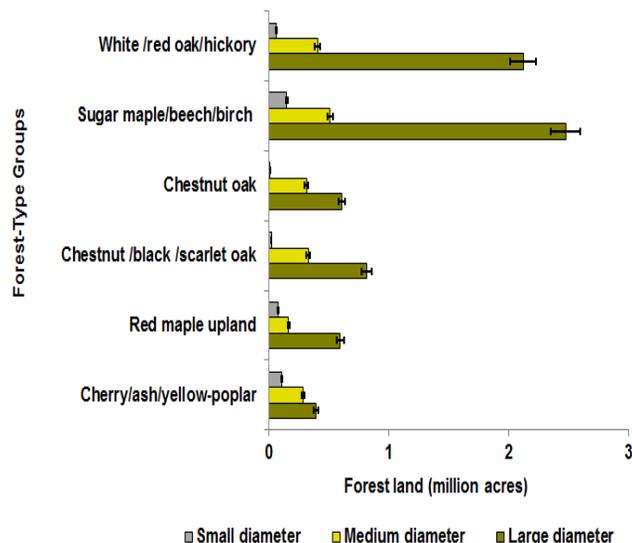


Figure 4. — Forest land by stand-size class\* for the major forest types and forest-type groups in acres, Pennsylvania, 2013.

## Volume, Biomass, and Trends

Pennsylvania contains more than 38 billion cubic feet of wood within its forests, an increase of 7 percent since 2008.

The major differences between individual species are highlighted in Table 2.

There are more than twice the number of red maples and almost double the cubic-foot volume when compared to any of the other major tree species. Black cherry and northern red oak are a distant second in cubic-foot volume. Yellow-poplar has the least number of trees while sweet birch has the lowest volume of the 10 major species.

Each tree greater than 4.9 inches d.b.h. found within the State represents on average 16 cubic feet of volume. A yellow-poplar tree represents a high of 36 cubic feet, while a sweet birch tree represents the low of 9 cubic feet.

Red maple contain the most biomass, followed by northern red oak and black cherry, while eastern hemlock and yellow-poplar contain the least amount for the 10 major species.

The species with the highest net annual growth as percent of standing volume are yellow-poplar (3.5 percent), black cherry (2.4 percent), and northern red oak (2.2 percent). Species with the least growth are white oak (1.3 percent) and chestnut oak (1.0 percent). Statewide, the overall annual growth rate is 2.0 percent of the standing volume.

The species with the highest mortality as percent of gross growth, are chestnut oak (55 percent), eastern hemlock (38 percent), and white oak (37 percent), while the lowest mortality are red maple (14.1 percent) and yellow-poplar (4.4 percent).

The interacting effects of growth rates and harvesting on net volume can be calculated over a 5-year cycle from the annual inventory data:

$$V_c = \frac{5(G-H)}{V_n}$$

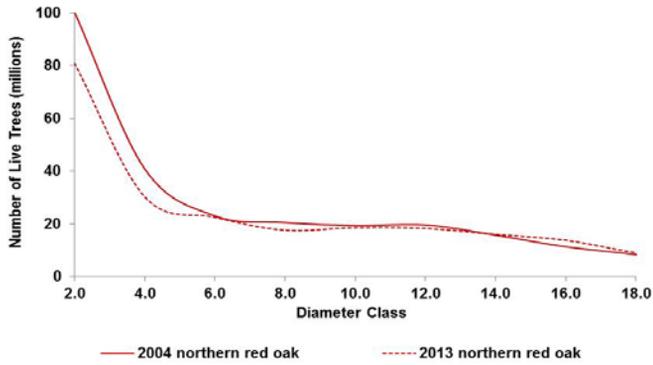
where  $V_c$  is the volume change,  $G$  is annual net growth,  $H$  is annual harvest removals, and  $V_n$  is ending net volume.

The largest accruals (gains in volume) are observed in yellow-poplar (11.7 percent), black cherry (8.7 percent), and sweet birch (8.4 percent). The lowest accruals are observed in chestnut oak (2.7 percent) and white oak (2.0 percent). There were no net depletions (losses in volume) observed in the 10 most common species found in the Commonwealth of Pennsylvania.

**Table 2.—Numbers, growing-stock (GS) tree volume, sawlog volume, oven-dry biomass, net growth, mortality, and harvest removals of GS trees on forest land, by major species, Pennsylvania, 2013**

Species	GS trees (million trees)	Net volume GS trees (million ft <sup>3</sup> )	Net volume sawlog trees (million bd.ft.)	Aboveground biomass (thousand tons)	Net growth (thousand ft <sup>3</sup> /yr)	Net mortality (thousand ft <sup>3</sup> /yr)	Harvest Removals (thousand ft <sup>3</sup> /yr)
Red maple	497	6,331	17,869	190,240	137,360	22,548	40,740
Black cherry	173	3,665	13,904	106,346	86,426	19,985	22,764
Northern red oak	131	3,657	15,882	120,172	80,465	24,353	35,463
Sugar maple	168	2,625	8,556	88,060	53,077	14,611	23,372
Chestnut oak	150	2,394	7,518	85,064	23,002	28,210	10,277
Eastern hemlock	138	1,786	5,862	37,736	27,517	16,822	13,916
Yellow-poplar	48	1,774	8,176	36,927	61,745	3,703	20,363
White ash	81	1,590	5,895	52,849	33,720	14,799	24,473
White oak	87	1,602	5,910	53,616	21,609	12,873	15,277
Sweet birch	153	1,492	3,280	59,952	32,571	8,703	7,634
Other softwood species	117	1,577	5,884	32,288	37,122	12,259	20,734
Other hardwood species	408	6,275	21,116	221,876	113,679	78,471	57,361
<b>All species</b>	<b>2,151</b>	<b>34,768</b>	<b>119,852</b>	<b>1,085,126</b>	<b>708,293</b>	<b>257,337</b>	<b>292,374</b>

## Can Regeneration Catch Up with a Mounting Poletimber Deficit ?



**Figure 5. — Number of live northern red oak trees 1 inch d.b.h. and greater on forest land Pennsylvania, 2004 and 2013.**

There is a concern for the lack of regeneration in the hardwood forests of Pennsylvania due largely to intensive deer browsing within limited early successional habitat and the potential impacts of this activity on stocking and species composition if the current situation continues. The lack of regeneration may be even more evident as one evaluates Pennsylvania's pole-sized timber resources. A comparison of 2000-2004 inventory with 2010-2013 data indicates that the overall number of oak trees in the sapling and pole-sized diameter classes is declining (Figs. 5, 6). This event is even more obvious in Figure 6,

## Literature Cited

Bechtold, W.A.; Patterson, P.L., eds. 2005. **The enhanced forest inventory and analysis program: national sampling design and estimation procedures**. Gen. Tech. Rep. SRS-80. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 85 p.

Ferguson, R.H. 1968. **The timber resources of Pennsylvania**. Resour. Bull. NE-8. Upper Darby, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 147 p.

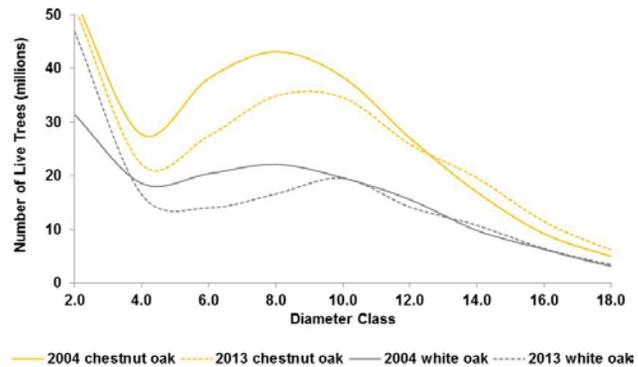
McCaskill, G.L.; McWilliams, W.H.; Butler, B.J.; Meneguzzo, D.M.; Barnett, C. J.; Hansen, M.H. 2011. **Pennsylvania's forest resources, 2008**. Res. Note NRS-89. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 4 p.

### How to Cite This Publication

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**Figure 6. — Number of live chestnut and white oak trees 1 inch d.b.h. and greater on forest land Pennsylvania, 2004 and 2013.**

which shows the troughs for chestnut and white oak tree numbers broadening, while the peaks become smaller as they shift toward the saw log-sized diameter classes. Both graphs also indicate that the only tree numbers increasing are found in the 14-inch diameter classes or greater as the oak forests mature. The same 2000-2013 FIA data also shows a drop in the average statewide numbers of pole-sized trees per acre of all species combined, from a high of 180 to a low of 155 trees, a 15 percent decrease.

O'Connell, B.M.; LaPoint, E.B.; Turner, J.A.; et al. 2014. **The Forest Inventory and Analysis database: database description and users manual version 6.0 for Phase 2**. Washington, DC: U.S. Department of Agriculture, Forest Service.

<http://www.fia.fs.fed.us/library/database-documentation/>

## Other Resources

U.S. Department of Agriculture, Forest Service. 2011. **Forest Inventory and Analysis national core field guide: field data collection procedures for phase 2 plots. Version 5.1**.

<http://www.fia.fs.fed.us/library/field-guides-methods-proc/> (accessed February 2013).

U.S. Department of Agriculture, Forest Service. 2012. **Forest Inventory and Analysis national core field guide: field data collection procedures for phase 2 plots. Version 6.0**.

<http://www.fia.fs.fed.us/library/field-guides-methods-proc/> (accessed February 2013).

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