USDA
United States Department of Agriculture

RESOURCE UPDATE FS-8

Forests of Indiana, 2013

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.

Overview

Indiana has nearly 4.9 million acres of forest land. Forested area has increased by about 2.8 percent (up 131,200 acres) since 2008 (Table 1). Timberland accounts for nearly 97 percent of that area, while the remaining 3 percent of forest is reserved or unproductive. An estimated at 2.2 billion live trees are on the State's forest land, an increase of 0.8 percent from 2008. Statewide, the density of trees 1 inch and larger averages 454 trees/acre. Net volume (10.4 billion ft^3) experienced an increase of about 6.5 percent, which averages 2,137 ft^3/acre (statewide, or about 27 cords/acre). Live tree aboveground biomass is estimated at 270.4 million oven-dry tons or an average of about 55.5 tons/acre statewide. Average annual net growth decreased by 32.4 percent partly due to reversions of nonforest to forest.[1] Statewide, average annual net growth is 48 ft^3/acre/year while annual harvest removals decreased by 12.6 percent. Annual mortality increased by 20.0 percent between 2008 and 2013; however, 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 prior to early 2000's were not identified until adoption of the annual inventory system and associated use of enhanced imagery and GIS technology. We improved our ability to detect forest at the outset 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 unevenly distributed among units: Northern (1.4 million acres), Lower Wabash (930,000 acres), Upland Flats (676,000 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; the Knobs survey unit contains about 40 percent of the forest.

Eighty-three percent, or 4.02 million acres, of forest land is privately owned. The state +owns 7.5 percent or 365,000 acres of forest land while the Federal government owns roughly 8 percent, or 380,000 acres. A little over 3 percent, or 159,000 acres of forest land is considered reserved.

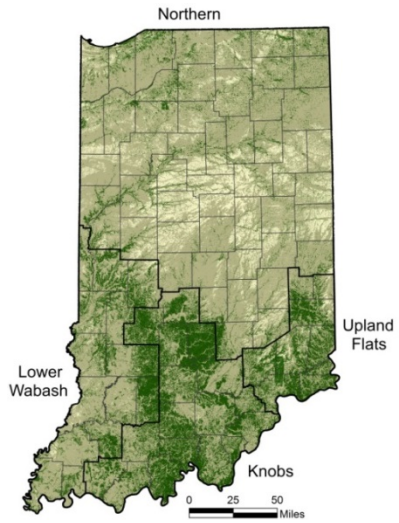

Figure 1.—Forest land (dark green) by survey unit, Indiana.

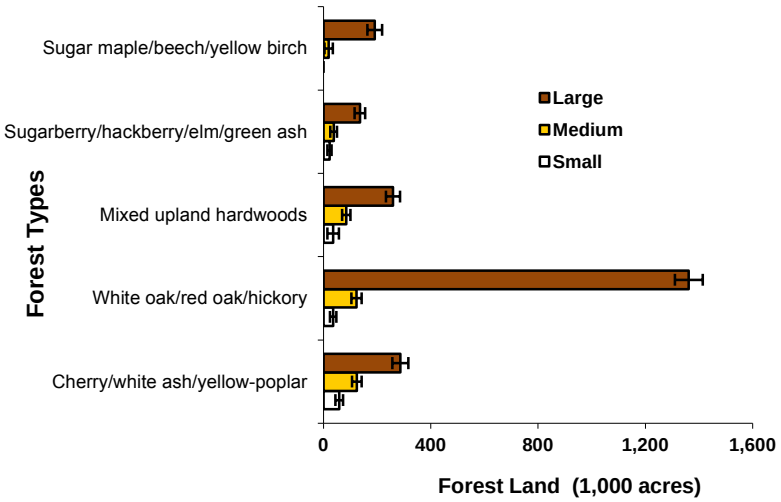

Figure 3.—Area of forest land by five most common forest-type groups and stand-size classes, Indiana, 2013. Error bars represent one standard error, the 66 percent confidence interval.

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).

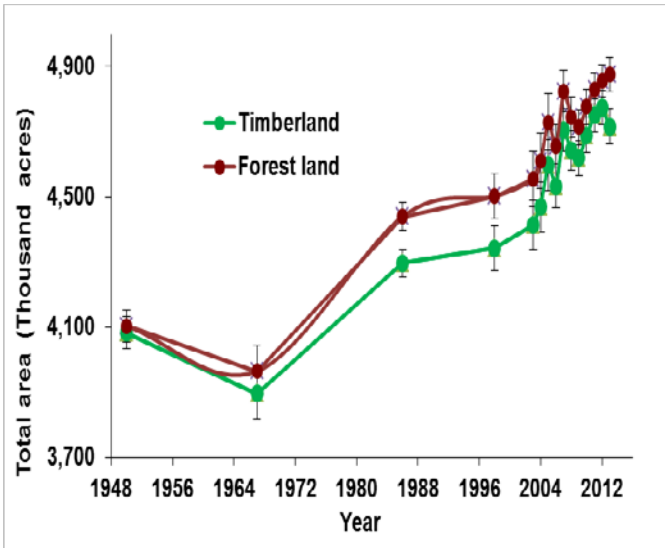

Figure 2.—Area of forest land and timberland by year, Indiana.

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) with the remainder in poletimber, seedling-sapling, and nonstocked at 15, 7, and <1 percent, respectively.

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 (470,000 acres) as are the mixed upland hardwoods (375,000 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 (218,000 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

Field 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 the most numerous tree species in Indiana with an estimated 357 million individuals; red maple (*Acer rubrum*) is second 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, also known as tulip tree (*Liriodendron tulipifera*) with a net volume of nearly 1.23 billion ft^3. 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 ft^3/year, respectively.

Black oak, followed by yellow-poplar, white ash (see next section), and sugar maple had 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 (*Agrilus 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).

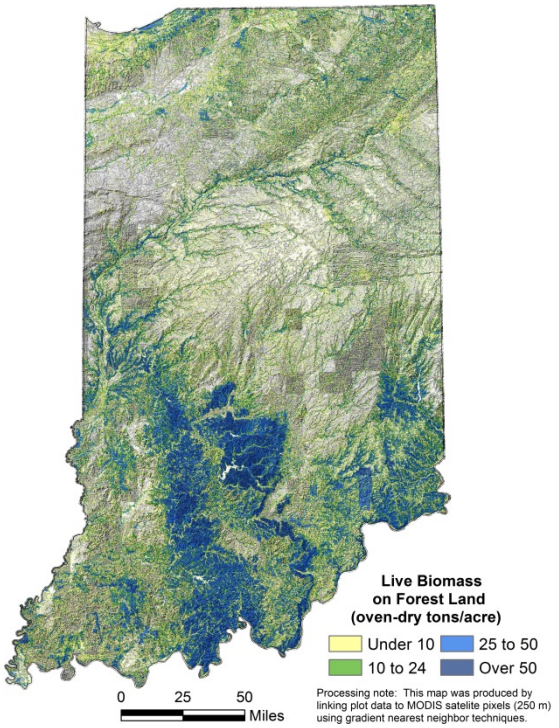

Figure 4.—Distribution of live-tree and sapling biomass on forest land, Indiana 2013.

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

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, 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	*Liriodendron tulipifera*	79.15	1,229.4	23,438.74	39,123.46	8,572.02	13,320.47
Sugar maple	*Acer saccharum*	356.84	1,083.08	32,231.91	26,471.56	7,631.22	8,004.54
White oak	*Quercus alba*	37.26	766.71	21,185.12	13,067.94	4,284.65	5,102.9
White ash	*Fraxinus americana*	102.19	574.4	15,687.87	12,336.97	7,879.76	6,275.7
Black oak	*Quercus velutina*	33.92	554.77	15,279.53	6,746.06	10,116.66	6,718.2
Red maple	*Acer rubrum*	110.16	465.74	11,411.58	13,233.55	3,008.57	1,035.61
Northern red oak	*Quercus rubra*	25.02	456.52	12,800.2	10,879.95	4,433.74	3,836.44
American sycamore	*Platanus occidentalis*	16.96	442.23	9,060.78	13,186.48	1,226.39	2,543.42
Shagbark hickory	*Carya ovata*	44.86	365.26	1,1591.81	6,582.19	1,075.14	1,619.3
Black cherry	*Prunus serotina*	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, 2 years after its initial North American discovery. Indiana's forest land contains an estimated 148.4 million ash trees: white ash (102.2 million), green ash (40.7 million), blue ash (3.4 million), and black ash (2.1 million); ash accounts for 783.4 million ft^3 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 most of Indiana, ash density is concentrated in the southern half of the State (Fig. 5). Though ash grows throughout the State, an average acre of Indiana forest land contains only seven ash trees. Ash yellows disease is present in Indiana, but EAB is likely to be the largest contributor to ash mortality in Indiana.

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 805,000 trees per year between 2009 and 2013 (over 4 million trees), resulting in a loss of nearly 11 million ft^3 of volume per year. Due to its ability to cause extensive decline and mortality of ash, EAB represents a significant threat to Indiana's ash resource. Ash wood 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, making it illegal to move any ash material or hardwood firewood out of the area into nonquarantined areas (Fig 5). For the most current information about EAB visit: www.emeraldashborer.info or http://www.in.gov/dnr/entomolo/3443.htm

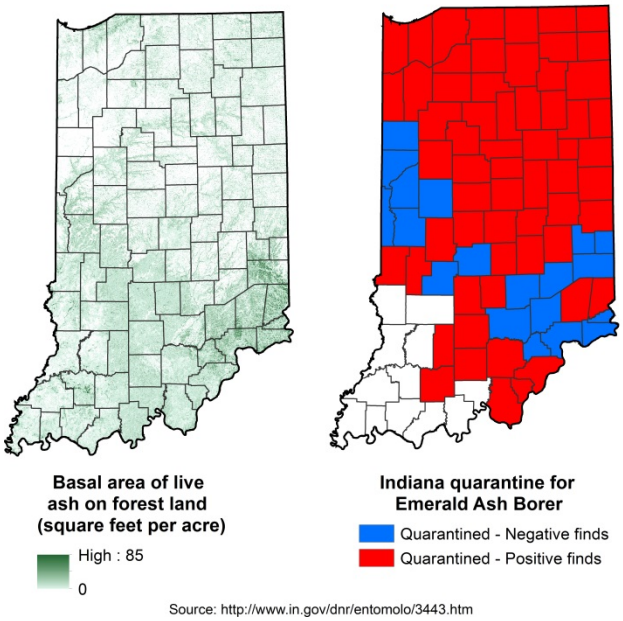

Figure 5.—Ash basal area (left) and State quarantined counties (right), as of March 14, 2013. Red counties have positive EAB findings. Blue counties are quarantined with no EAB findings to date. Pictured at the top left is an adult emerald ash borer and at the right is an emerald ash borer larvae in an ash tree's phloem area (Photo by David Cappaert, Michigan State University, Bugwood.org). The nonnative 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.

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How to Cite This Publication
Gormanson, Dale D. 2014.
Forest of Indiana, 2013.
Resource Update FS-8. Newtown Square,
PA: U.S. Department of Agriculture,
Forest Service, Northern Research Station. 4 p.
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