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Indiana's Forest Resources in 2002

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Indiana's Forest Resources in 2002

The North Central Research Station's Forest Inventory and Analysis (NCFIA) program began fieldwork for the fifth forest inventory of Indiana forest resources in 1999. This inventory initiated the new annual inventory system in which one-fifth of the field plots (considered one panel) in the State are measured each year. A complete inventory consists of measuring and compiling the data for all plots (or five panels). Once all panels have been measured, each will be remeasured approximately every 5 years. For example, in Indiana, the field plots measured in 2000 will be remeasured in 2005.

In 2002, NCFIA continued the annual inventory effort with the fourth panel of the fifth Indiana forest inventory. Previous inventories of Indiana occurred in 1950, 1967, 1986, and 1998 (Hutchison 1956, Spencer 1969, Spencer *et al.* 1990, Smith and Golitz 1988, Schmidt *et al.* 2000). All five panels of this fifth inventory cycle for Indiana's forest resources will be completed in 2003. However, because each year's sample is a systematic sample of the State's forest and because timely information is needed about Indiana forest resources, estimates have been prepared from data gathered during the first 4 years of the inventory. Data presented in this report represent 80 percent of the field plots (or four panels) for a complete inventory and are a combination of the first year's panel from 1999, the second year's panel from 2000, the third year's panel from 2001, and the fourth year's panel from 2002. An earlier report was for the combined 1999, 2000, and 2001 panels (Leatherberry *et al.* 2003). The results presented are estimates based on sampling; estimates for this report were compiled

assuming that the 1999, 2000, 2001, and 2002 data represent one sample. As additional annual inventories are completed, the precision of the estimates will increase and additional data will be released.

Data from new inventories are often compared with data from earlier inventories to determine trends in forest resources. However, for the comparisons to be valid, the procedures used in the two inventories must be similar. As a result of our ongoing efforts to improve the efficiency and reliability of the inventory, several changes in procedures and definitions have been made since the last Indiana inventory in 1998 (Schmidt *et al.* 2000). Although these changes will have little impact on statewide estimates of forest area, timber volume, and tree biomass, they may have significant impacts on plot classification variables such as forest type and stand-size class. Some of these changes make it inappropriate to directly compare portions of the 1999-2002 data with those published for earlier inventories.

RESULTS

Area

Forest land area was 4.5 million acres in 2002 (table 1). Over 17 percent of this area is owned by public agencies and 82.8 percent is owned by private landowners; 2.5 percent of the area is dominated by softwoods and 97 percent is dominated by hardwoods, with the remainder classified as nonstocked. Oak-hickory forests constitute almost 47 percent of the total hardwood forest land area. The white/red/jack pine forest group constituted 41.1 percent of all forest land dominated by softwoods.

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Timberland area, a component of forest land area, has continued to increase since its low point in the 1967 inventory (fig. 1). The area of timberland by forest type group was dominated by hardwoods (table 2) and particularly by the 2 million acres of oak-hickory group (table 3, fig. 2), although the maple/beech/birch group held a strong second place at 1.5 million acres. Hardwoods made up 97 percent of the total acreage, 96 percent of all public land acreage, and 97 percent of all private landholdings. Most forest type groups are in the sawtimber stand-size class, except for the pinyon/juniper group (which includes eastern redcedar). The upland oak component declined as a percentage of total timberland area: the 1950 oak-pine, oak-hickory, and white oak groups constituted 59.7 percent of the total timberland area, and the 1999-2002 oak-pine and oak-hickory groups made up 49.0 percent (table 3).

The acreage of timberland in the sawtimber class has increased by almost 1.2 million acres since 1950 (fig. 3). When one combines the sawtimber acreage with the poletimber acreage, it appears Indiana's forests are composed of many large-diameter and, presumably, old trees. Increased reforestation, both natural and by planting, appears to have resulted in a negligible number of acres in the nonstocked category.

Volume

The net volume of all live trees on forest land, which includes growing stock, rough trees, and rotten trees, was 8.5 billion cubic feet in 2002 (table 4). Hardwoods constituted 8.2 billion cubic feet and softwoods made up 296 million cubic feet. Oaks were 2.2 billion cubic feet or 27.4 percent of all hardwoods. Select oaks (red and white) were 1.3 billion cubic feet or 58.0 percent of all oaks and 15.9 percent of all hardwoods. This represents a considerable increase over the 1986 inventory, which listed the total volume of all live trees as 6.0 billion cubic feet, all hardwoods as 5.8 billion cubic feet, all oaks as 1.7 billion cubic feet, and all select oaks as 859 million cubic feet (Smith and Golitz 1988).

Net volume of all live trees with 1 inch or greater d.b.h., and salvable dead trees on timberland was 8.4 billion cubic feet (table 5, fig. 4). All live trees made up 8.2 billion cubic feet or 98.6 percent. The difference between the all live trees on timberland total and the 8.5 billion cubic feet of all live trees on forest land (table 4) represents the 256 million cubic feet on land that is either reserved (e.g., parks, wilderness areas) or of low productivity (incapable of growth greater than 20 cubic feet per acre per year at the

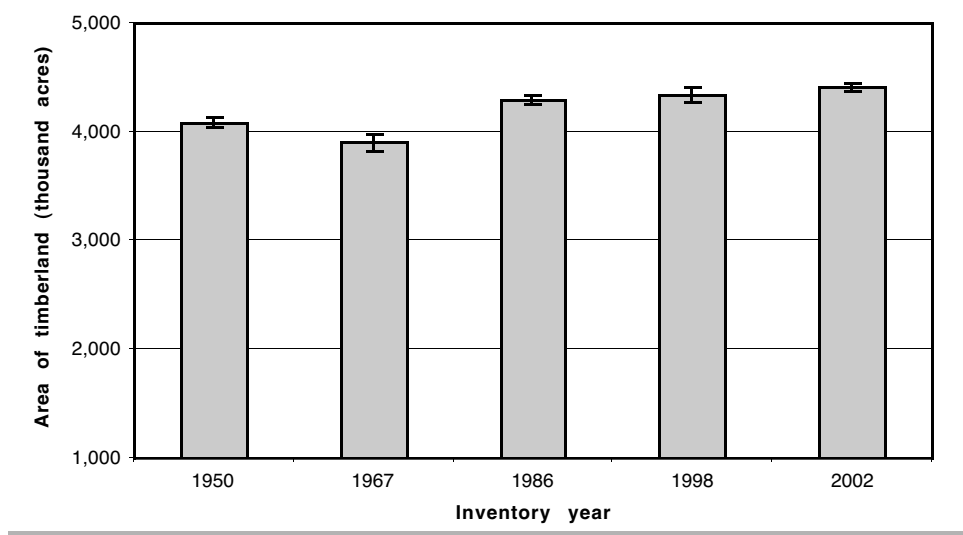


Figure 1. — Area of timberland, Indiana, 1950-2002. (Note: The sampling error associated with an inventory estimate is represented by the vertical line at the top of its bar.)

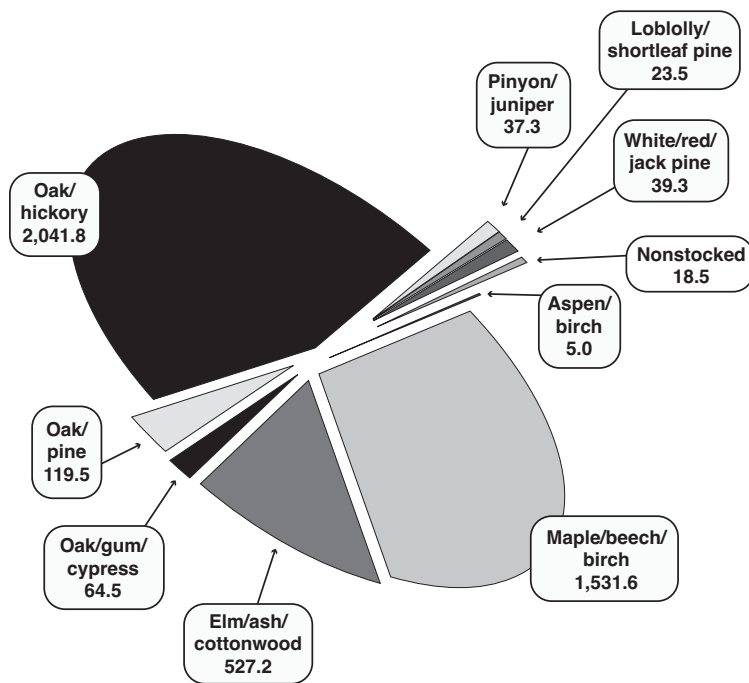


Figure 2. — Area of timberland by forest type group, in thousands of acres, Indiana, 1999-2002.

culmination of mean annual increment). Of the 7.4 billion cubic feet of growing-stock trees, 5.8 billion cubic feet or 78.9 percent was sawtimber. The sawtimber percentage breakdowns for softwoods and hardwoods were 72.4 and 79.2 percent, respectively.

Cull trees, at 868 million cubic feet, made up 10.5 percent of all live trees (table 5). The

softwood cull tree volume represented only 3.9 percent of the total softwood live tree volume, whereas hardwood culls represented 10.8 percent of the total hardwood volume. The phototropic and decurrent growth habits of hardwoods and the poor stem form resulting from inadequate self-pruning, particularly in more open stands, might explain the disparity in the cull percentage.

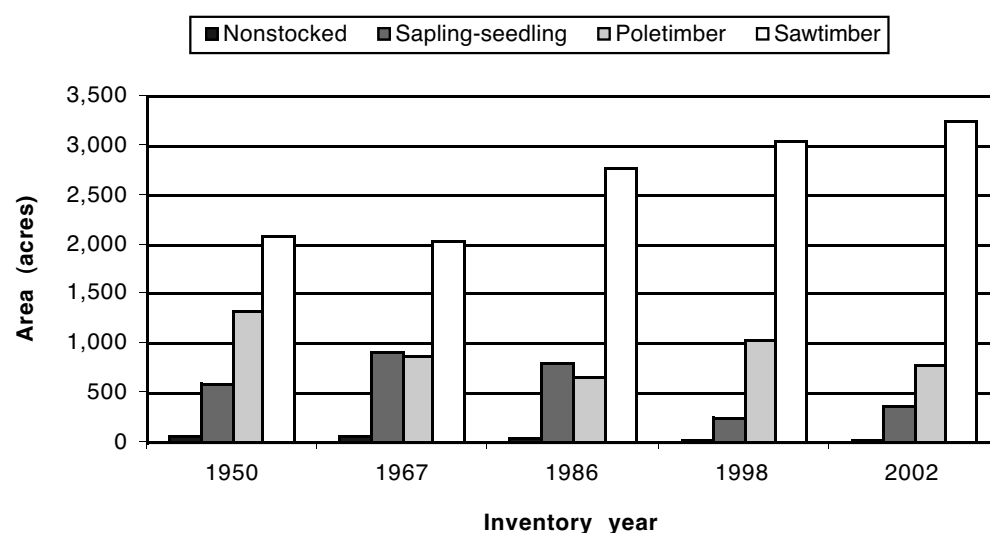


Figure 3. — Area of timberland by stand-size class, Indiana, 1950-2002.

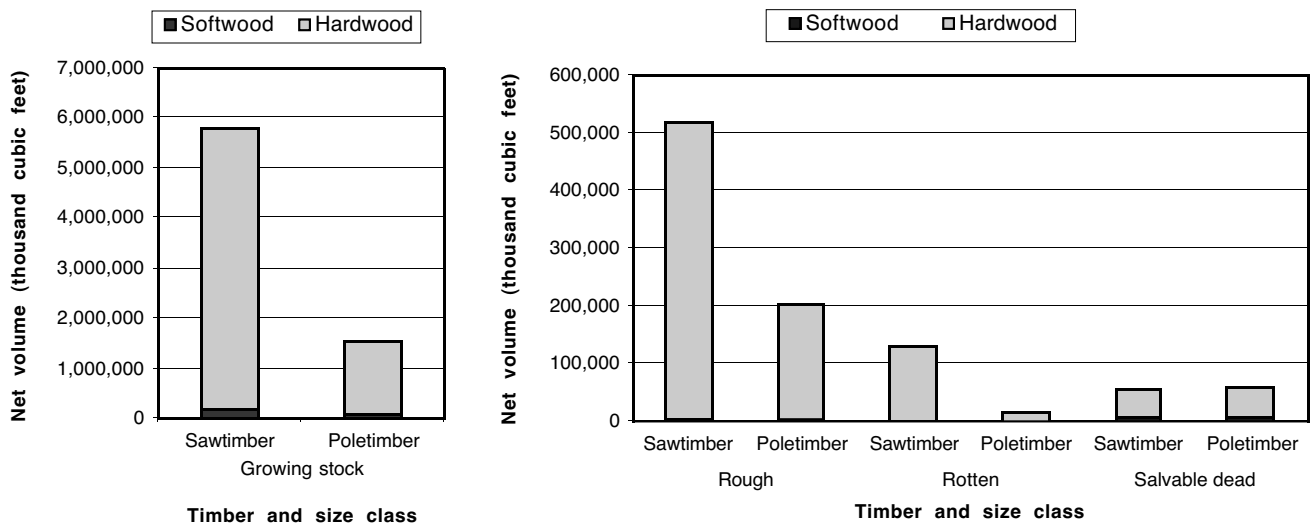


Figure 4. — Net volume of all live trees and salvable dead trees on timberland, in thousands of cubic feet, by timber class and size class, Indiana, 1999-2002.

The net volume of growing stock (trees with 5 inches or greater d.b.h.) on timberland totaled 7.4 billion cubic feet (table 6). The volume has more than doubled since 1950 (fig. 5). Over 96 percent of the volume (7.1 billion cubic feet) was hardwoods and 3.5 percent (257 million cubic feet) was in softwoods, with the remainder in the nonstocked category. In this table

and in figure 6, the volumes were calculated for softwoods and hardwoods for each forest type group. For example, the oak/pine group had 58.4 million cubic feet of softwoods and 95.6 million cubic feet of hardwoods.

Table 7 shows net volume of growing stock on timberland by species group and diameter

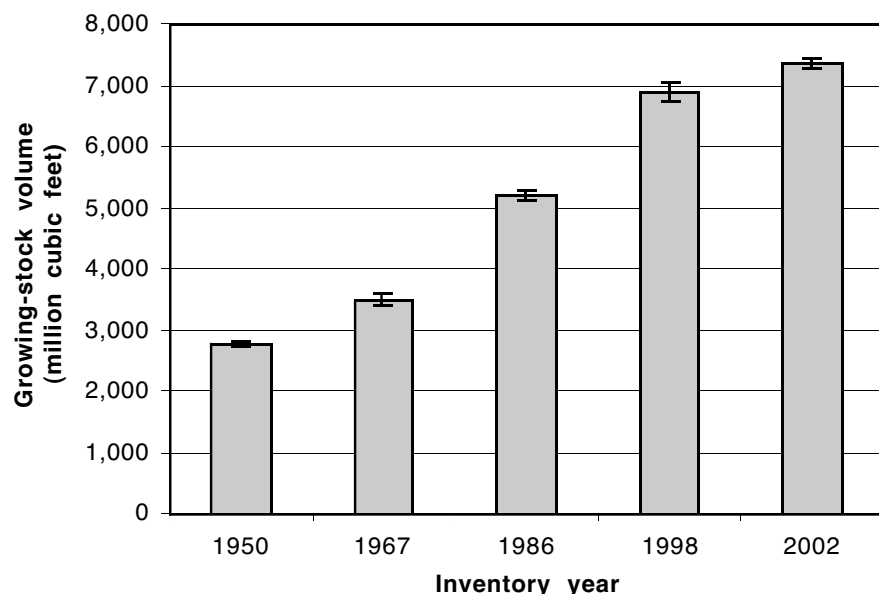


Figure 5. — Net volume of growing stock on timberland for Indiana, 1950-2002.

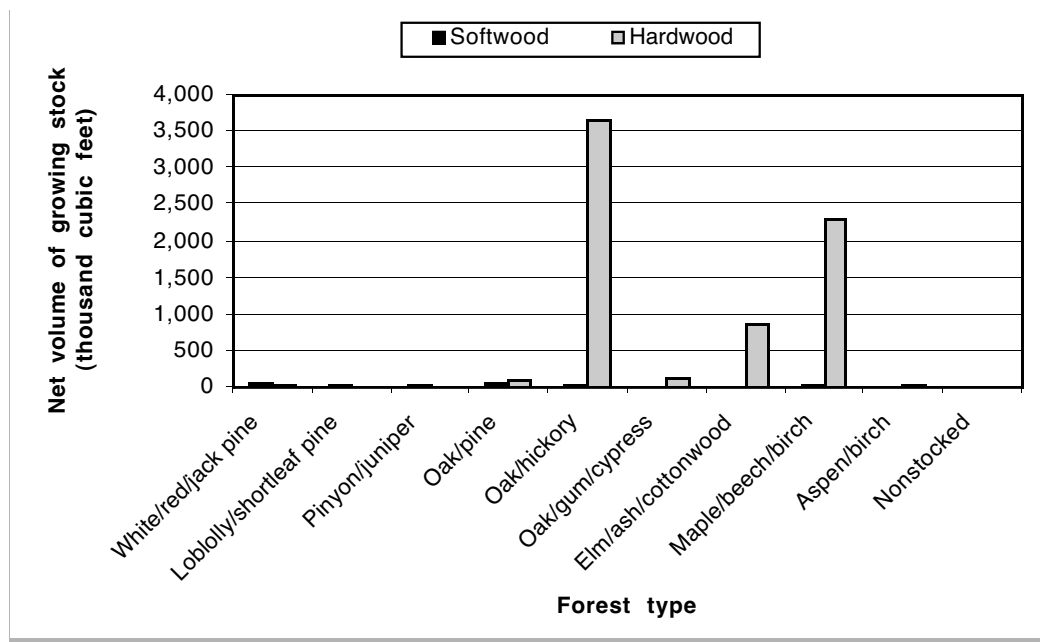


Figure 6. — Net volume of growing stock for Indiana, 1999-2002.

class. The totals for softwood and hardwood volumes, 257 million cubic feet and 7.1 billion cubic feet, respectively, are the same as the totals at the bottom of the columns in table 6. Total volume of oak growing stock on timberland was 2 billion cubic feet, which was 28.3 percent of all hardwood volume and 27.3 percent of all growing-stock volume. Trees that were at least 19 inches in diameter constituted 3.1 percent of the net volume of softwood growing stock and 31.7 percent of net hardwood volume.

The net volume of sawtimber on timberland was 28.0 billion board feet (table 8). As with many other measures of coverage and abundance in Indiana, hardwoods constituted the preponderance of the volume (96.7 percent or 27.0 billion board feet). Red and white oaks totaled 8.4 billion board feet or 31.1 percent of the hardwood total. The yellow-poplar species group had the greatest net volume at 3.9 billion board feet. Trees that were 19 or more inches in diameter were 4.2 percent of the softwood volume (38.7 million board feet) and 39.4 percent of the hardwood volume (10.7 billion board feet). In 1986, the

proportions were 1.3 percent and 32.6 percent, respectively (Smith and Golitz 1988).

Biomass

The live aboveground biomass on timberland in Indiana totaled 225.2 million dry tons in 2002 (table 9, fig. 7). Over 5.6 percent of that total was in 1- to 5-inch trees, 82.0 percent was in growing-stock trees, and 12.4 percent was in non-growing-stock trees. Private landowners held 84.3 percent or 190.0 million tons, and public landowners held 15.7 percent (35.3 million dry tons). Of the 184.7 million dry tons in growing-stock trees, 83.1 percent is on private land and 16.9 percent is on public land. Among non-growing-stock trees, 93.2 percent is on private land and 6.8 percent is on public land.

Bole volume was 74 percent of the growing-stock trees, and the remaining 26 percent was in stumps, tops, and limbs. Approximately the same proportions existed for the 27.9 million dry tons of non-growing-stock trees: 74.1 percent was in bolewood and 25.9 percent was in stumps, tops, and limbs.

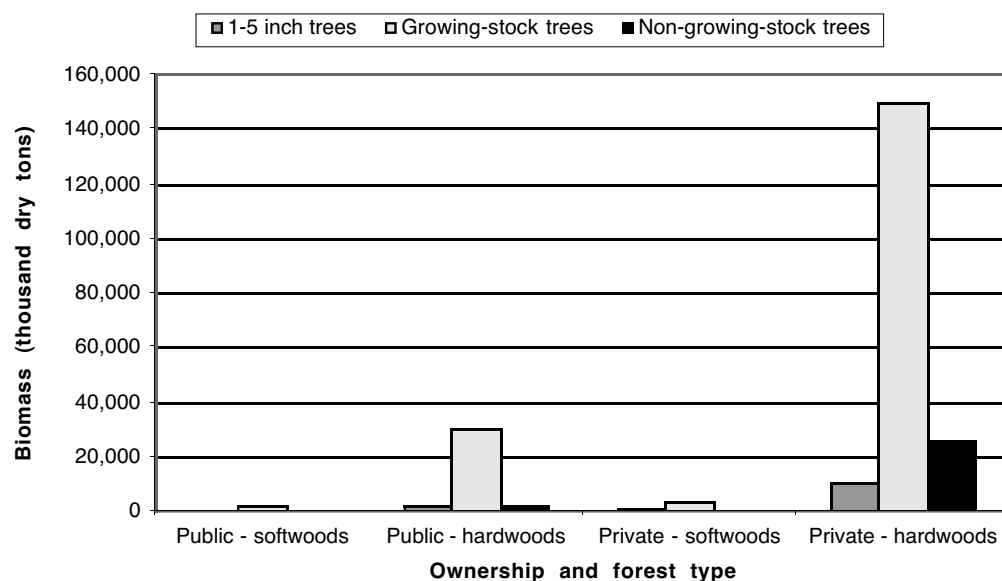


Figure 7. — Live aboveground biomass in Indiana, 1999-2002, by ownership type and forest type.

Growth, Removals, and Mortality

The growing stock on Indiana's timberland grew, on average, 250.6 million cubic feet per year (table 10). Softwoods increased by 3.1 million cubic feet per year, while hardwoods increased by 247.5 million cubic feet per year. Hardwood growth was 98.8 percent of the total growth. Yellow-poplar, other eastern soft hardwoods, and hickory increased the most, at 50.9, 37.5, and 26.2 million cubic feet, respectively. Select oaks (white and red) grew 29.3 million cubic feet per year.

Average annual removals of growing stock on timberland (table 11) totaled 113.7 million cubic feet per year. Softwood removals were 2.8 million cubic feet/year or 2.4 percent of the total. Hardwood removals were 110.9 million cubic feet/year. Removals from private property totaled 112.7 million cubic feet/year, 99.2 percent of all removals. Public land removals averaged 950 thousand cubic feet/year. The species group category "yellow-poplar" had the highest average annual removals at 21.1 million cubic feet/year or 19.0 percent of the total average hardwood removal. The next highest species group removal was select white oaks at 15.7 million

cubic feet/year (14.3 percent), followed by hickory at 11.8 million cubic feet/year or 10.7 percent of the hardwood total.

Average annual mortality of growing stock on timberland, 1998 through 1999-2002, was 69.9 million cubic feet per year (table 12). Over 90 percent, or 63.6 million cubic feet/year, was from hardwoods, while the remaining 6.3 million cubic feet/year was from softwoods. Across all species groups, 12.6 percent or 8.8 million cubic feet/year occurred on public lands. Looking at hardwoods alone, 9.2 percent or 5.8 million cubic feet/year of mortality was on public lands, while public land softwood mortality totaled over 2.9 million cubic feet/year or 46.9 percent of all softwood mortality. Among hardwood species groups, other red oaks was the largest category at 11.7 million cubic feet/year or 18.5 percent of all hardwood mortality. This species group also had the highest mortality on public lands, 2.4 million cubic feet/year. This 20.8 percent of the species groups' mortality that occurred on public lands was the highest percentage for all hardwoods and possibly reflected the impact of forest health issues such as oak decline from drought,

an aging hardwood and oak component of the forest, or that public land may have lower productivity than private land.

Forest Health

The changes to the forest resource reported above may be due in part to the health of the forest and its associated problems. This is particularly true for changes in growth and mortality. The work of biotic agents, such as insects and fungi, and abiotic agents, such as weather (drought), can negatively impact the growth and increase the mortality of the forest. The various agents involved in the health of the forest may be the reason for the red oaks having 18.5 percent of all hardwood mortality.

Specific agents affecting forest growth and mortality in recent years are the drought of 1999, eastern tent caterpillar defoliation, jumping oak gall discoloration (= defoliation) to white oak, fall webworm defoliation, oak wilt, Dutch elm disease, white pine root decline, oak tatters, and ash yellows. In recent years, a decline and death of yellow-poplar and oak has been observed and reported by foresters in southern Indiana. This observation would agree with the data showing that red oaks have the largest amount of mortality among hardwood species.

The decline of oak is believed to be related to the 1999 drought and associated attack by *Armillaria* root rot and Twolined chestnut borer. Some of the decline and subsequent mortality may also be the result of oak wilt. Observations over the last 30 years following other droughts and major insect defoliations (loopers and forest tent caterpillar) found the red oak species, especially black and scarlet oak, to be the first trees to decline and die from stress.

For yellow-poplar, the reason for the decline is not fully understood, but it is believed that the 1999 drought, *Armillaria* root rot, an unknown canker disease, site conditions, and age of the tree are involved in the mortality.

Yellow-poplar developed cankers on the main branches of the tree crown. Gradually the top dies back and the tree eventually dies. When the tree dies, the bark quickly falls off, the top decays, and the heartwood may or may not develop a dark stain. The future of the decline is hard to predict because the drought of 1987/1988 did not produce the yellow-poplar decline and mortality that is being reported now. Thus, there is no information from prior droughts to help guide management of yellow-poplar.

One future health concern is the increasing age and size of the trees, both hardwoods and conifers. It is anticipated that mortality will increase because of competition between large trees and because the trees do not necessarily respond well to stress as they grow older. For conifers, the increased mortality is becoming evident from reports by foresters and other natural resource professionals. Bark beetles, primarily *Ips* species, have increased activity in red pine stands across Indiana. The increase in bark beetle attacks and mortality is the result of age, stand density, and drought.

Another concern for the future is epidemic defoliations by spring feeding insects such as gypsy moth and the native defoliators (loopers and forest tent caterpillar). The gypsy moth management program in Indiana has held gypsy moth in place in the northeast corner of the State. The program is slowing the spread of gypsy moth into and across the State. Natural parasites and predators, although not known to develop and have an impact in low level gypsy moth populations, are present in Indiana. The fungus, *Entomophaga maimaiga*, the virus—NPV, and a small wasp that preys upon gypsy moth egg masses have been found in northeast Indiana killing larvae and eggs. Thus, the benefit of natural enemies of gypsy moth may be impacting the spread and development of gypsy moth in Indiana sooner than expected, given the prior research and survey knowledge that they impact the higher population levels of the generally infested area.

At the writing of this report, the native defoliators have returned to the southern forests of Indiana. Loopers were found in 2002 causing very light defoliation in southern Indiana. By 2003, the defoliation had increased to cover several thousand acres of forest. The forest tent caterpillar also returned in 2003 defoliating one area in southeast Indiana. As these defoliators work over the next few years, future survey reports should record additional changes in growth and mortality in the oaks and other species of the oak-hickory forest type.

Summary

Continuing long-term trends in Indiana, most measures of forested area and volumes show increases. Area has increased steadily since a low point in 1967, while standing volumes have continued to increase since 1950. By and large, Indiana's forests are healthy, but there are some suggestions of problems, particularly with the high mortality percentages for the other red oak forest type category.

As additional data become available from ensuing annual inventories a more precise picture of the direction of Indiana forests will emerge. Additional data related to the two most recent inventories of Indiana (2001 and 2002) are available at:
www.ncrs.fs.fed.us/4801/fiadb/index.htm.



APPENDIX

Inventory Methods

Since the 1986 inventory of Indiana, several changes have been made in NCFIA inventory methods to improve the quality of the inventory as well as meet increasing demands for timely forest resource information. The most significant difference between inventories is the change from periodic inventories to annual inventories. Historically, NCFIA periodically inventoried each State on a cycle that averaged about 12 years. However, the need for timely and consistent data across large regions, combined with national legislative mandates, resulted in NCFIA's implementation of an annual inventory system. Indiana was one of the first States in the North Central region, and in the Nation, to be inventoried with this new system, beginning with the 1999 inventory.

With an annual inventory system, about one-fifth of all field plots are measured each year. After 5 years, an entire inventory cycle will be completed. After the first 5 years, NCFIA will report and analyze results as a moving 5-year average. For example, NCFIA will be able to generate a report based on inventory results for 1999 through 2003 or for 2002 through 2006. Although there are great advantages to an annual inventory, one difficulty is reporting on results in the first 4 years. With the 2002 annual measurements, 80 percent of all field plots have been measured. Sampling error estimates for the 2002 inventory results are area of forest land 1.92 percent, area of timberland 2.04 percent, number of growing-stock trees on timberland 3.51 percent, volume of growing stock on timberland 3.05 percent, and volume of sawtimber on timberland 3.56 percent. These sampling error estimates are higher than those for the last periodic inventory completed in 1998 (i.e., 1.59 percent for timberland area and 2.18 percent for growing-stock volume) because of the smaller samples. Thus, caution should be used when drawing conclusions

based on this limited data set. As we complete ensuing measurements, we will have additional confidence in our results due to the increased number of field plots measured. As each measurement year is completed, the precision of estimates will improve.

Other significant changes between inventories include the implementation of new remote sensing technology, the implementation of a new field plot design, and the gathering of additional data. The advent of remote sensing technology since the previous inventory in 1998 has allowed NCFIA to use computer-assisted classifications of Multi-Resolution Land Characterization (MRLC) data and other remote sensing products to stratify the total area of the State and to improve the precision of estimates. Inventories in Indiana before 1999 used manual interpretation of aerial photos to stratify the sample (1950, 1967, 1986, and 1998 samples).

New algorithms were used in 1999-2002 to assign forest type and stand-size class to each condition observed on a plot. These algorithms are being used nationwide by FIA to provide consistency among States and will be used to reassign the forest type and stand-size class of every plot measured in the 1998 inventory when it is updated. This will be done so that changes in forest type and stand-size class will more accurately reflect actual changes in the forest and not changes in how values are computed. The list of recognized forest types, grouping of these forest types for reporting purposes, models used to assign stocking values to individual trees, definition of "nonstocked," and names given to the forest types changed with the new algorithms. As a result, comparisons between the published 2002 inventory results and those published for the 1998 inventory may not be valid. For additional details about algorithms used in both inventories, please contact NCFIA.

Sampling Phases

The 2002 Indiana survey was based on a three-phase inventory. The first phase used classified satellite imagery to stratify the State and aerial photographs to select plots for field measurement. The second phase entailed measurement of the traditional FIA set of mensurational variables, and the third phase focused on a set of variables related to the health of the forest.

The only land that could not be sampled was private land where field personnel could not obtain permission from the owner to measure the field plot, and plots that could not be accessed because of a hazard or danger to field personnel. The methods used in the preparation of this report make the necessary adjustments to account for sites where access was denied or hazardous.

Phase 1

The 2002 inventory used a computer-assisted classification of satellite imagery. FIA used the imagery to form two initial strata—forest and nonforest. Pixels within 60 m (2 pixel widths) of a forest/nonforest edge formed two additional strata—forest/nonforest and nonforest/forest. Forest pixels within 60 m on the forest side of a forest/nonforest boundary were classified into a forest edge stratum. Pixels within 60 m of the boundary on the nonforest side were classified into a nonforest edge stratum. The estimated population total for a variable is the sum across all strata of the product of each stratum's estimated area and the variable's estimated mean per unit area for the stratum.

Phase 2

Phase 2 of the inventory consisted of the measurement of the annual sample of field plots in Indiana. Current FIA precision standards for annual inventories require a sampling intensity of one plot for approximately every 6,000 acres. FIA has divided the entire area of the United States into non-overlapping hexagons, each of which contains 5,937 acres (McRoberts 1999). An array of field

plots was established by selecting one plot from each hexagon based on the following rules: (1) if a Forest Health Monitoring (FHM) plot (Mangold 1998) fell within a hexagon, it was selected; (2) if no FHM plot fell within a hexagon, the existing NCFIA plot from the 1998 inventory nearest the hexagon center was selected; and (3) if neither FHM nor existing NCFIA plots fell within the hexagon, a new NCFIA plot was established in the hexagon (McRoberts 1999). This array of plots is designated the Federal base sample and is considered an equal probability sample; its measurement in Indiana is funded by the Federal government.

The total Federal base sample of plots was systematically divided into five interpenetrating, non-overlapping 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 a State. Field crews measure vegetation on plots forested at the time of the last inventory and on plots currently classified as forest by trained photointerpreters using aerial photos or digital orthoquads.

Phase 3

NCFIA has two categories of field plot measurements—phase 2 field plots (standard FIA plots) and phase 3 plots (forest health plots)—to optimize our ability to collect data when available for measurement. Both types of plot are uniformly distributed both geographically and temporally. Phase 3 plots are measured with the full set of FHM vegetative and health variables (Mangold 1998) collected as well as the full set of measures associated with phase 2 plots. Phase 3 plots must be measured between June 1 and August 30 to accommodate the additional measurement of non-woody understory vegetation, ground cover, soils, and other variables. We anticipate that in Indiana the complete 5-year annual inventory will involve about 220 phase 3

plots. On the remaining plots, referred to as phase 2 plots, only variables that can be measured throughout the entire year are collected. In Indiana, the complete 5-year annual inventory is expected to involve about 1,150 phase 2 forested plots. The 1999-2002 annual inventory results represent field measures on 930 phase 2 forested plots and 122 phase 3 plots.

The new national FIA plot design (fig. 8) was first used for data collection in Indiana in 1999, the first annual inventory year. This design was also used in the 2000-2002 inventories and will be used in subsequent years. The national plot design requires mapping forest conditions on each plot. Because of the small sample (20 percent) each year, precision associated with change factors such as mortality will be relatively low. When the complete annual inventory has been completed in 2003, the full range of change data will be available.

The overall plot layout for the new design consists of four subplots. The centers of subplots 2, 3, and 4 are located 120 feet from the center of subplot 1. The azimuths to subplots 2, 3, and 4 are 0, 120, and 240 degrees, respectively. The center of the new plot is located at the same point as the center of the previous plot if a previous plot existed within the sample unit. Trees with 5 inches and larger d.b.h. are measured on a

24-foot-radius (1/24 acre) circular subplot. All trees less than 5 inches d.b.h. are measured on a 6.8-foot-radius (1/300 acre) circular microplot located 12 feet east of the center of each of the four subplots. Forest conditions that occur on any of the four subplots are recorded. Factors that differentiate forest conditions are forest type, stand-size class, land use, ownership, and density. Each condition that occurs anywhere on any of the subplots is identified, described, and mapped if the area of the condition is 1 acre or more.

Field plot measurements are combined with phase 1 estimates in the compilation process and table production. The number of published tables generated from less than five panels of data is limited. However, at www.ncrs.fs.fed.us/4801/fiadb/index.htm, other tabular data can be generated. For additional information, contact:

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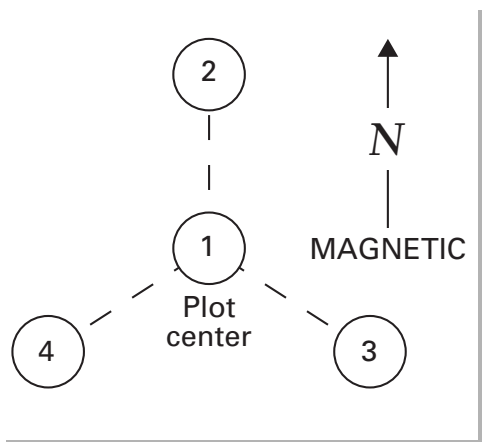


Figure 8. — Current NCFIA field plot design.

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TABLE TITLES

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Table 2.—Area of timberland by major forest type group, stand origin, and owner category, Indiana, 1999 - 2002

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Table 11.—Average annual removals of growing stock on timberland by species group and owner category, Indiana, 1998 to 1999 - 2002

Table 12.—Average annual mortality of growing stock on timberland by species group and owner category, Indiana, 1998 to 1999 - 2002



TABLES

Table 1. -- Area of forest land by forest type group and owner category, Indiana, 1999 - 2002

(In thousand acres)

Forest type group	Owner category		
	All owners	Public	Unidentified owner
Softwood type groups			
White / red / jack pine group	47.3	15.9	31.3
Loblolly / shortleaf pine group	23.5	16.1	7.4
Pinon / juniper group	44.2	6.9	37.3
All softwood types	115.0	39.0	76.0
Hardwood type groups			
Oak / pine group	126.6	21.9	104.7
Oak / hickory group	2,113.4	458.6	1,654.8
Oak / gum / cypress group	64.5	8.1	56.5
Elm / ash / cottonwood group	527.2	69.1	458.1
Maple / beech / birch group	1,566.3	173.3	1,393.0
Aspen / birch group	12.9	10.3	2.7
All hardwood types	4,410.9	741.1	3,669.8
Nonstocked	18.5	--	18.5
All forest types	4,544.4	780.1	3,764.3

All table cells without observations in the inventory sample are indicated by --. Table value of 0.0 indicates the acres round to less than 0.1 thousand acres. Columns and rows may not add to their total due to rounding.

Table 2. -- Area of timberland by major forest type group, stand origin, and owner category, Indiana, 1999 - 2002

(In thousand acres)

Major forest type group and stand origin	Owner category		
	All owners	Public	Unidentified owner
Softwood type groups			
Natural	39.4	--	39.4
Planted	60.7	24.0	36.6
All softwood types	100.1	24.0	76.0
Hardwood type groups			
Natural	4,181.9	610.4	3,571.6
Planted	107.6	30.1	77.5
All hardwood types	4,289.5	640.5	3,649.1
Nonstocked	18.5	--	18.5
All groups	4,408.1	664.5	3,743.6

All table cells without observations in the inventory sample are indicated by --. Table value of 0.0 indicates the acres round to less than 0.1 thousand acres. Columns and rows may not add to their totals due to rounding.

Table 3. -- Area of timberland by forest type group and stand-size class, Indiana, 1999 - 2002

(In thousand acres)

Forest type group	Stand-size class			
	All stands	Sawtimber	Poletimber	Sapling-seedling Non-stocked
Softwood type groups				
White / red / jack pine group	39.3	31.4	7.8	--
Loblolly / shortleaf pine group	23.5	19.6	3.9	--
Pinyon / juniper group	37.3	13.6	6.6	17.1
All softwood types	100.1	64.6	18.3	17.1
Hardwood type groups				
Oak / pine group	119.5	76.8	20.6	--
Oak / hickory group	2,041.8	1,658.4	289.3	94.0
Oak / gum / cypress group	64.5	55.4	--	9.1
Elm / ash / cottonwood group	527.2	363.1	106.2	58.0
Maple / beech / birch group	1,531.6	1,032.2	341.4	158.0
Aspen / birch group	5.0	5.0	--	--
All hardwood types	4,289.5	3,190.9	757.4	341.2
Nonstocked	18.5	--	--	--
All forest types	4,408.1	3,255.5	775.8	358.3
				18.5

Table 4. -- Net volume of all live trees on forest land by species group and owner category, Indiana, 1999 - 2002

(In thousand cubic feet)

Species group	Owner category		
	All owners	Public	Unidentified owner
Softwoods			
Loblolly and shortleaf pines	41,557	38,264	3,293
Other yellow pines	42,583	15,930	26,653
Eastern white and red pines	110,342	42,334	68,007
Jack pine	2,286	278	2,009
Cypress	--	--	--
Other eastern softwoods	99,846	13,349	86,497
Total softwoods	296,614	110,154	186,459
Hardwoods			
Select white oaks	856,816	223,747	633,068
Select red oaks	444,911	128,933	315,978
Other white oaks	164,999	72,032	92,967
Other red oaks	778,898	157,002	621,897
Hickory	800,024	130,976	669,048
Yellow birch	101	--	101
Hard maple	859,530	132,521	727,009
Soft maple	391,721	62,475	329,246
Beech	291,769	41,827	249,942
Sweetgum	93,224	21,827	71,396
Tupelo and blackgum	66,958	10,607	56,351
Ash	597,080	48,655	548,426
Cottonwood and aspen	278,002	52,729	225,273
Basswood	94,782	1,405	93,377
Yellow-poplar	910,593	184,323	726,270
Black walnut	247,267	22,908	224,360
Other eastern soft hardwoods	1,138,590	123,086	1,015,504
Other eastern hard hardwoods	137,884	9,577	128,307
Eastern noncommercial hardwoods	52,425	1,241	51,185
Total hardwoods	8,205,576	1,425,869	6,779,707
All species groups			
	8,502,190	1,536,023	6,966,166

All table cells without observations in the inventory sample are indicated by --. Table value of 0 indicates that the volume rounds to less than 1 thousand cubic feet. Columns and rows may not add to their totals due to rounding.

Table 5. -- Net volume of all live trees and salvageable dead trees on timberland by class of timber and softwood/hardwood categories, Indiana, 1999 - 2002

(In thousand cubic feet)

Class of timber	All species	Softwood species	Hardwood species
Live trees			
Growing-stock trees			
Sawtimber			
Saw log portion	5,171,335	165,974	5,005,361
Upper stem portion	653,543	20,288	633,255
Total	5,824,877	186,262	5,638,615
Poletimber	1,553,110	70,960	1,482,150
All growing-stock trees	7,377,987	257,222	7,120,765
Cull trees			
Rough trees ¹			
Sawtimber size	518,490	5,547	512,943
Poletimber size	203,111	4,639	198,472
Total	721,600	10,185	711,415
Rotten trees ¹			
Sawtimber size	130,615	--	130,615
Poletimber size	16,250	151	16,099
Total	146,866	151	146,714
All live cull trees	868,466	10,336	858,129
All live trees	8,246,453	267,558	7,978,895
Salvageable dead trees			
Sawtimber size	53,929	6,979	46,949
Poletimber size	60,757	5,866	54,892
All salvageable dead trees	114,686	12,845	101,841
All classes	8,361,139	280,403	8,080,736

All table cells without observations in the inventory sample are indicated by --. Table value of 0 indicates that the volume rounds to less than 1 thousand cubic feet. Columns and rows may not add to their totals due to rounding.

¹ Includes noncommercial species.

Table 6. -- Net volume of growing stock on timberland by forest group and softwood/hardwood species categories, Indiana, 1999 - 2002

(In thousand cubic feet)

Forest type group	All species	Softwood species	Hardwood species
Softwood type groups			
White / red / jack pine group	91,551	75,148	16,403
Loblolly / shortleaf pine group	53,297	44,562	8,735
Pinon / juniper group	24,214	16,444	7,771
All softwood types	169,061	136,153	32,909
Hardwood type groups			
Oak / pine group	153,970	58,381	95,590
Oak / hickory group	3,691,459	33,315	3,658,144
Oak / gum / cypress group	132,008	--	132,008
Elm / ash / cottonwood group	889,451	9,679	879,772
Maple / beech / birch group	2,323,065	19,694	2,303,371
Aspen / birch group	17,370	--	17,370
All hardwood types	7,207,324	121,069	7,086,256
Nonstocked	1,601	--	1,601
All forest types	7,377,987	257,222	7,120,765

All table cells without observations in the inventory sample are indicated by --. Table value of 0 indicates that the volume rounds to less than 1 thousand cubic feet. Columns and rows may not add to their totals due to rounding.

Table 7. -- Net volume of growing stock on timberland by species group and diameter class, Indiana, 1999 - 2002

(In thousand cubic feet)

Species group	All classes	Diameter class (inches at breast height)									
		5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Softwoods											
Loblolly and shortleaf pines	29,045	460	3,007	2,868	8,679	7,662	4,517	1,851	--	--	--
Other yellow pines	40,672	3,636	3,715	8,673	9,017	4,972	6,442	4,217	--	--	--
Eastern white and red pines	98,021	3,383	13,636	21,973	21,176	14,121	12,077	3,802	3,008	4,845	--
Jack pine	2,009	106	557	805	540	--	--	--	--	--	--
Cypress	--	--	--	--	--	--	--	--	--	--	--
Other eastern softwoods	87,475	17,691	24,768	17,336	8,667	11,889	7,126	--	--	--	--
Total softwoods	257,222	25,276	45,684	51,654	48,078	38,643	30,162	9,870	3,008	4,845	--
Hardwoods											
Select white oaks	762,377	15,039	30,570	47,846	56,217	89,250	105,086	92,584	80,799	184,763	60,224
Select red oaks	412,522	7,300	11,753	14,741	27,231	38,436	47,986	53,141	52,959	107,458	51,519
Other white oaks	134,833	1,546	2,971	10,014	18,622	30,061	24,094	14,989	21,110	11,427	--
Other red oaks	702,872	14,485	28,627	42,684	50,583	81,386	90,462	82,398	85,562	176,129	50,555
Hickory	756,168	26,343	59,107	87,519	120,105	115,192	114,015	111,970	60,759	46,040	15,117
Hard maple	725,678	58,375	67,814	94,204	100,587	92,574	120,198	83,854	29,639	69,849	8,585
Soft maple	309,099	25,879	39,867	37,302	34,439	29,073	31,283	19,115	42,391	35,136	14,615
Beech	201,393	5,511	9,852	9,012	15,931	18,266	24,728	36,781	18,383	56,393	6,535
Sweetgum	88,501	5,208	7,551	10,603	20,030	10,921	10,210	8,708	9,975	5,296	--
Tupelo and blackgum	58,758	6,920	7,209	6,435	5,546	3,958	10,812	6,301	2,407	--	--
Ash	499,942	24,928	37,971	56,724	59,444	75,577	71,563	79,463	36,837	50,879	6,555
Cottonwood and aspen	267,533	3,434	3,610	8,966	12,516	13,188	23,400	24,933	30,222	98,028	49,235
Basswood	74,847	3,794	7,894	9,962	8,750	5,632	8,258	4,332	4,962	21,262	--
Yellow-poplar	884,027	23,088	41,017	74,881	84,268	105,334	101,720	104,252	73,137	267,735	8,594
Black walnut	203,795	8,203	19,156	25,092	41,895	36,426	36,930	25,280	7,692	3,122	--
Other eastern soft hardwoods	953,735	85,322	100,593	121,378	98,174	98,582	99,993	64,068	72,130	161,429	52,066
Other eastern hard hardwoods	84,685	9,714	12,392	11,744	10,506	19,040	16,389	1,950	2,951	--	--
Total hardwoods	7,120,765	325,089	487,953	669,107	764,843	862,895	937,127	814,119	631,916	1,304,114	323,601
All species	7,377,987	350,365	533,637	720,761	812,922	901,539	967,289	823,989	634,923	1,308,960	323,601

All table cells without observations in the inventory sample are indicated by --. Table value of 0 indicates that the volume rounds to less than 1 thousand cubic feet. Columns and rows may not add to their totals due to rounding.

Table 8. -- Net volume of sawtimber on timberland by species group and diameter class, Indiana, 1999 - 2002

(In thousand board feet)¹

Species group	All classes	Diameter class (inches at breast height)								29.0+
		9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9		
Softwoods										
Loblolly and shortleaf pines	130,118	14,065	43,621	39,228	23,501	9,702	--	--	--	--
Other yellow pines	168,616	41,757	45,008	25,625	33,669	22,557	--	--	--	--
Eastern white and red pines	385,298	102,397	99,566	66,671	59,129	18,863	15,062	23,610	--	--
Jack pine	6,629	3,943	2,686	--	--	--	--	--	--	--
Other eastern softwoods	230,568	95,564	44,325	57,700	32,979	--	--	--	--	--
Total softwoods	921,229	257,725	235,206	189,225	149,279	51,122	15,062	23,610	--	--
Hardwoods										
Select white oaks	3,054,618	--	277,450	434,184	502,291	433,739	371,476	810,229	225,248	--
Select red oaks	1,817,891	--	134,543	191,180	239,148	263,837	261,038	508,848	219,295	--
Other white oaks	602,769	--	95,130	153,539	121,007	75,124	102,916	55,054	--	--
Other red oaks	2,936,477	--	248,919	401,632	445,301	402,151	413,829	818,201	206,444	--
Hickory	2,874,946	--	591,799	569,737	560,644	551,727	299,261	227,428	74,351	--
Hard maple	2,410,074	--	484,476	447,854	580,150	402,190	140,552	321,550	33,302	--
Soft maple	882,419	--	149,591	127,289	137,501	83,990	185,231	152,348	46,469	--
Beech	866,403	--	80,609	91,868	123,679	182,291	89,921	268,133	29,902	--
Sweetgum	292,198	--	91,230	49,833	46,016	38,882	44,093	22,144	--	--
Tupelo and blackgum	170,537	--	25,288	17,998	49,141	28,412	10,754	38,945	--	--
Ash	1,777,651	--	269,804	350,079	337,282	377,848	175,834	238,317	28,487	--
Cottonwood and aspen	1,268,539	--	58,941	64,839	117,208	127,226	155,316	502,258	242,750	--
Basswood	261,112	--	44,275	28,336	41,238	21,456	24,375	101,432	--	--
Yellow-poplar	3,884,958	--	422,308	539,086	529,897	546,531	388,244	1,415,880	43,011	--
Black walnut	731,519	--	204,337	177,596	178,447	120,841	35,425	14,872	--	--
Other eastern soft hardwoods	2,978,514	--	455,898	457,967	466,549	294,018	334,286	743,523	226,273	--
Other eastern hard hardwoods	231,809	--	48,212	86,892	74,719	8,843	13,143	--	--	--
Total hardwoods	27,042,432	--	3,682,811	4,189,908	4,550,219	3,959,106	3,045,693	6,239,162	1,375,533	--
All species	27,963,662	257,725	3,918,018	4,379,133	4,699,498	4,010,228	3,060,755	6,262,772	1,375,533	--

All table cells without observations in the inventory sample are indicated by --. Table value of 0 indicates that the volume rounds to less than 1 thousand board feet. Columns and rows may not add to their totals due to rounding.

¹International 1/4-inch rule.

Table 9. -- All live aboveground tree biomass on timberland by owner category, softwood/hardwood species category, and tree biomass component, Indiana, 1999 - 2002

(In dry tons)

Owner category and softwood/hardwood category	All components	All live 1-5 inch trees	Tree biomass component					
			Growing-stock trees			Non-growing-stock trees		
			Total	Boles	Stumps, tops, and limbs	Total	Boles	Stumps, tops, and limbs
Public								
Softwoods	1,480,161	14,451	1,434,072	1,193,611	240,462	31,637	26,424	5,213
Hardwoods	33,773,102	2,089,479	29,810,757	21,997,047	7,813,710	1,872,866	1,373,224	499,642
Total	35,253,263	2,103,930	31,244,829	23,190,657	8,054,172	1,904,503	1,399,648	504,856
Private								
Softwoods	4,111,366	533,418	3,365,303	2,606,139	759,164	212,646	151,065	61,581
Hardwoods	185,861,004	10,060,296	150,052,694	110,828,007	39,224,687	25,748,013	19,096,280	6,651,733
Total	189,972,370	10,593,714	153,417,997	113,434,146	39,983,851	25,960,659	19,247,346	6,713,313
All ownerships								
Softwoods	5,591,527	547,869	4,799,376	3,799,750	999,626	244,283	177,489	66,794
Hardwoods	219,634,106	12,149,775	179,863,451	132,825,054	47,038,397	27,620,880	20,469,505	7,151,375
Total	225,225,633	12,697,644	184,662,826	136,624,804	48,038,023	27,865,162	20,646,993	7,218,169

All table cells without observations in the inventory sample are indicated by --. Table value of 0 indicates the aboveground tree biomass rounds to less than 1 dry ton. Columns and rows may not add to their totals due to rounding.

Table 10. -- Average annual net growth of growing-stock on timberland by species group and owner category, Indiana, 1998 to 1999 - 2002

(In thousand cubic feet per year)

Species group	Owner category		
	All owners	Public	Unidentified owner
Softwoods			
Loblolly and shortleaf pines	-340	-340	--
Other yellow pines	394	482	-89
Eastern white and red pines	854	-819	1,673
Jack pine	57	--	57
Other eastern softwoods	2,119	557	1,562
Total softwoods	3,084	-119	3,204
Hardwoods			
Select white oaks	18,126	3,449	14,676
Select red oaks	11,275	1,561	9,714
Other white oaks	2,554	1,863	691
Other red oaks	10,832	3,495	7,337
Hickory	26,168	3,162	23,006
Hard maple	20,976	1,886	19,089
Soft maple	8,182	1,492	6,690
Beech	20,381	1,007	19,374
Sweetgum	2,323	1,075	1,248
Tupelo and blackgum	-283	117	-400
Ash	21,901	2,337	19,565
Cottonwood and aspen	5,851	172	5,679
Basswood	2,499	--	2,499
Yellow-poplar	50,942	7,617	43,325
Black walnut	6,894	1,715	5,180
Other eastern soft hardwoods	37,512	3,136	34,375
Other eastern hard hardwoods	1,397	214	1,183
Eastern noncommercial hardwoods	--	--	--
Total hardwoods	247,531	34,299	213,233
All species groups	250,615	34,179	216,436

All table cells without observations in the inventory sample are indicated by --. Table value of 0 indicates that the volume rounds to less than 1 thousand cubic feet. Columns and rows may not add to their totals due to rounding.

Table 11. -- Average annual removals of growing-stock on timberland by species group and owner category, Indiana, 1998 to 1999 - 2002

(In thousand cubic feet per year)

Species group	Owner category		
	All owners	Public	Unidentified owner
Softwoods			
Eastern white and red pines	2,666	--	2,666
Other eastern softwoods	105	--	105
Total softwoods	2,770	--	2,770
Hardwoods			
Select white oaks	15,723	--	15,723
Select red oaks	10,559	--	10,559
Other white oaks	3,655	950	2,705
Other red oaks	4,529	--	4,529
Hickory	11,752	--	11,752
Hard maple	6,222	--	6,222
Soft maple	10,741	--	10,741
Beech	2,290	--	2,290
Tupelo and blackgum	390	--	390
Ash	7,271	--	7,271
Cottonwood and aspen	783	--	783
Yellow-poplar	21,128	--	21,128
Black walnut	3,718	--	3,718
Other eastern soft hardwoods	8,347	--	8,347
Other eastern hard hardwoods	3,834	--	3,834
Eastern noncommercial hardwoods	--	--	--
Total hardwoods	110,942	950	109,992
All species groups	113,713	950	112,763

All table cells without observations in the inventory sample are indicated by --. Table value of 0 indicates that the volume rounds to less than 1 thousand cubic feet. Columns and rows may not add to their totals due to rounding.

Table 12. -- Average annual mortality of growing-stock on timberland by species group and owner category, Indiana, 1998 to 1999 - 2002

(In thousand cubic feet per year)

Species group	Owner category		
	All owners	Public	Unidentified owner
Softwoods			
Loblolly and shortleaf pines	326	326	--
Other yellow pines	1,353	376	977
Eastern white and red pines	4,466	2,268	2,198
Other eastern softwoods	185	--	185
Total softwoods	6,330	2,970	3,360
Hardwoods			
Select white oaks	2,351	31	2,320
Select red oaks	1,331	--	1,331
Other white oaks	197	197	--
Other red oaks	11,747	2,440	9,307
Hickory	5,909	285	5,624
Hard maple	6,070	--	6,070
Soft maple	3,110	244	2,866
Beech	386	--	386
Ash	1,811	55	1,756
Cottonwood and aspen	6,503	644	5,860
Basswood	100	--	100
Yellow-poplar	1,960	268	1,691
Black walnut	314	--	314
Other eastern soft hardwoods	19,250	1,586	17,664
Other eastern hard hardwoods	2,528	71	2,457
Eastern noncommercial hardwoods	--	--	--
Total hardwoods	63,567	5,823	57,744
All species groups	69,897	8,793	61,105

All table cells without observations in the inventory sample are indicated by --. Table value of 0 indicates that the volume rounds to less than 1 thousand cubic feet. Columns and rows may not add to their totals due to rounding.

Moser, W. Keith; Brand, Gary J.; Marshall, Philip T.; Gallion, Joey.

2004. **Indiana's forest resources in 2002.** Resour. Bull. NC-232. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station. 25 p.

Results of the 2002 annual inventory of Indiana show 4.5 million acres of forest land. The oak-hickory type is the largest forest type on the landscape, making up over 46.5 percent of all forested land. Softwoods (or "conifers") comprise approximately 2.5 percent of Indiana's forested acreage. Between 1998 and 1999-2002, the net volume of all live trees and salvable dead trees on timberland increased by 6 percent, from 7.9 billion cubic feet to 8.4 billion cubic feet.

KEY WORDS: Annual inventory, forest area, forest type, volume, biomass, Indiana.

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