



Forests of Indiana, 2013

Overview

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 estimates presented in this update are for the measurement years 2009-2013 with comparisons between estimates reported in 2008. The current, 2009-2013 sample set consists of 7,065 plots with 1,809 of them being forested or partially forested. About 20 percent of the plots were measured each year with observations collected across a period of 5 years. Data used in this publication were accessed from the FIA Database in April 2014. See Bechtold and Patterson (2005) and O’Connell et al. (2013) for definitions and technical details.

Currently, Indiana houses nearly 4.9 million acres of forest land. Forested area has increased by about 2.8 percent (131,200 acres) since 2008 (Table 1). Timberland accounts for nearly 97 percent, while the remaining 3 percent of forest is reserved or unproductive. The number of live trees on Indiana’s forest land in 2013 was estimated at 2.2 billion trees, an increase of 0.8 percent from 2008. Statewide, the number of trees, one inch and larger per acre in 2013 averages 454. Net volume (10.4 billion ft³) experienced an increase of about 6.5 percent, which statewide in 2013, averages 2.1 thousand cubic feet per acre (statewide, about 26 cords per acre). Live tree biomass (above ground) is estimated at 270.4 million oven-dry tons or statewide, on average, about 55.5 tons per acre. Average annual net growth decreased by 32.4 percent partly due to reversions of nonforest to forest¹. Statewide, average annual net growth is 48 cubic feet per acre per year while annual harvest removals decreased by 12.6 percent. Annual mortality increased by 20.0 percent between 2008 and 2013; however, when put in perspective as a percentage of net volume, mortality in 2008 was 1.0 percent of net volume and mortality in 2013 was 1.14 percent of net volume, a difference of only 0.14 percent. Similar trends were observed on Indiana’s timberlands (Table 1).

Table 1.—Indiana forest statistics, change between 2008 and 2013

	2008 Estimate	Sampling error (percent)	2013 Estimate	Sampling error (percent)	Percent change since 2008
Forest Land					
Area (thousand acres)	4,744.2	1.3	4,875.4	1.1	2.8
Number of live trees ≥ 1 in diameter (million trees)	2,194	2.3	2,211.8	2.0	0.8
Net volume live trees ≥ 5 in diameter (million ft ³)	9,785.8	2.0	10,419.5	1.6	6.5
Live tree aboveground biomass (thousand oven-dry tons)	256,602.8	1.8	270,440.0	1.5	5.4
Net growth live trees ≥ 5 in (thousand ft ³ /yr)	348,535.9	5.0	235,698.4	4.5	-32.4
Harvest removals of live trees ≥ 5 in (thousand ft ³ /yr)	82,013.9	14.8	71,709.7	14.8	-12.6
Annual mortality of live trees ≥ 5 in (thousand ft ³ /yr)	98,585.6	8.3	118,326.2	6.4	20.0
Timberland					
Area (thousand acres)	4,588.0	1.3	4,715.3	1.1	2.8
Number of live trees ≥ 1 in diameter (million trees)	2,109.0	2.3	2,122.5	2.0	0.6
Net volume live trees ≥ 5 in diameter (million ft ³ /yr)	9,436.0	2.0	10,055.7	1.7	6.6
Live tree aboveground biomass (thousand oven-dry tons)	247,448.6	1.9	260,805.6	1.6	5.4
Net growth of growing-stock trees ≥ 5 in (thousand ft ³ /yr)	304,987.4	5.2	217,551.5	4.3	-28.7
Harvest removals of growing-stock trees ≥ 5 in (thousand ft ³ /yr)	72,334.0	15.6	65,609.5	15.1	-9.3
Annual mortality of growing-stock trees ≥ 5 in (thousand ft ³ /yr)	74,707.2	9.6	85,243.6	7.5	14.1

¹ Some nonforest to forest reversions that occurred during and prior to the 1990’s to early 2000’s were not identified until early on in the adoption of the annual inventory system and stem from use of enhanced imagery and GIS technology that began in the early 2000’s. We improved our ability to detect forest early on in the implementation of the annual inventory system and thus, more plots were field measured. As a result, higher estimates of growth were recorded in earlier annual inventories resulting in an artificially inflated growth estimate.



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 (930 thousand acres), Upland Flats (676 thousand acres), and Knobs (1.9 million acres (Fig. 1). The three southern tier survey units comprise about 40 percent of the land and water area but contain over 70 percent of the forest with the Knobs survey unit containing about 40 percent of the forest.

Eighty three percent or over 4.02 million acres of forest land is privately owned. The state owns 7.5 percent or 365 thousand acres of forest land while the federal government owns roughly eight percent or 380 thousand acres. A little over 3 percent or 159 thousand acres of forest land is considered reserved.

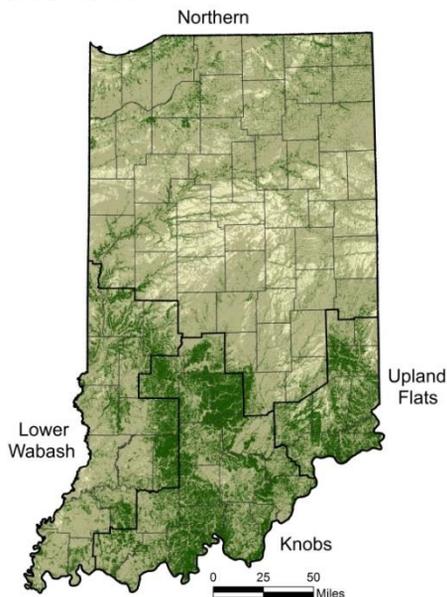


Figure 1.—Forest land (dark green) by survey unit, Indiana.

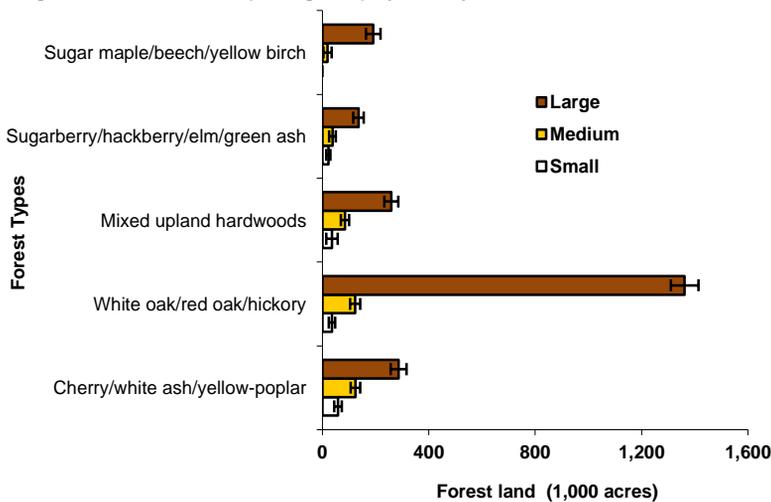


Figure 3.—Area of forest land by five most common forest-type groups and stand-size classes, Indiana, 2013. Error bars represent one standard error, the 66 percent confidence interval.

The total area of 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).

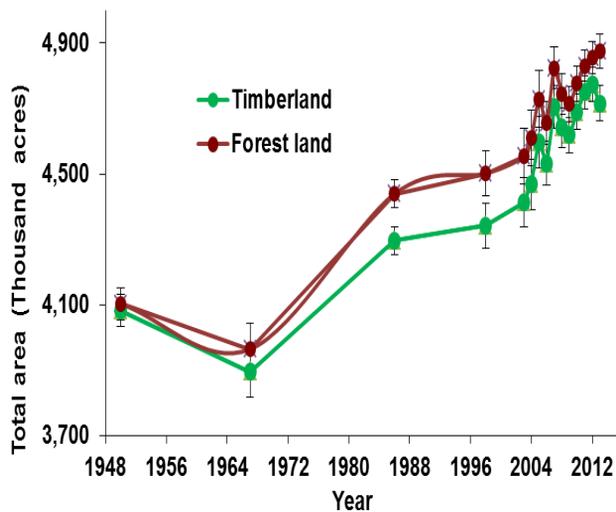


Figure 2.—Area of forest land and timberland by year, Indiana.

Hardwoods are the dominant species in Indiana. Some forest-type groups are much more common than others. The oak/hickory group alone occupies 72 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 thousand acres. The oak/pine group occupies almost 160,000 acres which represents 3 percent of the forest land wood basket.

Forest land consists mainly of sawtimber stands (78 percent); 15 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 large stand-size class (Fig. 3). The cherry/white ash/yellow - poplar group is less common (470 thousand acres) as are the mixed upland hardwoods (375 thousand acres). Both show similar distributions across stand-size classes with a large proportion in the medium and large diameter classes (Fig. 2). The sugar maple/beech/yellow birch forest-type group is relatively abundant (218 thousand acres) and occurs mostly in large stand-size classes (Fig. 3).

Currently, nearly half (48 percent) of the stands are over 61 years of age.

Volume, Biomass, and Trends

Crews recorded 96 species (including unknowns collected to the genus level) on Indiana forest land in the measurement years included in the 2013 dataset. Hardwoods are the dominate forest land species comprising 97 percent. Sugar maple (*Acer saccharum*) is by far the most numerous tree in Indiana with an estimated 357 million individuals; red maple (*Acer rubrum*) is second behind with an estimated 110 million trees in Indiana (Table 2).

Interestingly, the most numerous species, sugar maple, is not the most voluminous species in the state. That distinction belongs to the State tree, yellow-poplar, a.k.a. the tulip tree (*Liriodendron tulipifera*) with a net volume of nearly 1.23 billion cubic feet. These yellow-poplars also store approximately 23.4 million tons of woody biomass in their tissues.

Of the top 10 most voluminous species, yellow-poplar and sugar maple are growing the most vigorously with each accumulating over 39 and 26 million cubic feet per year respectively.

Black oak followed by yellow-poplar, white ash (see next section), and sugar maple show the highest mortality in Indiana. Black oaks that are stressed from drought, gypsy moth defoliation, old age, fire, poor site conditions, or other factors often succumb to secondary agents such as twolined chestnut borer (*Agilus bilineatus*), Hypoxylon canker (*Hypoxylon mammatum*), and shoestring root rot (*Armillaria mellea*). This scenario, in which a primary agent stresses the tree and a secondary agent kills it, is known as "oak decline" and is responsible for considerable black oak mortality.

Several species are removed in harvests, but yellow-poplar removals are nearly double or more, by volume, than most species except sugar maple (Table 2).

Biomass is distributed throughout the State, with the largest concentrations in the southern tier of Indiana (Fig. 4)

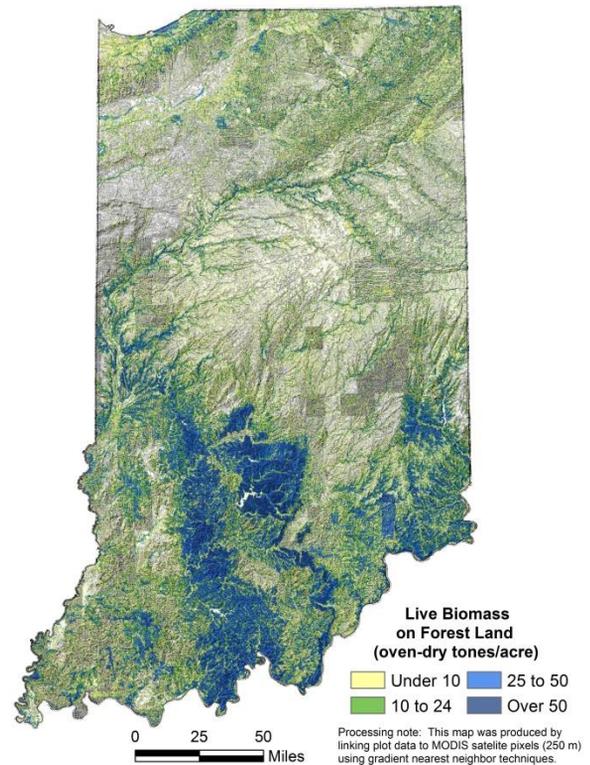


Figure 4.—Distribution of live-tree and sapling biomass on forest land, Indiana 2013

Table 2.—Number, volume, biomass, growth, mortality, and removals of live trees on forest land by species of the top 10 tree species by net volume, Indiana, 2009-2013.

Common Name	Latin Name	Million Trees ^a	Net Volume ^b (million ft ³)	Aboveground Biomass ^a (thousand dry tons)	Average Annual Net Growth ^b (thousand ft ³)	Average Annual Mortality ^b (thousand ft ³)	Average Annual Harvest Removals ^b (thousand ft ³)
Yellow-poplar	<i>Liriodendron tulipifera</i>	79.15	1,229.4	23,438.74	39,123.46	8,572.02	13,320.47
Sugar maple	<i>Acer saccharum</i>	356.84	1,083.08	32,231.91	26,471.56	7,631.22	8,004.54
White oak	<i>Quercus alba</i>	37.26	766.71	21,185.12	13,067.94	4,284.65	5,102.9
White ash	<i>Fraxinus americana</i>	102.19	574.4	15,687.87	12,336.97	7,879.76	6,275.7
Black oak	<i>Quercus velutina</i>	33.92	554.77	15,279.53	6,746.06	10,116.66	6,718.2
Red maple	<i>Acer rubrum</i>	110.16	465.74	11,411.58	13,233.55	3,008.57	1,035.61
Northern red oak	<i>Quercus rubra</i>	25.02	456.52	12,800.2	10,879.95	4,433.74	3,836.44
American sycamore	<i>Platanus occidentalis</i>	16.96	442.23	9,060.78	13,186.48	1,226.39	2,543.42
Shagbark hickory	<i>Carya ovata</i>	44.86	365.26	1,1591.81	6,582.19	1,075.14	1,619.3
Black cherry	<i>Prunus serotina</i>	105.62	349.52	8,634.17	10,622.88	4,255.22	3,045.37

^a Trees ≥ 1 in diameter

^b Trees ≥ 5 in diameter

Emerald Ash Borer a Significant Threat

The emerald ash borer (EAB) (*Agrilus planipennis*), a wood-boring beetle native to Asia, was identified in Indiana during the spring of 2004, two years after its initial North American discovery. Indiana’s forest land contains an estimated 148.4 million ash trees: white (102.2 million), green (40.7 million), blue (3.4 million), and black (2.1 million) that account for 783.4 million ft³ of volume. Rarely the most abundant species in a stand, ash generally makes up less than 25 percent of the total live-tree basal area (Woodall et al 2011). Distributed throughout the majority of Indiana, ash density is concentrated in the southern half of the State and in the northeastern corner (Fig. 5). Spread over the whole State, an average acre of Indiana forest land contains 7 ash trees. Although ash yellows disease is present in Indiana, EAB is likely to be the largest contributor to ash mortality throughout the State. Ash mortality and EAB has been recorded across much of Indiana forest land. On average, mortality of live ash trees 5-inches and larger is estimated at 805 thousand trees per year between 2009 and 2013 (over 4 million trees), resulting in a loss of nearly 11 million ft³ of volume per year. Due to its ability to cause extensive decline and mortality of ash, as evidenced by the millions of dead trees left in the wake of infestation, EAB represents a significant threat to Indiana’s ash resource and has been under a federal quarantine since 2006, meaning all counties are federally quarantined. In addition, Indiana has also issued its own quarantine for much of the state. The quarantine makes it illegal to move any ash material or hardwood firewood out of the area into non-quarantined areas (Fig 5).

For the most up to date information about EAB visit: www.emeraldashborer.info or <http://www.in.gov/dnr/entomolo/3443.htm>

References

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.

O’Connell, B.M.; LaPoint, E.B.; Turner, J.A.; Ridley, T.; Boyer, D.; Wilson, A.M.; Waddell, K.L.; Pugh, S.A.; Conkling, B.L. 2013. **The Forest Inventory and Analysis database: database description and users manual version 5.16 for Phase 2**. Washington, DC: U.S. Department of Agriculture, Forest Service. (<http://www.fia.fs.fed.us/library/database-documentation/>)

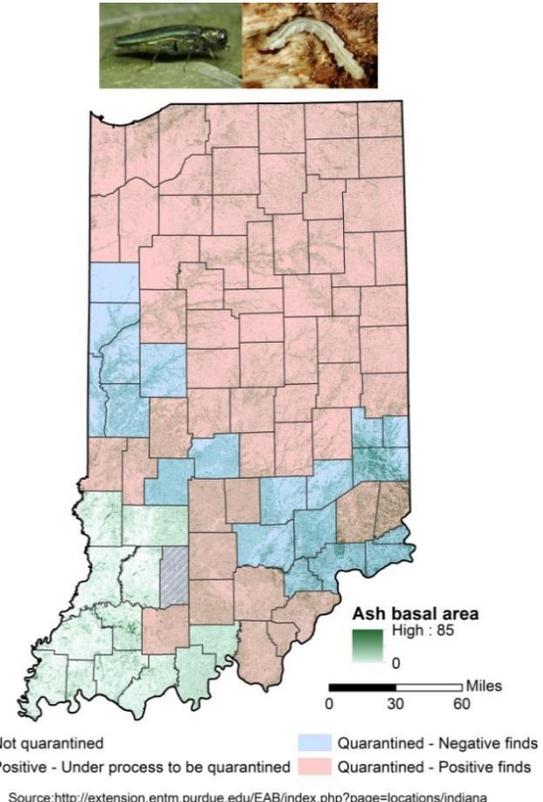


Figure 5.—Ash basal area and State quarantined counties, current as of 3-14-2013. Pink counties have positive EAB findings. Blue counties are quarantined with no EAB findings to date and the hatched county has a positive find and will be quarantined. Pictured at the top left is an adult emerald ash borer and at the right is an emerald ash borer larvae in an ash tree’s phloem area (David Cappaert, Michigan State University, Bugwood.org). The non-native invasive emerald ash borer kills trees when damage from larval phloem (inner bark) or cambium galleries and outer sapwood cavities girdles trees, severing water and nutrient transport and essentially disrupting the living connection between roots and leaves. In effect, the trees starve to death.

Woodall, C.W.; Webb, M.N.; Wilson, B.T.; Settle, J.; Piva, R.J.; Perry, C.H.; Meneguzzo, D.M.; Crocker, S.J.; Butler, B.J.; Hansen, M.; Hatfield, M.; Brand, G.; Barnett, C. 2011. **Indiana’s Forests 2008**. Resour. Bull. NRS-45. Newtown Square: U.S. Department of Agriculture, Forest Service, Northern Research Station. 56 p.

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