USDA
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RESOURCE UPDATE FS-127

Forests of Indiana, 2016

This resource update provides an overview of forest resources in Indiana based on an inventory conducted by the U.S. Forest Service, Forest Inventory and Analysis (FIA) program at the Northern Research Station in cooperation with the Indiana Department of Natural Resources. Estimates are based on field data collected using the FIA annualized strategic sample design and are updated yearly. The current 2011-2016 sample set consists of 5,381 plots with 1,372 of them being forested or partially forested. In 2014, NRS-FIA changed to a 7-year inventory cycle, wherein 1/7th (14.3 percent) of the plots will be measured annually until 2020. This report includes inventory years 2011-2016 (2016) with comparisons made to 2007-2011 (2011). Data used in this publication were accessed from the FIA database in May 2017. See Bechtold and Patterson (2005), O'Connell et al. (2017), and Gormanson et al. (2017) for definitions and technical details. FIA estimates, tabular data, and maps may be generated at http://www.fia.fs.fed.us/tools-data/. For more information about the FIA program visit the links on page 4 of this resource update.

Overview

Indiana has nearly 4.9 million acres of forest land. Forested area has increased by about 0.6 percent (28,000 acres) since 2011 (Table 1). Timberland accounts for nearly 97 percent, while the remaining 3 percent of forest is reserved or unproductive. There were an estimated 2.1 billion live trees in 2016, a decrease of 3.3 percent from 2011. The density of trees (≥1 inch) averages 440 trees per acre. Net volume of live trees is 10.7 billion ft^3, a 5.3 percent increase since 2011. Statewide average volume is 2,200 ft^3/acre, or a little over 27 cords/acre. Net volume of sawtimber trees is 26.7 billion board feet (bd ft), an increase of 10.8 percent since 2011. Statewide average sawtimber volume is 5,503 bd ft/acre. Average annual net growth decreased 21.9 percent because the forests are maturing with increasing mortality and increasing tree/stand size. Statewide, average annual net growth is 43 ft^3/acre/year, while annual harvest removals showed no significant change. Annual mortality increased nearly 33 percent between 2011 and 2016; however, as a percentage of net volume, mortality was 1.3 percent, up from 1.1 percent in 2011. Similar trends were observed on Indiana's timberlands (Table 1).

Table 1.—Indiana forest statistics, change between 2011 and 2016

	2011 Estimate	Sampling error (percent)	2016 Estimate	Sampling error (percent)	Percent change since 2011
Forest Land					
Area (1,000 acres)	4,830.4	1.0	4,858.6	1.2	0.6
Number of all live trees ≥1 inch diameter (million trees)	2,200.8	1.8	2,128.1	2.2	-3.3
Net volume of all live trees ≥5 inches diameter (million ft^3)	10,156.0	1.5	10,689.9	1.9	5.3
Net volume of sawtimber trees (million bd ft--Doyle rule)	24,138.3	1.9	26,738.9	2.3	10.8
All live tree aboveground biomass (1,000 oven-dry tons)	264,927.1	1.4	275,333.5	1.7	3.9
Annual net growth of all live trees ≥5 inches (thousand ft^3/yr)	267,514.1	4.3	209,058.3	5.2	-21.9
Annual mortality of all live trees ≥5 inches (thousand ft^3/yr)	107,108.4	6.7	142,346.1	6.0	32.9
Annual harvest removals of all live trees ≥5 inches (thousand ft^3/yr)	79,649.6	15.4	79,618.0	13.4	0.0
Annual other removals of all live on forest land (thousand ft^3/yr)	6,259.7	50.0	14,197.9	30.0	126.8
Timberland					
Area (1,000 acres)	4,679.1	1.1	4,692.3	1.3	0.3
Number of all live trees ≥1 inch diameter (million trees)	2,115.1	1.9	2,045.2	2.3	-3.3
Net volume of all live trees ≥5 inches diameter (million ft^3/yr)	9,824.3	1.6	10,306.1	2.0	4.9
Net volume of sawtimber trees (million bd ft--Doyle rule)	23,558.0	1.9	25,700.9	2.3	9.9
All live tree aboveground biomass (1,000 oven-dry tons)	256,111.1	1.5	265,288.8	1.8	3.6
Annual net growth of growing stock trees ≥5 inches (thousand ft^3/yr)	238,736.0	4.1	199,575..5	4.6	-16.4
Annual mortality of growing stock trees ≥5 inches (thousand ft^3/yr)	79,495.1	7.9	100,162.8	7.0	26.0
Annual harvest removals of growing stock trees ≥5 inches (thousand ft^3/yr)	75,593.1	15.8	70,919.8	13.8	-6.2
Annual other removals of growing-stock on timberland (thousand ft^3/yr)	6,072.6	57.9	12,929.7	34.4	112.9

Forest Area

Indiana is divided into four survey units, with forest land (4.9 million acres) unevenly distributed among units: Northern (1.4 million acres), Lower Wabash (962,000 acres), Upland Flats (669,000 acres), and Knobs (1.84 million acres) (Fig. 1). The three southern survey units comprise about 40 percent of the land and water area but contain over 70 percent of the forest; the Knobs survey unit contains about 40 percent of the forest.

Eighty-four percent or over 4.1 million acres of forest land is privately owned. The state and local government owns 8.1 percent or 394,000 acres of forest land while the Federal government owns roughly 7.5 percent or 370,000 acres. A little over 3 percent or 164,400 acres of forest land is considered reserved.

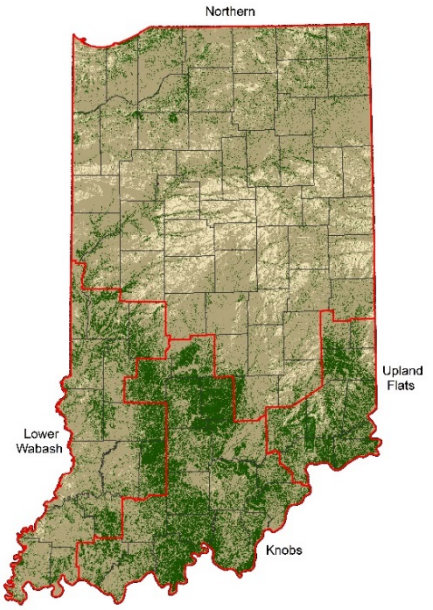


Figure 1.—Forest land (dark green) by survey unit, Indiana.

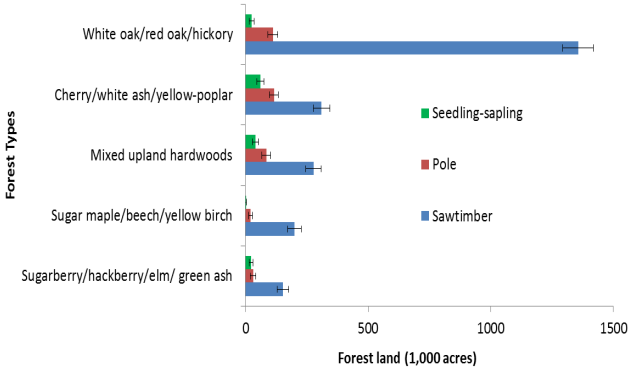
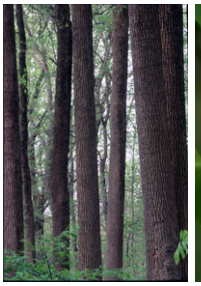
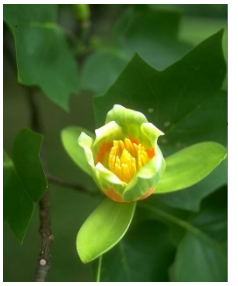


Figure 3.—Area of forest land by five common forest-type groups and stand-size classes, Indiana, 2016. Error bars represent 1 standard error or a 68-percent confidence interval.





The yellow-poplar (tulip-poplar or tuliptree) is the State Tree. Photo by Indiana Department of Natural Resources, used with permission.

Indiana's forest land (4.9 million acres) and timberland (4.7 million acres) has modest increases over the past several decades following a trend since 1967 (Fig. 2); however, it appears that this trend is stabilizing.

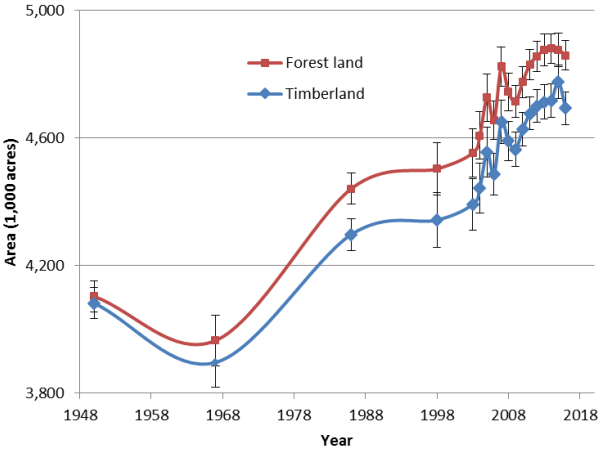


Figure 2.—Area of forest land and timberland in Indiana by inventory year. Error bars represent 1 standard error or a 68-percent confidence interval.

Hardwood species are the dominant species in Indiana. Some forest-type groups are much more common than others. The oak/hickory group alone occupies 71 percent of forest land, the bulk of which resides in the white oak/red oak/hickory forest type (1.5 million acres). Softwoods alone occupy 103,000 acres.The oak/pine group occupies 146,00 acres which represents 3 percent of the forest land.

Forest land consists mainly of sawtimber stands (nearly 80 percent); 13 percent of forest land is made up of poletimber stands, 7 percent contain seedling-sapling stands, and less than 1 percent is considered nonstocked.

Indicative of a maturing (aging) forest, white and red oak/hickory is found primarily in the sawtimber stand-size class (Fig. 3). The cherry/white ash/yellow-poplar forest-type group is less common (485,458 acres) as are the mixed upland hardwoods (401,424 acres). Both show similar distributions across stand-size classes with a large proportion in the pole and sawtimber stand-size classes. The sugar maple/beech/yellow birch forest-type group is relatively abundant (220,571 acres) and occurs mostly in the sawtimber stand-size class (Fig. 3). Currently, about 52 percent of the stands are over 61 years of age.

Volume, Biomass, and Trends

The net volume of trees on forest land increased by 5.3 percent to nearly 10.7 billion ft^3 since 2011 (Table1). Yellow-poplar (*Liriodendron tulipifera*) continues to be the most voluminous species followed by sugar maple (*Acer saccharum*), white oak (*Quercus alba*) and black oak (*Quercus velutina*) (Table 2). Black cherry (*Prunus serotina*), red maple (*Acer rubrum*), American sycamore (*Platanus occidentalis*), and black walnut (*Juglans nigra*) showed the greatest percentage increases in volume since 2011. Of the 93 tree species tallied over the 2016 inventory period, the 12 species shown in Table 2 make up 66 percent of Indiana's total net live tree volume.

Since 2011, sawtimber volume on forest land increased by 10.8 percent to a total of 26.7 billion board feet. Yellow-poplar is the leading sawtimber species by volume, followed by sugar maple and white oak. Sawtimber volume estimates for black cherry, red maple, and black walnut show the greatest percent increases. The 12 species shown below also comprise 72 percent of Indiana's sawtimber volume.

Live tree biomass (aboveground) is estimated at 275.3 million oven-dry tons or about 56.7 tons per acre. The 12 species shown in Table 2 comprise over 66 percent of Indiana's aboveground biomass.

In terms of average annual growth and removals on forest land, yellow-poplar has the greatest growth rate and also the greatest estimated removals of all tree species (Fig. 4). The 2012 drought and tulip-tree scale (*Toumeyella liriodendri*) epidemic in southern Indiana may have lessened the total amount of growth for yellow-poplar; thus without the drought and scale, yellow-poplar growth may have been greater. In addition, removals increased in the southern Indiana Knobs and Upland Flat Survey Units (Fig. 1), where foresters realized that large yellow-poplar may not survive because of drought intolerance and other site conditions.

Tuliptree scale dripping honeydew. Photo by Indiana Department of Natural Resources, used with permission.

Total net annual growth outpaced removals by a ratio (G:R) of 2.6:1 in 2016, although ratios varied considerably among species (Fig. 4). Among the 12 most voluminous species, red maple had the largest growth to removals ratio (10.6:1) and white ash had the smallest (0.0:1).

White ash (*Fraxinus Americana*) and black oak have high mortality rates relative to growth due to emerald ash borer (*Agrilus planipennis*) and oak decline complexes, respectively (Gormanson et al. 2016).

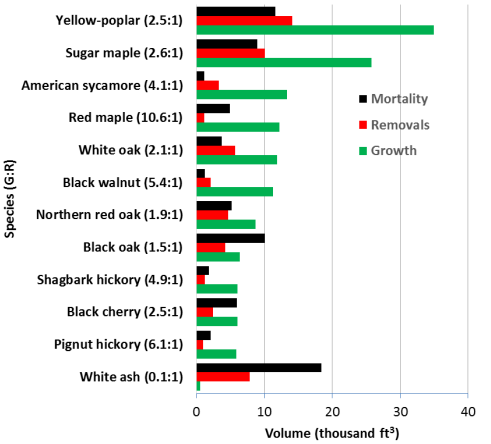


Figure 4.—Average annual net growth, removals, and mortality of net volume on forest land, and growth to removals ratio (G:R) for select species, Indiana, 2016.

Table 2.—Net volume and percent change for 12 species since 2011 on forest land; sawtimber volume and percent change since 2011 on forest land; and biomass on forest land, Indiana, 2016.

volume	Volume of live trees on forest land (million ft^3)[a.]	Sampling error (percent)	Percent change since 2011	Volume of sawtimber trees on forest land (million bd ft--Doyle)	Sampling error (percent)	Percent change since 2011	Aboveground biomass on forest land (thousand tons)	Sampling error (percent)
Yellow-poplar	1,243.1	6.9	7.2	4,053.6	7.4	10.8	23,612	6.7
Sugar maple	1,136.9	5.2	6.4	2,216.2	6.3	10.3	33,601	4.9
White oak	770.7	6.7	3.8	2,206.4	6.9	6.9	21,259	6.6
Black oak	570.7	7.5	4.4	1,772.7	8.8	11.1	15,655	8.4
White ash	535.2	6.7	-4.6	1,290.3	8.9	-1.3	14,574	7.1
American sycamore	508.2	10.1	18.9	1,720.9	10.9	21.3	10,381	9.9
Red maple	501.8	9.1	9.2	1,026.8	10.9	17.8	12,062	8.6
Northern red oak	428.4	8.4	-7.3	1,427.8	8.8	-0.1	12,010	8.2
Black cherry	375.1	8.6	16.5	609.9	11.2	48.9	9,178	8.0
Shagbark hickory	362.8	7.8	-2.1	861.8	8.6	-2.3	11,484	7.6
Black walnut	338.2	7.9	12.9	692.3	9.8	19.9	8,297	7.6
Pignut hickory	316.0	8.0	4.5	779.4	8.9	9.4	9,887	7.8
Total of all species	10,689.9	1.9	5.3	26,738.9	2.3	10.8	275,333	1.7

[a.] *Trees ≥ 5 inches in diameter*

Invasive Plant Species

Invasive plant species (IPS) are both native and nonnative species that can cause negative ecological effects. These species can quickly invade forests, changing light, nutrient, and water availability. IPS can form dense monocultures which not only reduce regeneration but also impact wildlife quality through altering forest structure and forage availability. Aside from the invasive species' effects on forested environments, they can also impact agricultural systems. An example is common barberry (*Berberis vulgaris*), an alternate host for wheat stem rust (*Puccinia graminis*), which can cause the compete loss of grain fields. Common buckthorn (*Rhamnus cathartica*) is another troublesome IPS as it is an alternate host for the soybean aphid (*Aphis glycines*). While there are some beneficial uses for these invaders, (e.g., reed canarygrass (*Phalaris arundinacea*) has culinary, medicinal, and soil contaminant extraction uses [Kurtz 2013]), the negative effects are worrisome. Each year the inspection, management, and mitigation of IPS costs billions of dollars nationally.

In 2016, FIA assessed the presence and cover of 40 IPS (nonnative bush honeysuckles [*Lonicera* spp.] counted as one species) on 173 forested plots in Indiana. One hundred and sixty (92 percent) of the plots had one or more invasive plant species. These species were found throughout the state. The number of IPS observed per plot ranged from zero (13 plots) to eight (3 plots; Fig. 5). When considering at this figure, it is important to remember that this inventory is only on forest land so areas with less forest have fewer plots. Throughout the State, 20 IPS were observed with multiflora rose the most common invasive plant species (136 plots; 79 percent). Five IPS—multiflora rose (*Rosa multiflora*), nonnative bush honeysuckle, Japanese honeysuckle (*Lonicera japonica)*, Japanese stiltgrass (*Microstegium vimineum*), and garlic mustard (*Alliaria petiolata*)— were found on over one-quarter of the plots (Table 3). It is important to continue monitoring IPS as these species pose a threat to Indiana's forest land.

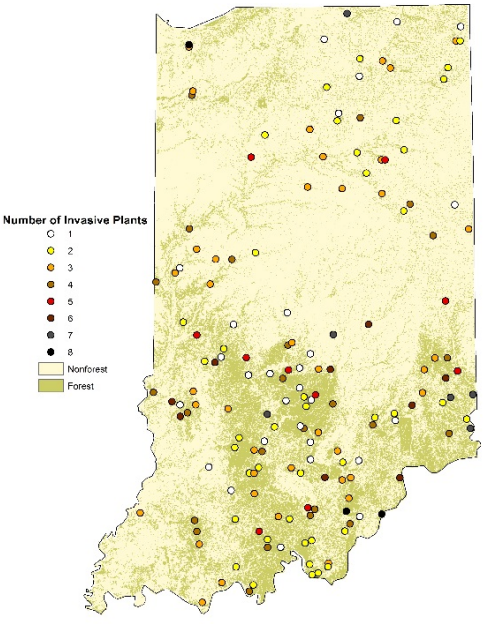


Figure 5.—Number of invasive plant species per plot, Indiana, 2016.

Table 3. —Most common invasive plant species found in Indiana

Invasive Plant Species	No. Plots (%)
Multiflora rose	136 (79%)
Nonnative bush honeysuckle	62 (36%)
Japanese honeysuckle	57 (33%)
Japanese stiltgrass	54 (31%)
Garlic mustard	41 (31%)
Autumn olive	32 (18%)

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How to Cite This Publication
Gormanson, Dale D.; Kurtz, Cassandra M. 2017. **Forests of Indiana, 2016**. Resource Update FS-127. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 4 p.

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Contact Information
Dale D. Gormanson, Forester
USDA Forest Service, Northern Research Station
1992 Folwell Ave.
St. Paul, MN 55108
Ph: 651-649-5126/ Fax:651-649-5140
dgormanson@fs.fed.us

The published report is available online at https://doi.org/10.2737/FS-RU-127