



# **THE SUSTAINABILITY OF INDIANA'S FOREST RESOURCES 2015**

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## OVERVIEW

This report presents a forest resource sustainability analysis based on data gathered by the Forest Inventory & Analysis (FIA) program, which is part of the Forest Service within the United States Dept. of Agriculture. This data pertains to the forest resources of Indiana and addresses the issue of sustainable forestry being practiced. The FIA program was first implemented in Indiana in 1950 (Hutchison 1956). Subsequent inventories were completed in 1967 (Spencer 1969), 1986 (Spencer *et al.* 1990, Smith and Golitz 1988), 1998 (Schmidt *et al.* 2000), 2003 (Woodall *et al.* 2005), 2008 (Woodall *et al.* 2011), and the latest just completed in 2013 (report in press).

Since 1999, the forests of Indiana are inventoried using an annual inventory system. This allows for dynamic monitoring of Indiana's forest resources with comprehensive reports published every 5 years. The results presented in this report are estimates based on sampling techniques presented by Bechtold and Patterson (2005). Data from some of the most recent Indiana inventories may be accessed through the FIA EVALIDator program web site at <http://apps.fs.fed.us/Evalidator/evalidator.jsp>.

With the annual system, the total sample of plots was systematically divided into five interpenetrating, nonoverlapping subsamples or panels. Each year the plots in a single panel are measured, and panels are selected on a 5-year, rotating basis (McRoberts 1999). For estimation purposes, the measurement of each panel of plots may be considered an independent systematic sample of all land in Indiana. Field crews measure vegetation on plots forested at the time of the last inventory and on plots currently classified as forest by trained photointerpreters, who make their assessment on the basis of aerial photos or digital orthoquads. Such an inventory system allows for annual estimates of forest resource attributes such as area, growth, and removals.

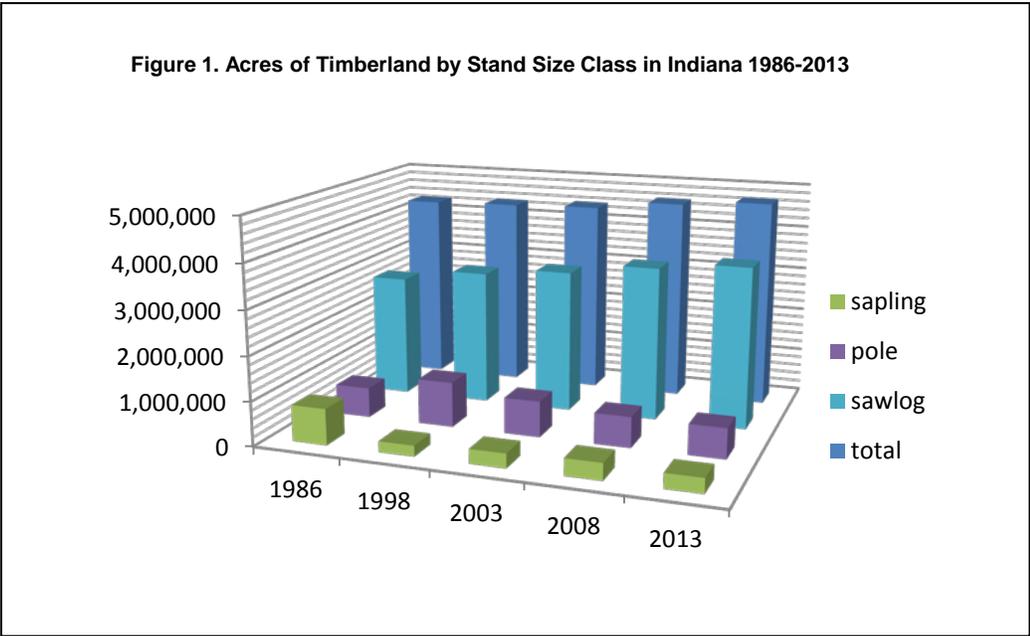
For a detailed explanation of sample layout, collection protocols, and glossary terms, please review Part B of the latest Forest Service publication covering the Indiana inventory (Woodall *et al.* 2006).

## RESULTS

### Area

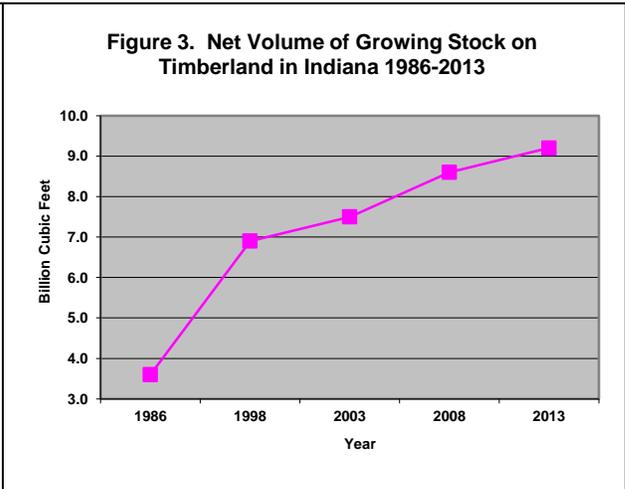
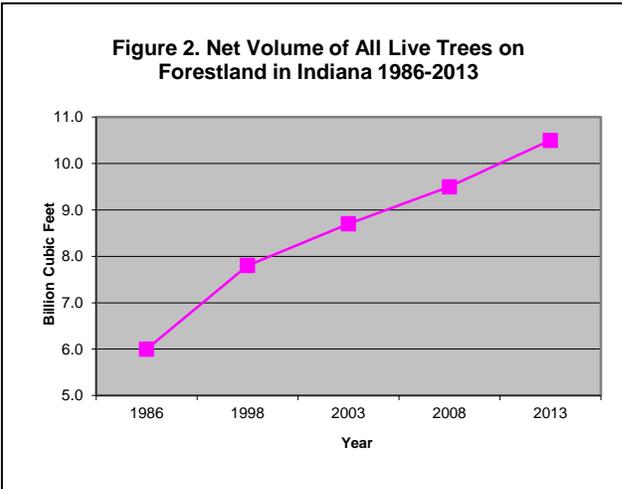
In 2013, forestland area (including reserved or low-productivity land) totaled nearly 4.9 million acres. Private landowners own approximately 84 percent of the forestland with the remainder belonging to public agencies. Hardwoods dominate the occupancy of this area with nearly 97 percent, with the remainder classified as softwoods or nonstocked. Of this 97 percent hardwood, the oak-hickory forest type is most predominant.

Timberland area has continued to increase since the 1986 inventory, with steady increases in the saw timber stand-size class. The area of timberland in the sapling-seedling and pole timber classes has slightly decreased, indicating the natural development of mature timberland stands. This stand development progression is not unusual for hardwood forests managed primarily with single-tree selection harvest methods, as is common in Indiana (Figure 1).



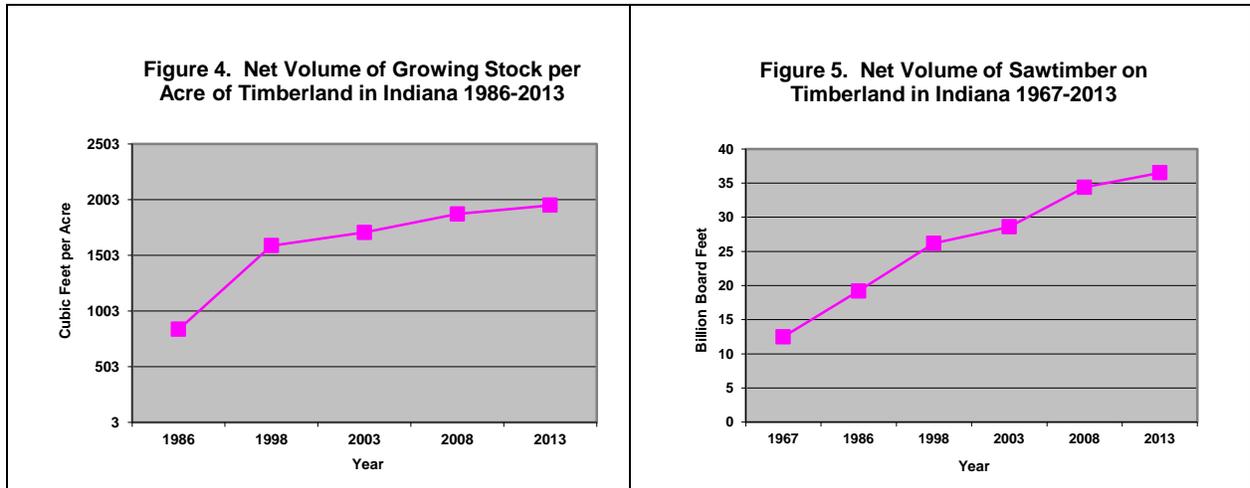
**Volume**

In 2013, the net volume of all live trees on forestland, which includes growing stock, rough, and rotten trees, was over 10.5 billion cubic feet. Hardwoods constituted the majority with over 10.3 billion cubic feet. This indicates a considerable and steady increase over the 1986, 1998, 2003, and 2008 inventories, which estimated the total cubic foot volume of all live trees as 6.0 billion cubic feet, 7.8 billion cubic feet, 8.7 billion cubic feet, and 9.8 billion cubic feet respectively (Figure 2).



The net volume of growing-stock (trees with a d.b.h. greater than or equal to 5 inches) on timberland in 2013 totaled 9.2 billion cubic feet, nearly quadruple the 2.5 billion cubic feet estimated during the 1950 inventory. For the 1986, 1998, 2003, and 2008 inventories, the net volume was estimated at 3.6 billion cubic feet, 6.9 billion cubic feet, 7.5 billion cubic feet, and 8.6 billion cubic feet respectively (Figure 3). Combining the net volume of growing

stock with the area discussion above, we can observe the increases of volume per acre of timberland basis as well (Figure 4). Since 1986 the net volume of growing stock per acre of timberland has more than doubled (838 cubic feet per acre in 1986 to 1877 cubic feet per acre in 2013).



The net volume of saw timber (trees with a d.b.h. greater than or equal to 11 inches for hardwoods and 9 inches for softwoods) on timberland in 2013 was over 36.5 billion board feet (International 1/4-inch rule), more than double the amount of saw timber volume estimated in 1967. This number can be compared with 34.4 billion board feet in 2008, 28.6 billion board feet in 2003, 26.2 billion board feet in 1998, 19.2 billion board feet in 1986, and 12.5 billion board feet in 1967 (Figure 5). Trees that were 19 or more inches in diameter made up 14.8 percent of the softwood saw timber volume and 45.6 percent of the hardwood saw timber volume. In 1986, these proportions were 1.3 percent and 32.6 percent, respectively.

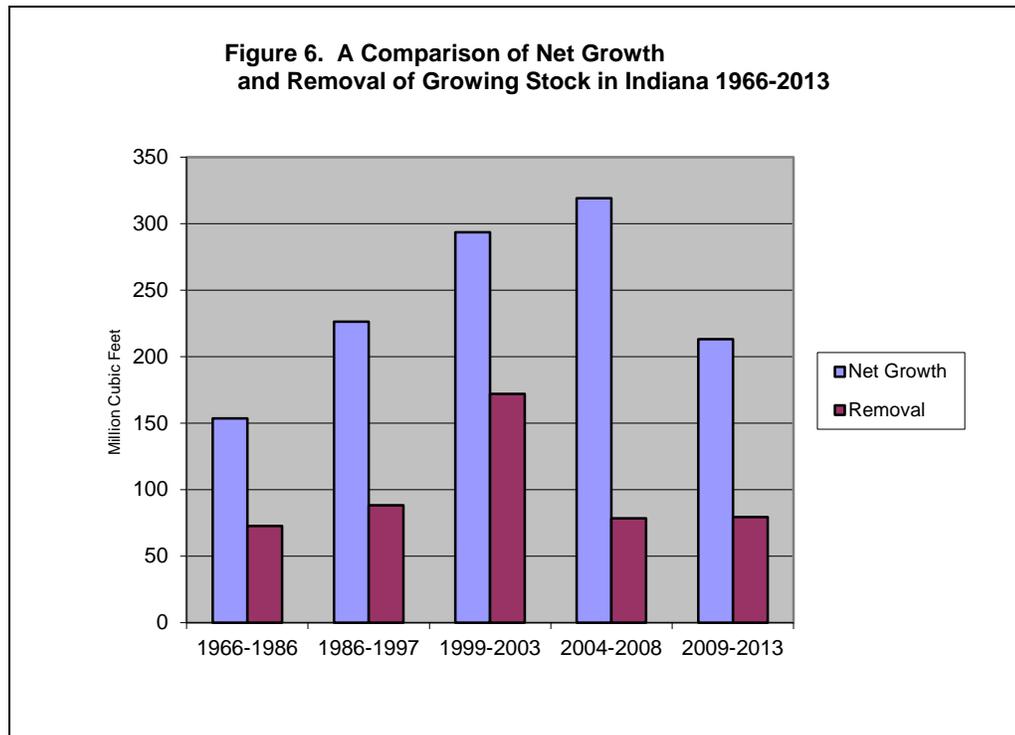
### **Growth, Removals and Mortality**

Between 2009 and 2013, the growing stock on Indiana's timberland grew, on average, 305.7 million cubic feet per year. Average annual mortality during this same time was estimated to be 92.6 million cubic feet per year, resulting in a net average growth (gross growth minus natural mortality) of 213.1 million cubic feet per year.

For the same time period, the average annual removals of growing stock on timberland totaled 79.3 million cubic feet per year. Removal is defined as the sum of the following volumes: the yearly average volume taken out for roundwood forest products (harvesting), the volume of logging residues (volume in tops left in woods at harvests, cut-offs for log length and cull removal, etc.), and the volume of other removals (such as firewood cutting, thinning, specialty products). Also classified as removal is volume from all land-use changes permanently removing trees from the timberland base (for example, timberland that becomes reserved forest land or is permanently converted to nonforest use such urban/residential).

With regards to the sustainability of growth, removals, and mortality, a perspective can often be gained by comparing the net growth (growth minus mortality) to removal. A net growth-

to-removal ratio of 1.00 indicates that the volume of growth equals that being removed, which is an indicator of forest resource sustainability. A ratio of 2.00 indicates that the volume of growth twice exceeds that of removal. To maintain historical comparisons, we'll use total removals. Comparing growth-to-removal ratios among inventories indicates that removals from Indiana's forestland have been conducted in a sustainable manner for a long period of time. The latest data indicate between 2009-2013, the ratio was reported as 2.7 (213.1:79.3). Between 2004-2008, the ratio was reported as 4.07 (319.1:78.5). Between 1999-2003, the ratio was reported as 1.71 (293.6:172.1). For 1986-1997, the ratio was reported as 2.57 (226.3:88.2) and for 1966-1986 the ratio was 2.12 (153.6:72.6), all above a ratio of 1.00 that indicates a minimum threshold for sustainability (Figure 6).



## SUMMARY

As was found in both comprehensive forest resource assessments in 2003 (Woodall *et. al.*, 2005) and 2008 (Woodall *et. al.*, 2011), the forests of Indiana continue to expand and mature. The inventory and monitoring of Indiana's forests indicates that forestland area and volume have been steadily increasing for decades. Hardwood forests continue to dominate the majority of Indiana's forests both in terms of acreage and volume. Average annual growth far exceeds removals continuing a long-term trend for Indiana's forests. The greatest risks to Indiana's forest resources are not the rather stable levels of removals across Indiana, but rather the conversion of forests to non-forest conditions (e.g., urban sprawl), advanced stages of stand development, and invasive species/pests (e.g., emerald ash borer). Given these constant forest health threats both to Indiana's forests and those across the Nation, the objective monitoring of Indiana's hardwood forests will ensure their economic viability, productivity and sustainable management into the future.

## LITERATURE CITED

- Bechtold, W.A.; Patterson, P.L. eds. 2005. Forest Inventory and Analysis national sample design and estimation procedures. Gen. Tech. Rep. GTR-80. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 85 p.
- Hutchison, O.K. 1956. Indiana's forest resources and industries. For. Ser. Rep. 10. Washington, DC: U.S. Department of Agriculture, Forest Service. 44 p.
- McRoberts, R.E. 1999. Joint annual forest inventory and monitoring system, the North Central perspective. *Journal of Forestry*. 97(12): 27-31.
- Miles, P.D. 2015. Forest Inventory EVALIDator web-application version 1.6.0.01. St. Paul, MN: U.S. Department of Agriculture, Forest Service, Northern Research Station. [Available only on internet: <http://apps.fs.fed.us/Evalidator/evalidator.jsp>]
- Schmidt, T.L.; Hansen, M.H.; Solomakos, J.A. 2000. Indiana's forests in 1998. *Resour. Bull. NC-196*. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station. 139 p.
- Smith, W.B.; Golitz, M.F. 1988. Indiana forest statistics, 1986. *Resour. Bull. NC-108*. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 39 p.
- Spencer, J.S. 1969. Indiana's timber. *Resour. Bull. NC-7*. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 61 p.
- Spencer, J.S.; Kingsley, N.P.; Mayer, R.V. 1990. Indiana's timber resource, 1986: an analysis. *Resour. Bull. NC-113*. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station. 85 p.
- Woodall, C.W.; Johnson, D.; Gallion, J.; et al. 2005. Indiana's forests, 1999-2003, part A. *Resour. Bull. NC-253A*. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station. 95 p.
- Woodall, C.W.; Hansen, M.; Brand, G.; McRoberts, R.; Gallion, J.; Jepson, E. 2006. Indiana's forests, 1999-2003, part B. *Resour. Bull. NC-253B*. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station. 86 p.
- Woodall, C.W.; Webb, M.N.; Gallion, J. 2009. Indiana's forest resources, 2008. *Res. Note. NRS-36*. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 4 p.
- Woodall, Christopher W.; Webb, Mark N.; Wilson, Barry T.; Settle, Jeff; Piva, Ron J.; Perry, Charles H.; Meneguzzo, Dacia M.; Crocker, Susan J.; Butler, Brett J.; Hansen, Mark; Hatfield, Mark; Brand, Gary; Barnett, Charles. 2011. Indiana's Forests 2008. *Resour. Bull. NRS-45*. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 56 p. [CD included].

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