Indiana DNR Classified Forests
Report of Continuous Forest Inventory (CFI)
Summary of years 2015-2019

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FOREWORD

This report provides an overview of forest-resource attributes for privately owned land enrolled in the Indiana DNR Division of Forestry's Classified Forest and Wildland Program, based on findings from a continuous annual inventory conducted by the Forest Resource Information (FRI) Section of the Indiana DNR Division of Forestry (DoF). The CFI inventory of DoF Classified Forest lands is based on a sample of 2,948 plots located randomly across those lands enrolled in the program at a sampling rate of approximately one plot for every 200 forested acres. It should be noted that there are also acres enrolled in the program that originated as Classified Wildlife acres under the DNR Division of Fish & Wildlife but are now managed with the Classified Forest program. These acres are not included in this sample.

Information in this report is gathered from quantitative and qualitative measurements that describe forest-site attributes; stand characteristics; tree measurements on live and dead stems such as species, diameter, height, damage, and tree quality; counts of regeneration; and estimates of growth, mortality, and removals. All estimates in this assessment are estimates of a population based on a statistical sample derived from the expansion of plot data and therefore may differ slightly from complete censuses of some populations (e.g., total acres). Given the multitude of estimates of forest-resource attributes, they are organized in "core tables" (e.g., forest-land area vs. live tree volumes), which are updated annually.

This report is a summary of the five panels of plot installation and data collection for the years 2015-2019, which constitute an entire cycle or total sample population. All initial plots have been installed and measured. Change attributes such as growth, removals, and mortality rely on measuring the same plots at two points in time. Re-measurements began in 2017, so only 60% of the sample have been re-measured thus far. Therefore, these reported estimates are not as statistically reliable as they will be after all plots have been re-measured.

EXECUTIVE SUMMARY/HIGHLIGHTS

This is the fifth annual report of results of the classified forest continuous forest inventory (CFI). The goal of the first five years was to install all of the plots within the CFI sample frame and produce baseline resource estimates. These baseline data/estimates are now being used as a monitoring baseline to compare to future re-measurement data in compilation of statistical-change estimates (e.g., tree growth/mortality). Details of the results are discussed below, and tabular results can be found in the additional "Part B" report. Baseline resource estimates of Classified Forest properties are:

- 839,017 forested acres with the balance in non-forest (i.e., open areas) and water.
- 97% of the forested acres are hardwoods.
- 74% of the forested acres are sawlog-sized stands.
- Forests contain 329 million live trees.
- Sugar-maple trees and seedlings are more abundant than trees of any other species.
- The total live-tree volume is 1.762 billion cubic feet.
- There is 4.588 billion board feet (Doyle) of sawlog volume.
- Yellow poplar, sugar maple and white oak, in order, are the species with the most sawlog volume.
- 60% of the sawlog volume is considered grade 1 or 2.
- Multiflora rose, Japanese honeysuckle, bush honeysuckle and stiltgrass are the most common invasive species.
- There are 55.79 million short tons of forest carbon stocks.

FOREST COMPOSITION

Area

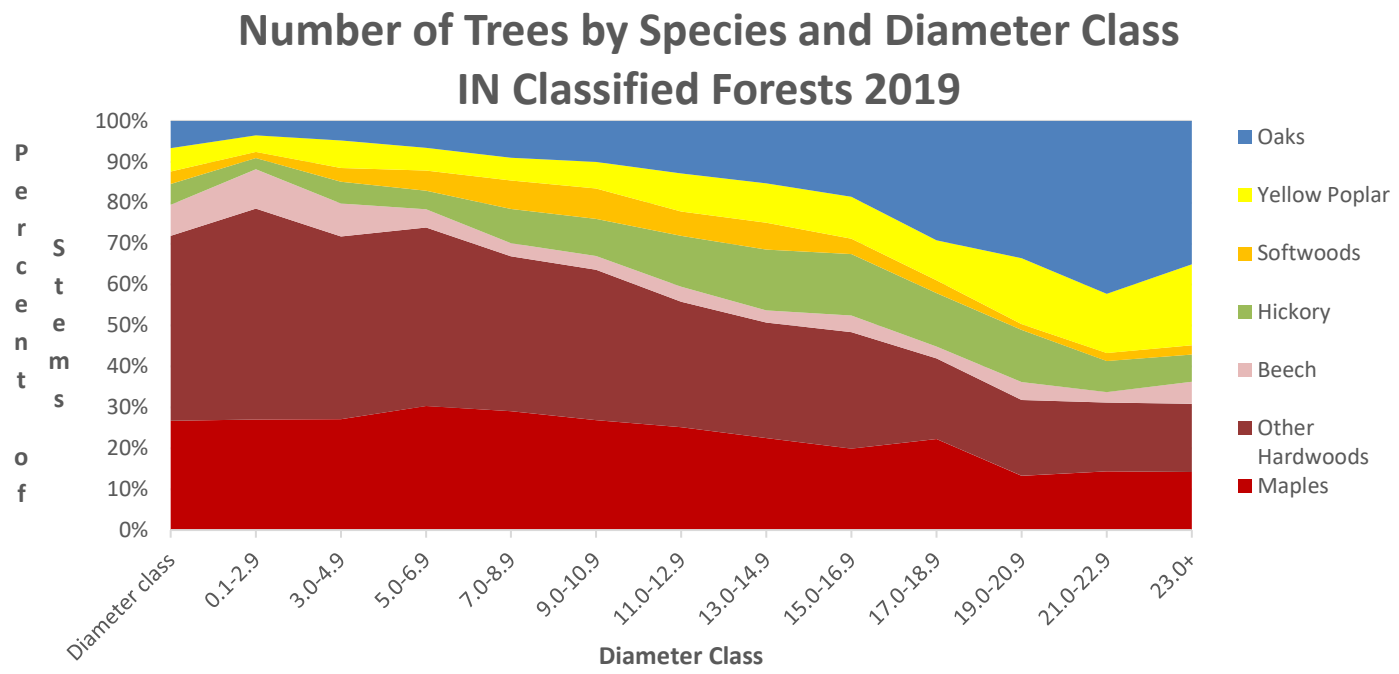
Classified Forest lands comprise approximately 839,017 acres considered forest land (land considered stocked with trees or seedlings that is at minimum 1 acre in size and 120 feet in width), with the remaining acres being non-forest (open fields, rights-of-way, etc.), census water (bodies of water >5 acres and permanent rivers/streams), and non-census water (bodies of water <5 acres and small streams). Like most of Indiana's forests, Classified Forests are predominantly hardwoods, with 97% of the total forest area classified as hardwood forest types. The primary hardwood forest types were white oak/red oak/hickory (181,690 acres, 21%), hard maple/basswood (70,899 acres, 8%), white oak (56,410 acres, 6%), yellow poplar (55,210 acres, 6%), and cherry/ash/poplar (49,707 acres, 5%), as shown in Table 1. Many forest types are similar and therefore difficult to discern. For example, mixed upland hardwoods, hard maple/basswood, sugar maple/beech/birch and some in the miscellaneous hardwood forest types each would include a heavy component of maple. Seventy-four percent of the area was considered sawlog-sized stands (large diameter or 11.0 inches d.b.h. and greater), with the remainder classified as poles (medium diameter or 5.0-10.9 inches d.b.h.) and seedling/saplings (small diameter or 1.0-4.9 inches d.b.h.), as shown in Table 1.

Number of Live Trees

It is estimated that there are 329 million live trees on Classified Forest lands. In terms of the total number of live trees, sugar maple was by far the most abundant species at 68.0 million trees, followed by beech, yellow poplar, and red maple with 24.9 million, 18.8 million and 17.6 million trees, respectively (Table 2). More than half of the number of trees were less than 3 inches d.b.h., with 230.6 million (70%) being less than 5 inches d.b.h. An

item of concern is the lack of oak stems in the smaller diameter classes (Figure 1). In this sample, all oak species combined represent only 3.8% of all saplings 1 inch to less than 5 inches d.b.h. while all oaks represent 18.5% of all stems that are 15 inches d.b.h. and greater. The lack of oak seedlings/saplings and abundance of other shade-tolerant seedlings/saplings suggests a future decline of oak/hickory forest types as mature stands senesce.

Figure 1



Volume of All Live Trees

The net volume of all live trees, which includes growing stock, rough, and rotten trees, 5 inches d.b.h. and more, was 1.762 billion cubic feet (cuft). Hardwoods constituted 1.696 billion cuft or 96%. Oaks made up 400.7 million cuft or 22%, maples were 374.8 million cuft or 21%, yellow poplar was 261.3 million cuft or 14%, and hickories were 196.7 million cuft or 11% of the total volume (Table 3). Approximately 281.9 million cuft or 16% of the volume is in pole-sized trees (trees <11 inches d.b.h.) with the remainder being sawlog-sized (11 inches and greater d.b.h.). A total of 362.4 million cuft or 20% is 23 inches or greater d.b.h. (Table 3). It was estimated that 1.641 billion cuft of the total volume was in growing stock trees, with the remainder in rough cull and rotten cull trees. These volumes are presented in cubic feet because board foot volume estimates are only calculated on sawtimber-sized trees (hardwoods 11" d.b.h. and greater, softwoods 9" d.b.h. and greater).

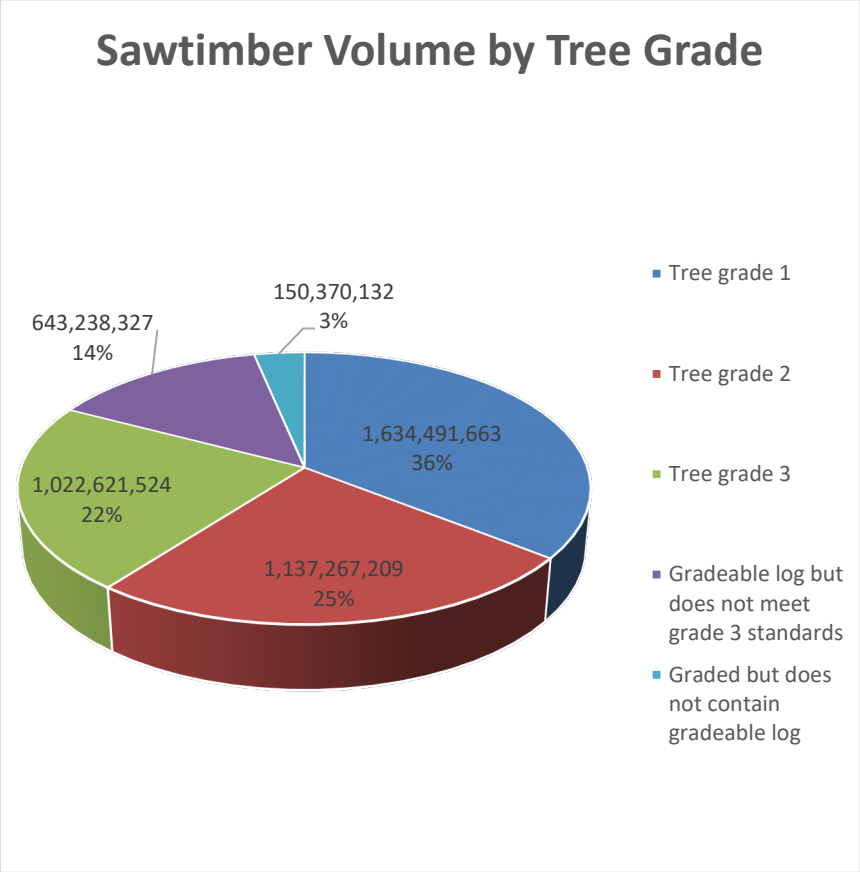
Volume of Sawtimber-sized Trees

The total net sawtimber volume was 4.588 billion board feet Doyle scale. Yellow poplar was the most voluminous species, with 904.6 million board feet (MMBF) or 19.7%, followed by sugar maple (465.8 MMBF) and white oak (447.4 MMBF). Northern red oak, black oak, and pignut hickory were the other major hardwood species ranked by sawlog volume, with 307.5, 245.3, and 194.6 MMBF, respectively (Table 4).

Grade of Sawtimber-sized Trees

Trees are graded using the Forest Service tree-grading system. It grades the best 12-foot section in the butt 16 foot for hardwoods. Grade 1 must yield 10 feet clear of defects; grade 2 must yield 8 feet clear; grade 3 must yield 6 feet clear; grade 4 must only be sound (tie grade); and grade 5 has a non-gradable butt log (due to form or rot) but has a gradable upper log (above the butt 16-foot log). It was estimated that 1.634 billion BF of the total net sawtimber volume was grade 1, and 1.137 billion BF and 1.022 billion BF in grades 2 and 3, respectively (Figure 2). Ninety-eight percent of the sawtimber volume of trees had 0-10% cull deductions.

Figure 2



Standing Dead Trees

There were an estimated 10.3 million standing dead trees 5 inches d.b.h. and greater. The individual species with the largest number of standing dead trees were white ash and sassafras, with 2.3 and 1.5 million stems, respectively (Table 5). As with the number of live trees, the number of standing dead trees decreased as the diameter increased. Of the 10.3 million standing dead trees, 5.9 million had a diameter from 5-9 inches d.b.h., 3.0 million were from 9-15 inches d.b.h., 894,000 were from 15-19 inches d.b.h., and the remaining 427,000 were 19 inches d.b.h. and greater (Table 5).

CHANGE ATTRIBUTES

Change attributes are determined by looking at the same data at two different points in time. We began to re-measure plots beginning in 2017 and therefore only 60% of the total sample is completed. Given this, these reported estimates are not as statistically reliable as they will be after all plots have been re-measured.

Growth

Net growth is defined as the gross or total growth, less mortality. The average annual net volume growth of all live trees, which includes growing stock, rough, and rotten trees, 5 inches d.b.h. and more, was 30.035 million cubic feet per year. Hardwoods grew 28.852 million cuft/year or 96% of the total growth, while cedar and pines merely netted 1.182 million cuft/yr. Yellow poplar and sugar maple were the top two individual species gaining in volume with 8.483 million cuft or 28% and 7.209 million cuft or 24%, respectively. As species groups, maples were 10.188 million cuft or 34%, oaks constituted 9.221 million cuft or 30%, yellow poplar was 8.483 million cuft or 28%, and hickories were 4.539 million cuft or 15% of the total growth (Table 5). The ashes showed a negative growth (a negative growth value would mean that mortality was larger than the gross growth) losing 12.590 million cuft annually. Approximately 6.675 million cuft or 22% of the growth is in pole-sized trees (trees <11 inches d.b.h.), with the remainder being sawlog-size (11 inches and greater d.b.h.).

Looking at sawlog-size average annual total volume growth, trees collectively grew an average of 131.4 million board feet Doyle annually. Hardwoods grew 125.7 million bdft/year, while cedar and pines grew 5.6 million bdft/year. Oaks constituted 32.8 million bdft or 25%, yellow poplar was 28.0 million bdft or 21%, maples were 23.9 million bdft or 18%, and hickories were 12.8 million bdft or 9% of the total growth (Table 6). White ash had higher mortality than sawlog growth.

Mortality

The average annual volume mortality of all trees was 23.213 million cuft per year. Hardwoods accounted for 22.719 million cuft/year or nearly 98% of the total mortality. White ash was 14.765 million cuft or 63%. The next individual species with the most volume lost to mortality was black oak, losing 1.753 million cuft or 7%. Collectively, all of the oak species accounted for 2.261 million cuft or nearly 10% of all mortality (Table 7).

Looking at sawlog-size volume mortality, forests lost an average of 41.9 million board feet Doyle annually. Ashes constituted 32.7 million bdft or 78%, and oaks were 7.1 million bdft or 17% of the total (Table 8).

Mortality would actually be higher than reported; however, any recently deceased trees used in a salvage harvest are not counted as mortality. These trees and their associated volume would be captured and reported as removals rather than mortality.

Some of the high mortality is easily explained. The ash decline can be contributed to emerald ash borer. Ash will continue to increase in mortality loss as this invasive pest continues to spread. Others, however, are more complex.

Several possible factors, such as intermittent droughts over the last 20 years (with the latest severe in 2012), an outbreak of tulip scale attacking yellow poplar a few years ago, other possible insects and diseases, and natural age progression of many individual tree species, could be contributing to the volume lost to mortality.

Yellow poplar will always be susceptible to extreme drought conditions on certain sites. Many of our oaks are nearing their maturity age. Trees show less vigorous growth attributes with age and therefore are potentially more likely to succumb to issues brought about by insects, diseases, drought, etc. In a younger, more vigorous growth stage these oak trees would normally overcome such attacks. With more than half of the mortality volume occurring in the oak species, this will continue to be an issue without serious management efforts to promote younger oak trees to replace the aging stands of oak we now enjoy.

Removals

The average annual volume removals of all trees was 18.053 million cuft per year. White ash was 4.6 million cuft or 26%, followed by white oak at 3.2 million cuft or 18%, sugar maple at 3.1 million cuft, and green ash at 2.4 million cuft (Table 9).

Looking at sawlog-size volume removals, 58.0 million board feet Doyle was removed annually. Ashes were 23.4 million bdft or 40% of the removals, oaks were 20.0 million bdft or 34%, and maples followed at 10.2 million bdft or 17% (Table 10).

ANCILLARY DATA ITEMS

Invasive Species

If present, crews identify any invasive species found on plot and measure the area of the plot that species occupies. These area estimates are then expanded to the entire 839,017 forested acres to estimate a total area that each invasive species occupies. Some plots may have multiple species present, while the majority of plots are free from invasive species. There were an estimated 81,133 cumulative acres with invasive species present … less than 10% of the total acreage. This can be attributed to concerted management activities to control invasive plants on forested lands enrolled in the classified system. Multiflora rose, Japanese (vine) honeysuckle, bush honeysuckle, and stiltgrass are the most prevalent, covering 23,184 acres, 16,905 acres, 14,772 acres, and 10,302 acres, respectively, with autumn olive, black locust, reed canary grass, garlic mustard, tree of heaven, and others also present.

Carbon

Carbon uptake and storage are a few of the many ecosystem services provided by forests. Carbon cycles through living organisms. Carbon dioxide (CO_2) is a gaseous component of the earth's atmosphere that plays several vital roles in the environment. Being a carbon source for plants is one of those roles. Through a process called photosynthesis, plants and photosynthetic algae and bacteria use energy from sunlight to combine CO_2 from the atmosphere with water to form carbohydrates. These carbohydrates are carbon-based sugars necessary for tree functioning and to make wood for growth. Every part of a tree stores carbon, including the trunks, branches, leaves, and roots. While the chemical composition of trees varies from species to species, by weight, trees are about 50% carbon.

Carbon is also found in soils. Carbon in soils come from the organic matter from trees and other vegetation in varying degrees of decomposition. In fact, soil carbon represents about 50% of the total carbon stored in forest systems in the United States. Soils release carbon dioxide when soil microbes break down organic matter. Some

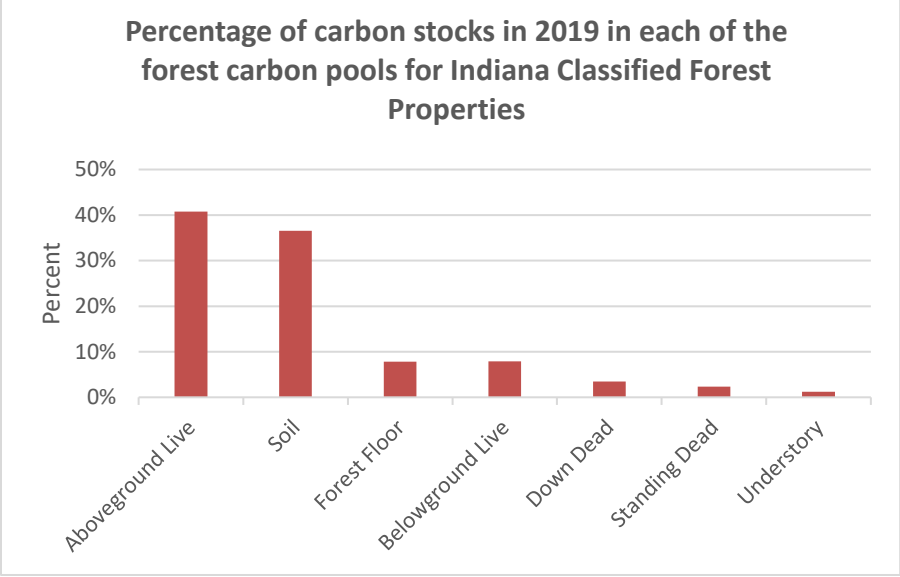
soil carbon can decompose in hours or days, but most resides in soils for decades or centuries. In some conditions, carbon resides in soils for thousands of years before fully decomposing. Soil carbon is generally considered very stable, meaning it does not change much or quickly in response to vegetation dynamics.

Because forests are naturally dynamic systems, the carbon contained within forests is always changing. On the scale of minutes, forests can simultaneously take up and store carbon through photosynthesis and release carbon as cells in trees respire, and soils release carbon through decomposition by soil microbes. Over months and years, the balance uptake and loss of carbon in a forest determines whether the forest is gaining or losing carbon stocks. The amount of carbon uptake and storage depends on the growing conditions and species of the trees in a given system. For example, in some temperate forests, a warm and wet climate can support forests that grow quickly and store a great deal of carbon. The opposite might be true of forests with a cold and dry climate. Younger forests generally take up and store carbon at greater rates than older forests.

CFI data has begun to provide carbon estimates for the Indiana Classified Forest system lands. We will be able to use this as baseline data and monitor carbon estimate trends over time. Early data indicates that annual carbon stock estimates are nearly 56 million short tons.

In 2019 about 40.7% of the forest carbon stocks on the classified forests are stored in the aboveground portion of live trees, which includes all live woody vegetation at least 1 inch in diameter (Fig. 3). The soil carbon pool, which consists of organic material in the mineral soil to a depth of one meter (excluding roots), is the second largest carbon pool, storing another 36.6% of the forest carbon stocks. The remaining forest carbon stocks can be found in the forest floor (litter), belowground portion of live trees, down dead material, standing dead trees, and the understory.

Figure 3



SUMMARY

The establishment of a statistically rigorous forest-resource monitoring program modeled after many aspects of the nation's forest inventory program (FIA) on Indiana's Classified Forests is already yielding a baseline of resource information. Estimates from this baseline compare favorably with prior estimates available from the FIA program.

Change estimates will become more reliable in the future as more plots are re-measured to provide smaller error estimates. The CFI system was not designed to produce change estimates until plots are re-measured (beginning in 2017 with 20% measured annually).

Even when all CFI plots are re-measured for change estimates, it is possible that the uncertainty associated with estimates of harvest will be relatively high as harvest is often only observed on a minority of plots, and individual trees found harvested on those plots even less, compared to growth. We will strive to augment this removal data with other potential data sources in the future.

INVENTORY METHODS AND TECHNIQUES

In order to better understand Indiana's public forests, to assist in providing public disclosure for forest management, and with third-party certification from SFI and FSC in mind, DoF began designing a CFI system in 2007 on State Forest lands. We then expanded this CFI system to include private lands enrolled in the Classified Forest system in 2011. We chose to mirror the USDA FIA program for several reasons. The DNR began to negotiate with FIA to build the CFI system to meet the certification audit requirements and yet coincide with the existing FIA standards. A unique system was designed, and implementation of plot establishment on the State Forests began in calendar year 2008. The expansion to include the Classified Forest lands began in 2011. The plots on Classified lands were spaced such that an approximately equal number of plots per year per natural region, chosen as the reporting unit (an annual panel), would be completed. Annually, these panels can stand alone as an independent survey; therefore, some results of significant value can be analyzed and reported on an annual basis. It took two years to complete the first panel, so 2016 marked our fifth completed panel, or 100% of the total sample.

Quality Assurance/Quality Control

The CFI program is the key program that provides the information needed to assess the status and trends of the DoF's Classified Forest lands. The goal of the CFI is to assure the production of complete, accurate and unbiased forest information of known quality. Specific measurement quality objectives (MQO) for precision are designed to provide a window of performance that we strive to achieve for every field measurement (quality assurance or QA). Quality control (QC) procedures include direct feedback to field staff to provide continual real-time assessment and improvements or refinements of field-staff performance. These data-quality goals were adapted from the USFS FIA program goals, which were developed from knowledge of measurement processes in forestry and forest ecology.

At the heart of CFI quality is extensive staff training and expertise. Field staff meets minimum forest-inventory requirements of a forestry education and background. In addition, each field-staff member begins with extensive

on-the-job training. Once field-staff members have a comfort level for what is expected, they begin production-data collection on their own.

To quantify and evaluate how the field staff is performing, a second measurement (quality check), taken on a sample of completed field plots, is performed by a trained and certified QA staff. This technique is done blindly, or without the production-crew data on hand, and then the two sets of data are compared, analyzed, and scored to the given MQO standards. Three percent of the plots are pre-selected and considered mandatory quality-check plots. The field staff does not have knowledge of which plots are mandatory checks. Field staff turn in completed data at given time intervals, and if no mandatory check plots are in that batch of production plots, then a random plot (non-mandatory) is picked to perform a quality check so that timely feedback can continuously be provided to the production field staff.

Each datum measured in the field has an associated MQO for precision. This is an assigned tolerance or acceptable level of measurement error, and measures the ability of field staff to make repeatable measurements or observations within the assigned tolerances. In the analysis of QA data, an observation is within tolerance when the difference between the production field-staff data and the quality-check data do not exceed the assigned tolerance or MQO for that data element. For some data elements, the tolerance is "no error," thus only observations that are identical are within tolerance. For example, the tolerance for measurement of tree d.b.h. is +/- 0.1 inch for each 20.0 inches of diameter of a live tree with the MQO for d.b.h. set at 95%. The quality of the data is evaluated by comparing the desired rate of differences within tolerance (as a % of observations) to the MQO. In the example above, the objective for d.b.h. would be that 95% or more of the d.b.h. observations are within +/- 0.1 inch for each 20.0 inches of diameter for all trees measured by both production field staff and QA staff.

Analysis of this QA dataset assures two things for the program: 1) a measurement of the accuracy of the data being collected and 2) an indicator of future training needs and refinement of the production field staff. With continuous program monitoring and productive feedback to field staff, the QAQC portion of the CFI program should continually improve the quality of the data over time.

Field Production Protocols

With the annual inventory system, about one-fifth of all field plots are measured each year. After five years, an entire inventory cycle is completed. After the first five years, results can be analyzed and reports created as a moving five-year average. For example, Indiana CFI will be able to generate a report based on inventory results for 2011-2012 through 2016 (the first report with all plots completed), 2013-2017, and so on.

Field plots of the inventory consist of installing and measuring of the annual sample of field plots (panel) in each natural region. It was determined for desired CFI precision standards that the sampling intensity would be one plot for approximately every 200 acres. Indiana CFI used the FIA non-overlapping hexagonal method to assist with establishing plot locations using Arc Map.

Field crews measure vegetation on plots based on FIA standards and protocols with few exceptions. Instead of the four subplot design that FIA uses, Indiana CFI only uses one 24-foot-radius (1/24 acre) circular subplot with the offset 6.8-foot-radius (1/300 acre) microplot. Trees with a d.b.h. of 5 inches and larger are measured on the 24-foot-radius circular subplot. All trees 1 inch d.b.h. and larger are measured on the 6.8-foot-radius circular

microplot, located 12 feet east of the center of the subplot. Both tree and forest measurements are collected. Some measurements include:

- General stand characteristics such as forest type, stand size and age, slope and aspect, and any recent disturbances
- Tree species, diameter, several different heights, damage, amount of rotten or missing wood, crown measurements, and tree quality
- Counts of tree regeneration
- Presence of identified invasive plants

Specific field protocols can be found in the Indiana CFI Field Data Collection Procedures for Plots Field Manual (internal document). With few exceptions, the FIA field manual (version 9.0) will suffice and is readily available online at https://www.fia.fs.fed.us/library/field-guides-methods-proc/docs/2019/core_ver9-0_10_2019_final.pdf

Estimation Errors or Quality of the Estimates

The four primary sources of error common to all sample-based estimates are sampling, measurement, prediction, and non-response error. For each of these sources of error, a definition within the context of the CFI inventory is provided, along with a discussion of methods used to quantify and reduce this error.

Sampling Error

The process of sampling (selecting a random subset of a population and calculating estimates from this subset) causes estimates to contain error they would not have if every member of the population had been observed and included in the estimate. The CFI inventory of DoF Classified Forest property is based on a sample of 2,948 plots located randomly across those lands enrolled in the Classified Forest Program, a sampling rate of approximately one plot for every 200 acres. Along with every estimate is an associated sampling error that is typically expressed as a percentage of the estimated value but that can also be expressed in the same units as the estimate or as a confidence interval (the estimated value plus or minus the sampling error). This sampling error is the primary measure of the reliability of an estimate. A sampling error can be interpreted to mean that the chances are two-out-of-three that, if a 100% inventory were taken using these methods, the results would have been within the limits indicated (i.e., 67% confidence interval).

The sampling errors for State-level estimates of the major attributes presented in this report are shown in the Part B tabular data report. The estimators used by CFI are unbiased under the assumptions that the sample plots are a random sample of the total population, and the observed value for any plot is the true value for that plot. Deviations from these basic assumptions are not reflected in the computation of sampling errors. The following sections on measurement, prediction, and nonresponsive error address possible departures from these basic assumptions.

Measurement Error

Errors associated with the methods and instruments used to observe and record the sample attributes are called measurement errors. On CFI plots, attributes such as the diameter and height of a tree are measured with different instruments, and other attributes such as species and crown class are observed without the aid of an instrument. On a typical CFI plot, six to 12 trees are observed, with 15 to 20 attributes recorded on each tree. In

addition, many attributes that describe the plot and conditions on the plot are observed. Errors in any of these observations affect the quality of the estimates. If a measurement is biased (such as tree diameter consistently being taken at an incorrect place on the tree), then the estimates that use this observation (such as volume) will reflect this bias. Even if measurements are unbiased, high levels of random error in the measurements will add to the total random error of the estimation process.

To ensure that all CFI observations are made to the highest standards possible, a regular program of quality assurance and quality control is an integral part of all CFI data-collection efforts, as described earlier.

Prediction Error

Errors associated with using mathematical models (such as volume models) to provide observations of the attributes of interest based on sample attributes are referred to as prediction errors. Area, number of trees, volume, biomass, growth, removals, and mortality are the primary attributes of interest presented in this report. Area and number-of-trees estimates are based on direct observation and do not involve the use of prediction models; however, CFI estimates of volume, biomass, growth, removals, and mortality use model-based predictions in the estimation process. Models are used to predict volume and biomass estimates of individual tree volumes. In the future, change estimates such as growth, mortality and removals will be based on these model-based predictions of volume from both the future plot re-measurements and the measurements taken in this first inventory.

Users of CFI estimates should be aware of the possible prediction errors in CFI estimates. In comparing CFI estimates to other data sources, users need to be aware of the prediction models used in both estimates. If both estimates are based on the same prediction models with matching fitted parameter values, then the prediction bias of one estimate should cancel out that of the other estimate. If the estimates are based on different prediction models, then the user should be aware of the prediction error of both models.

Non-response Error

Non-response error refers to the error caused by not being able to observe some of the elements in the sample. In CFI, non-response occurs when crews are unable to measure a plot (or a portion of a plot) at a selected location. Non-response falls into the following three classes:

- Denied access – Entire plots or portions of plots where the field crew is unable to obtain permission from the landowner and is therefore unable to measure the trees on the plot.

- Hazardous/inaccessible – Entire plots or portions of plots where the conditions present prevent a crew from safely getting to the plot or measuring the trees on the plot.

- Other – Plots where the field crew is unable to obtain a valid measurement for a variety of reasons other than those stated above.

Non-response has two effects on the sample. First, it reduces the sample size. The reduced sample size is reflected in the sampling errors discussed in that section. Second, non-response can cause bias in the estimates if the portion of the population not being sampled differs from the portion being sampled. Fortunately, in CFI,

unlike in many survey samples, non-response rates are relatively low. The non-response plots in this inventory were not permanently removed from the CFI system of plots. In future inventories, we will again attempt to measure these plots. At that time, we (1) may be able to obtain permission to access these plots (for the Classified Forest system), (2) the hazardous conditions may have changed, or (3) other circumstances that caused us to not measure plots could be different.

Data Management

This collected data is then imported, housed, and processed using a sophisticated Oracle database system. This Oracle system consists of three different but linked databases: MIDAS, NIMS and FIADB. Midas is the pre-field database and historical data-housing unit. NIMS is the post-field housing and processing database. FIADB is the database housing the presentation tables. So this Oracle system not only houses the data but also processes and readies the data for distribution. "Processing" the data combines certain measurements to determine some calculated estimates (e.g., using tree diameter, tree height, site index measurements, tree species, etc. to estimate tree volume using a volume equation).

Distribution is accomplished by eventually loading the post-processed data (FIADB tables) into a customized access database that is very similar in functionality to the USFS FIA EVALIDator online tool. This access database is used to assist with the analysis and interpretation of data. One can create customized tables with error estimates using this EVALIDator access database.

Oracle processing protocols are documented as well (several internal documents). Most protocols are scripts written in sequel programming code or are instructions for the processing of the data and are intended for the database manager or advanced user only. An access EVALIDator user guide was created (beta version – work in progress) with the intent of being used as a reference guide after a training session on how to use EVALIDator has been attended.

APPENDIX

Table 1.—Area of forest land by forest type group and stand size class, IN Classified Forests, 2015-2019.

Table 2.—Number of all live trees by species and diameter class, IN Classified Forests, 2015-2019.

Table 3.—Net volume of all live trees by species and diameter class, IN Classified Forests, 2015-2019.

Table 4.—Sawtimber volume of all live trees by species and diameter class, IN Classified Forests, 2015-2019.

Table 5.—Net growth of all live trees by species and diameter class, IN Classified Forests, 2015-2019.

Table 6.—Total growth of sawtimber by species and diameter class, IN Classified Forests, 2015-2019.

Table 7.—Mortality of all live trees by species and diameter class, IN Classified Forests, 2015-2019.

Table 8.—Mortality of sawtimber by species and diameter class, IN Classified Forests, 2015-2019.

Table 9.—Removals of all live trees by species and diameter class, IN Classified Forests, 2015-2019.

Table 10.—Removals of sawtimber by species and diameter class, IN Classified Forests, 2015-2019.

Table 11.—Number of standing dead trees 5 inches d.b.h. and greater by species and diameter class, IN Classified Forests, 2015-2019.

Table 1.—Area of forest land by forest type group and stand-size class, Indiana Classified Forests, 2015-2019.

Forest type	Stand-size	Large diameter	Medium diameter	Small diameter	Nonstocked
All	839,017	620,820	124,006	63,032	31,160
White oak / red oak / hickory	181,690	151,407	22,528	7,755	-
Hard maple / basswood	70,899	56,940	9,248	4,712	-
White oak	56,410	54,737	1,673	-	-
Yellow poplar	55,210	42,865	8,588	3,758	-
Cherry / white ash / yellow poplar	49,707	23,960	14,478	11,269	-
Mixed upland hardwoods	42,474	31,518	7,478	3,478	-
Sugar maple / beech / yellow birch	41,980	37,854	3,374	752	-
Northern red oak	29,955	28,880	322	752	-
Sugarberry / hackberry / elm / green ash	29,647	18,214	8,269	3,164	-
Other miscellaneous hardwood forest types	253,998	154,088	42,607	26,137	31,160
Miscellaneous softwood forest types	14,025	12,701	1,324	-	-
Pine/Hardwood	13,024	7,658	4,114	1,251	-

Table 2.—Number of all live trees by species and diameter class, Indiana Classified Forests, 2015-2019.

Species	Diameter class	0.1-2.9	3.0-4.9	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	21.0-22.9	23.0+
All	329,370,080	170,002,036	60,619,821	28,255,129	19,047,584	13,046,618	10,962,810	8,242,625	6,081,860	4,538,798	3,448,304	1,962,774	3,161,722
sugar maple	68,058,229	37,201,824	12,723,774	6,508,364	3,991,255	2,451,629	1,891,791	1,177,804	828,439	664,790	275,500	145,842	197,217
other hardwood species	37,272,411	19,297,218	6,084,591	3,524,179	2,301,865	1,841,531	1,250,535	941,721	741,742	426,676	383,690	176,231	302,420
American beech	24,954,638	16,325,221	4,917,310	1,265,232	612,245	437,690	402,480	248,524	244,300	131,151	150,959	49,330	170,195
Yellow poplar	18,867,032	6,911,850	4,122,089	1,580,488	1,052,661	856,083	1,019,431	790,413	623,770	444,612	554,554	284,305	626,776
red maple	17,601,904	7,812,546	3,611,069	1,869,253	1,317,702	888,789	756,633	499,781	280,287	206,462	137,877	73,601	147,903
other oaks	15,834,506	4,892,072	2,075,129	1,458,106	1,275,177	951,019	992,691	809,264	672,967	727,830	770,879	525,876	683,486
sassafras	14,257,588	8,351,882	2,756,039	1,101,277	770,165	544,710	346,784	222,731	94,980	21,904	30,756	-	16,358
flowering dogwood	11,777,507	8,228,991	3,177,862	291,944	69,857	8,852	-	-	-	-	-	-	-
American elm	11,654,735	5,154,220	3,436,575	1,570,116	737,980	358,713	196,864	108,023	42,029	23,455	17,908	8,852	-
other hickories	10,657,013	2,902,996	2,286,425	742,111	977,079	731,193	858,862	716,154	507,339	369,395	301,706	86,556	177,199
white ash	10,614,849	7,032,001	1,230,839	720,137	428,252	300,052	256,717	147,795	240,579	85,413	49,791	56,495	66,777
pawpaw	10,342,571	10,023,614	311,825	7,131	-	-	-	-	-	-	-	-	-
hackberry	9,372,218	4,449,760	2,076,484	1,099,196	672,850	311,963	282,699	194,861	104,605	59,971	30,245	23,318	66,265
black cherry	9,058,490	2,978,108	2,003,772	1,331,010	818,168	682,542	498,219	298,328	215,437	121,613	60,175	23,950	27,169
eastern hophornbeam	6,854,497	5,494,943	913,138	326,819	83,373	36,225	-	-	-	-	-	-	-
American hornbeam	6,734,949	5,212,940	1,309,213	166,399	30,415	15,983	-	-	-	-	-	-	-
sweetgum	6,690,227	4,146,515	707,316	505,028	287,166	221,342	239,849	204,431	174,647	127,577	21,563	23,916	30,877
other maples	6,488,265	2,995,138	811,258	808,478	626,843	327,358	199,182	242,878	119,038	147,723	44,464	62,168	103,736
white oak	6,280,382	1,143,504	904,435	420,315	435,434	349,776	413,732	448,272	455,112	596,696	386,340	303,540	423,224
shagbark hickory	6,211,849	1,798,990	938,057	534,067	612,075	450,753	502,064	509,990	406,252	225,126	139,341	62,332	32,802
eastern redcedar	6,153,161	1,552,306	1,810,902	1,000,145	903,882	497,652	171,704	162,036	39,642	14,894	-	-	-
other elms	6,023,216	3,298,701	1,113,197	774,793	433,916	204,451	89,263	75,462	15,526	9,056	-	-	8,852
other softwood species	3,816,731	1,007,642	181,781	390,241	436,725	466,674	481,472	379,044	189,304	125,600	48,290	38,349	71,612
other ashes	3,793,110	1,789,053	1,116,737	260,300	172,500	111,634	111,838	65,109	85,861	8,852	44,260	18,112	8,852

Table 3.—Net volume of all live trees by species and diameter class, Indiana Classified Forests, 2015-2019.

Species	Diameter class	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	21.0-22.9	23.0+
All	1,762,285,554	64,382,555	95,278,747	122,300,817	169,138,819	193,444,579	202,809,171	204,665,804	204,219,561	143,641,860	362,403,641
yellow poplar	261,334,622	4,152,269	6,026,765	9,341,423	18,149,284	22,368,765	24,993,214	23,789,697	39,366,048	25,103,475	88,043,682
sugar maple	235,754,475	16,839,456	22,124,369	25,148,277	31,802,418	29,194,517	29,253,399	31,203,343	16,886,822	10,716,333	22,585,541
other hardwood species	182,785,932	12,319,381	15,879,196	18,619,304	21,625,795	23,009,543	22,009,239	19,324,351	17,901,505	8,762,115	23,335,505
white oak	144,657,608	973,996	2,289,249	3,206,602	6,186,582	9,815,004	13,656,319	24,487,851	20,331,818	20,059,631	43,650,557
northern red oak	91,184,323	636,805	1,234,235	2,259,127	4,038,864	5,830,762	6,651,435	9,135,732	17,253,220	16,438,869	27,705,275
red maple	91,165,889	4,635,020	7,045,610	8,472,782	11,768,511	11,812,770	9,195,118	9,365,893	7,731,122	5,266,532	15,872,530
other oaks	90,994,712	1,978,445	3,961,242	4,345,982	6,583,909	6,298,723	7,700,848	12,706,341	15,415,013	11,699,048	20,305,162
black oak	73,898,419	892,391	1,302,559	2,206,464	3,887,313	6,075,108	6,619,864	9,048,116	9,950,526	9,461,583	24,454,494
shagbark hickory	70,050,910	1,269,939	3,160,081	4,588,610	7,978,466	12,128,035	14,014,253	10,364,205	8,673,460	4,656,925	3,216,937
pignut hickory	67,999,216	973,010	2,371,156	3,603,217	7,993,472	9,284,058	8,215,667	9,641,527	9,681,160	4,099,182	12,136,766
redcedar and pine species	65,644,831	2,905,030	6,193,336	8,342,380	9,456,354	11,965,912	7,027,967	6,350,321	2,778,588	2,767,064	7,857,878
American beech	65,442,726	2,986,154	3,006,330	4,132,116	6,279,216	5,809,813	7,973,857	5,721,483	8,315,429	3,402,597	17,815,729
black walnut	50,377,967	1,263,053	2,213,749	5,034,281	6,615,990	6,983,384	9,916,024	3,740,336	5,815,998	2,567,765	6,227,387
other maples	47,912,248	1,670,458	2,826,951	2,970,453	2,566,156	5,529,601	4,148,482	6,601,666	2,628,332	4,590,247	14,379,903
bitternut hickory	44,996,232	754,978	2,281,179	2,996,507	4,724,272	6,009,603	7,555,788	6,077,281	6,762,396	2,593,247	5,240,981
black cherry	44,595,929	2,548,403	3,751,124	5,641,841	6,873,329	6,533,713	6,453,872	5,239,391	3,553,119	1,730,984	2,270,153
American sycamore	39,993,228	631,420	1,218,693	2,325,744	1,822,477	3,860,872	3,168,669	4,573,825	2,594,208	3,980,316	15,817,003
white ash	39,536,257	1,552,157	2,069,081	2,877,951	3,920,452	3,550,111	7,766,252	3,615,556	2,980,515	3,887,485	7,316,698
elms	26,725,141	4,693,951	5,088,151	4,464,210	3,798,662	3,592,622	1,623,223	1,356,435	811,449	646,629	649,808
other hickories	13,706,498	96,769	366,924	603,263	1,360,603	2,267,009	2,029,939	1,880,022	2,317,846	-	2,784,126
other ashes	13,528,390	609,472	868,767	1,120,284	1,706,691	1,524,657	2,835,743	442,431	2,470,985	1,211,834	737,525

Table 4.—Sawtimber volume of all live trees by species and diameter class, Indiana Classified Forests, 2015-2019.

Species	Diameter class	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-22.9	23+
All	4,587,988,854	9,538,929	316,270,180	451,907,064	554,167,341	627,885,316	688,032,129	511,074,804	1,429,113,091
yellow poplar	904,652,497	-	36,220,096	57,829,049	75,337,691	80,339,985	147,646,740	96,512,819	410,766,118
sugar maple	465,836,836	-	60,615,186	68,785,404	78,312,097	93,414,236	52,772,601	36,192,090	75,745,222
white oak	447,475,138	-	12,251,837	23,828,320	37,076,763	73,740,620	65,283,464	70,113,940	165,180,194
other hardwood species	308,283,148	-	34,694,669	42,402,849	44,859,027	42,542,855	52,798,288	21,924,908	69,060,553
northern red oak	307,544,178	-	8,152,497	14,868,389	19,526,725	29,861,723	61,159,192	62,691,503	111,284,148
black oak	245,372,445	-	8,018,673	15,099,209	19,192,698	29,135,020	34,641,753	35,278,443	104,006,649
pignut hickory	194,665,899	-	16,245,451	22,864,716	24,048,322	31,533,750	33,313,586	13,883,891	52,776,183
red maple	181,444,472	-	18,864,445	23,203,152	22,446,502	25,379,813	21,302,051	17,928,044	52,320,465
shagbark hickory	177,101,965	-	15,899,529	29,809,116	39,193,073	33,026,121	28,442,600	17,736,336	12,995,191
American beech	169,953,794	-	12,290,644	14,274,832	22,317,457	17,640,425	26,213,785	11,617,002	65,599,650
other oaks	165,292,445	-	12,030,652	11,380,501	18,374,853	29,995,704	32,033,808	22,103,107	39,373,822
bitternut hickory	125,763,276	-	9,811,021	14,809,516	22,161,487	18,822,751	24,175,130	10,066,981	25,916,389
American sycamore	115,566,300	-	3,299,585	9,097,929	7,956,011	14,091,574	8,642,720	14,789,526	57,688,953
black walnut	110,371,888	-	12,857,703	17,342,880	27,497,151	10,874,283	18,227,252	5,918,705	17,653,914
white ash	98,345,096	-	6,827,853	8,119,854	19,561,840	9,302,618	10,213,691	13,160,153	31,159,088
pin oak	89,895,257	-	542,922	4,077,881	2,518,385	10,254,734	19,579,513	20,470,741	32,451,081
eastern white pine	87,720,567	2,599,222	9,427,344	14,699,514	8,304,192	12,460,936	3,356,233	12,292,487	24,580,638
other softwoods and redcedar	84,834,542	6,939,708	11,360,775	17,135,169	13,903,560	11,277,614	8,870,893	-	15,346,826
silver maple	79,297,358	-	1,429,680	6,612,520	6,623,492	14,132,262	8,244,282	11,929,707	30,325,416
black cherry	75,928,630	-	11,979,072	13,759,504	13,378,984	14,719,936	10,456,128	5,963,089	5,671,918
sweetgum	70,124,903	-	6,915,784	10,631,810	15,341,348	15,642,730	4,078,308	5,978,128	11,536,797
other hickories	38,455,618	-	2,518,812	5,630,397	5,788,911	4,978,723	8,114,409	-	11,424,365
other ashes	31,623,612	-	3,218,529	3,260,286	7,855,537	1,384,462	8,465,702	4,523,208	2,915,888
other maples	12,438,988	-	797,422	2,384,265	2,591,236	3,332,442	-	-	3,333,623

Table 5.—Net growth of all live trees by species and diameter class, Indiana Classified Forests, 2015-2019.

Species	Diameter class	0.1-2.9	3.0-4.9	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	21.0-22.9	23.0+
All	30,035,478	-	-17,364	3,170,413	1,646,836	1,966,652	3,043,431	2,487,253	2,801,495	2,581,628	4,030,642	3,171,589	5,152,905
yellow poplar	8,483,872	-	-	468,631	173,368	554,473	612,045	462,417	1,742,550	385,088	1,366,393	1,325,214	1,393,692
sugar maple	7,209,220	-	-	1,098,987	997,266	853,005	1,049,412	527,400	801,158	733,924	556,816	188,382	402,870
northern red oak	2,987,738	-	-	61,188	36,961	64,268	229,130	201,407	283,637	33,827	708,454	444,539	924,327
white oak	2,644,224	-	-	16,971	1,256	20,468	118,743	173,976	188,805	905,447	233,287	214,587	770,684
other hardwood species	2,525,300	-	-	234,483	203,372	103,954	496,808	176,685	468,697	246,069	193,316	-	401,914
red maple	1,892,927	-	-	122,008	155,381	323,076	160,800	227,097	119,227	175,059	356,094	81,752	172,434
pignut hickory	1,750,072	-	-	17,079	58,797	87,512	106,298	340,685	449,807	314,331	221,042	72,591	81,930
shagbark hickory	1,626,486	-	-	50,727	87,244	149,987	248,340	401,283	256,914	160,296	47,521	-	224,173
other oaks	1,407,025	-	-	9,579	103,263	115,715	57,937	161,325	63,544	234,313	143,576	229,189	288,587
black walnut	1,371,217	-	-	-16,771	143,800	326,178	238,553	176,061	177,625	60,818	144,004	-	120,949
redcedar and pine species	1,182,576	-	-	-3,073	-202,106	90,835	75,414	227,837	35,051	149,277	-	346,809	462,534
American beech	1,181,655	-	-	246,457	148,314	125,346	311,701	-19,075	182,436	184,386	40,754	69,043	-107,707
pin oak	1,105,893	-	-	40,490	54,542	21,981	31,324	111,139	6,022	253,284	260,521	93,827	232,765
other maples	1,086,763	-	-	133,743	77,424	133,061	207,522	526,394	171,721	78,793	108,538	112,214	-462,647
bitternut hickory	953,674	-	-	114,555	44,291	134,860	118,565	126,144	69,780	143,555	101,409	-	100,515
American sycamore	894,701	-	-	22,575	38,738	-35,638	192,505	64,180	71,700	51,788	-	84,533	404,321
hackberry	680,044	-	-	186,674	82,125	-12,177	9,282	113,209	99,811	96,388	-	104,733	-
American basswood	640,934	-	-	17,417	13,608	47,595	16,078	79,106	57,596	46,958	242,758	-	119,819
sweetgum	633,378	-	-	62,401	-2,752	108,292	50,353	-	282,277	103,482	-	29,326	-
black cherry	597,125	-	-	-44,418	-335,347	344,160	115,911	-	165,138	226,347	-	125,333	-
chinkapin oak	565,146	-	-	79,227	54,845	48,258	34,464	23,537	28,860	178,544	70,568	-	46,844
black oak	511,585	-	-	36,427	61,077	84,427	56,455	229,764	449,975	64,512	210,440	-179,524	-501,967
elms	485,903	-	-	268,165	-111,123	122,306	7,918	113,155	-	14,329	71,154	-	-
other hickories	208,854	-	-	4,742	15,772	31,912	80,499	-	-	75,928	-	-	-
ash species	-12,590,835	-	-17,364	-57,851	-253,277	-1,877,200	-1,582,626	-1,956,471	-3,370,837	-2,335,113	-1,046,005	-170,958	76,867

Table 6.—Total growth of sawtimber by species and diameter class, Indiana Classified Forests, 2015-2019.

Species	Diameter class	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-22.9	23.0+
All	131,431,248	640,099	25,153,393	13,048,158	19,173,705	16,009,885	17,473,588	14,939,809	24,992,610
yellow poplar	28,086,567	-	3,348,784	1,871,942	5,247,979	1,486,245	5,371,924	5,130,680	5,629,012
sugar maple	17,019,284	-	6,575,382	1,718,900	2,785,430	2,222,560	1,768,661	620,353	1,327,999
other hardwood species	10,634,675	-	2,348,462	1,305,138	2,779,718	1,038,255	1,418,209	92,881	1,652,011
northern red oak	9,664,363	-	1,086,589	514,141	824,078	107,687	2,391,043	1,574,433	3,166,393
white oak	8,717,391	-	388,356	410,101	1,288,644	2,901,976	687,311	673,548	2,367,454
black oak	6,255,100	-	306,045	573,965	1,263,483	1,043,799	684,374	1,298,277	1,085,157
shagbark hickory	5,180,906	-	1,934,195	981,146	721,444	501,215	161,204	-	881,701
other oaks	4,953,342	-	548,934	452,330	251,526	1,228,571	644,391	699,324	1,128,265
pignut hickory	4,636,241	-	212,882	860,015	1,297,311	1,010,006	641,096	272,407	342,524
eastern white pine	4,238,765	-	36,538	102,151	77,114	432,394	-	1,419,468	2,171,100
ash species	4,039,489	-	555,227	527,383	604,462	171,145	578,454	1,305,352	297,466
black walnut	3,847,319	-	1,950,483	418,436	482,092	178,299	430,693	-	387,316
American beech	3,645,487	-	762,541	498,990	511,906	566,025	132,734	238,473	934,816
red maple	3,586,103	-	574,897	372,102	300,976	482,104	1,041,970	256,652	557,401
American sycamore	3,553,416	-	1,275,414	162,793	91,166	171,369	-	304,548	1,548,125
pin oak	3,242,955	-	334,181	276,514	16,810	769,813	848,928	322,742	673,966
silver maple	2,975,614	-	601,446	1,176,781	-	216,232	320,145	342,556	318,453
black cherry	2,699,824	-	1,254,031	-	427,121	630,558	-	388,114	-
bitternut hickory	2,416,731	-	556,249	319,382	202,444	462,757	352,449	-	523,450
other pines and redcedar	1,432,381	640,098	135,675	505,950	-	150,659	-	-	-
other hickories	605,296	-	367,082	-	-	238,214	-	-	-

Table 7.—Mortality of all live trees by species and diameter class, Indiana Classified Forests, 2015-2019.

Species	Diameter class	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	21.0-22.9	23.0+
All	23,213,044	-	18,349	1,407,033	2,484,753	3,124,146	2,482,658	3,150,624	4,373,763	2,869,745	1,289,492
white ash	14,764,899	-	18,349	213,574	427,855	1,974,822	1,619,490	2,195,516	3,878,707	2,578,164	1,289,492
black oak	1,753,618	-	-	18,487	-	-	-	-	-	291,581	-
black cherry	917,982	-	-	184,070	468,138	80,065	185,709	-	-	-	-
sugar maple	877,048	-	-	61,872	236,186	103,320	-	268,715	206,955	-	-
other hardwood species	731,862	-	-	216,365	194,767	320,730	-	-	-	-	-
elms	662,165	-	-	121,142	336,139	-	204,884	-	-	-	-
sassafras	459,504	-	-	-	110,409	149,834	-	199,260	-	-	-
white oak	454,466	-	-	29,064	72,034	65,267	-	-	288,101	-	-
green ash	421,591	-	-	-	-	244,394	177,197	-	-	-	-
yellow poplar	304,767	-	-	-	50,524	-	-	254,243	-	-	-
eastern redcedar	301,688	-	-	73,685	164,423	63,580	-	-	-	-	-
red maple	251,418	-	-	251,418	-	-	-	-	-	-	-
American beech	232,889	-	-	-	-	-	-	232,889	-	-	-
hackberry	200,800	-	-	-	-	122,133	78,667	-	-	-	-
pine species	191,861	-	-	46,162	145,699	-	-	-	-	-	-
other maples	190,661	-	-	89,954	100,707	-	-	-	-	-	-
black walnut	181,595	-	-	83,873	-	-	97,722	-	-	-	-
American basswood	162,522	-	-	-	43,533	-	118,989	-	-	-	-
hickories	98,174	-	-	17,368	80,806	-	-	-	-	-	-
northern red oak	53,532	-	-	-	53,532	-	-	-	-	-	-

Table 8.—Mortality of sawtimber by species and diameter class, Indiana Classified Forests, 2015-2019.

Species	Diameter class	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-22.9	23.0+
All	41,913,725	-	3,299,800	6,476,871	11,401,597	8,875,143	4,347,255	4,245,766	3,267,295
white ash	32,418,366	-	2,722,131	4,713,700	10,601,585	7,946,033	4,347,255	2,087,663	-
black oak	6,354,507	-	-	-	-	929,109	-	2,158,103	3,267,295
white oak	800,012	-	-	-	800,012	-	-	-	-
yellow poplar	652,996	-	-	652,996	-	-	-	-	-
sugar maple	652,956	-	-	652,956	-	-	-	-	-
sassafras	457,220	-	-	457,220	-	-	-	-	-
green ash	331,025	-	331,025	-	-	-	-	-	-
American basswood	246,643	-	246,643	-	-	-	-	-	-

Table 9.—Removals of all live trees by species and diameter class, Indiana Classified Forests, 2015-2019.

Species	Diameter class	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	21.0-22.9	23.0+
All	18,053,980	427,449	257,537	336,866	329,129	-	2,185,745	1,172,982	3,427,024	6,023,346	3,893,902
white ash	4,681,770	-	129,273	80,261	-	-	1,295,411	-	1,303,523	1,873,302	-
white oak	3,268,538	-	-	-	-	-	-	-	445,776	-	2,822,762
sugar maple	3,117,335	98,122	43,201	-	-	-	646,573	-	-	1,258,298	1,071,141
green ash	2,416,420	-	-	-	-	-	-	-	650,513	1,765,906	-
chestnut oak	1,200,139	-	-	-	-	-	-	750,383	449,756	-	-
black oak	643,737	-	-	-	-	-	-	-	-	643,737	-
yellow poplar	577,456	-	-	-	-	-	-	-	577,456	-	-
sweetgum	482,104	-	-	-	-	-	-	-	-	482,104	-
black walnut	455,566	32,967	-	-	-	-	-	422,599	-	-	-
black cherry	310,820	-	-	173,273	137,547	-	-	-	-	-	-
shagbark hickory	243,761	-	-	-	-	-	243,761	-	-	-	-
common persimmon	191,583	-	-	-	191,583	-	-	-	-	-	-
other	464,755	296,360	85,063	83,332	-	-	-	-	-	-	-

Table 10.—Removals of sawtimber by species and diameter class, Indiana Classified Forests, 2015-2019.

Species	Diameter class	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-22.9	23.0+
All	58,009,767	-	617,055	-	6,022,480	3,669,535	9,579,247	21,850,853	16,270,597
white ash	14,808,736	-	-	-	3,539,375	-	4,396,675	6,872,686	-
white oak	13,819,168	-	-	-	-	-	1,439,478	-	12,379,690
sugar maple	10,207,122	-	-	-	1,795,959	-	-	4,520,256	3,890,907
green ash	8,672,345	-	-	-	-	-	2,195,160	6,477,185	-
chestnut oak	3,931,132	-	-	-	-	2,383,198	1,547,934	-	-
black oak	2,337,338	-	-	-	-	-	-	2,337,338	-
sweetgum	1,643,389	-	-	-	-	-	-	1,643,389	-
black walnut	1,286,337	-	-	-	-	1,286,337	-	-	-
shagbark hickory	687,145	-	-	-	687,145	-	-	-	-
common persimmon	359,515	-	359,515	-	-	-	-	-	-
black cherry	257,540	-	257,540	-	-	-	-	-	-

Table 11.—Number of standing dead trees 5” d.b.h. and greater by species and diameter class, Indiana Classified Forests, 2015-2019.

Species	Diameter class	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	21.0-22.9	23.0+
All	10,376,569	3,550,758	2,422,842	1,493,445	956,323	632,452	506,787	387,119	178,934	132,566	115,342
white ash	2,371,701	475,325	417,616	389,130	259,210	228,649	231,151	154,100	100,312	83,202	33,006
sassafras	1,587,818	856,463	370,224	220,841	100,220	16,615	23,455	-	-	-	-
other hardwoods	975,456	373,417	220,963	176,767	108,242	14,602	7,301	51,969	15,064	-	7,131
yellow poplar	626,853	230,083	130,281	87,887	85,429	55,081	7,131	14,603	7,301	9,056	-
American elm	551,439	219,932	173,731	87,285	43,322	18,112	9,056	-	-	-	-
sugar maple	366,104	106,487	104,294	60,086	14,432	40,274	25,006	15,526	-	-	-
slippery elm	402,597	142,108	110,765	57,413	35,816	30,620	16,819	9,056	-	-	-
black locust	320,102	81,509	84,387	75,638	7,131	37,546	16,187	17,704	-	-	-
eastern redcedar	461,807	250,506	130,694	50,940	29,667	-	-	-	-	-	-
black cherry	446,238	155,052	154,684	34,470	49,621	27,169	25,243	-	-	-	-
white oak	266,323	48,494	68,220	47,609	-	25,243	32,972	18,112	17,908	7,763	-
eastern white pine	422,037	184,453	116,840	33,638	42,029	18,112	18,112	8,852	-	-	-
other oaks	265,530	57,617	56,086	24,582	30,420	25,875	24,378	31,679	7,131	0	7,763
red maple	221,901	86,843	50,078	15,526	16,819	-	7,763	9,056	8,852	9,056	17,908
American beech	159,721	23,455	14,432	31,422	16,154	28,865	-	7,301	7,301	7,131	23,659
black oak	138,065	23,659	16,154	7,301	26,556	16,154	-	7,301	7,763	7,301	25,875
hickories	223,834	44,561	39,846	25,005	23,950	16,357	23,659	34,095	7,301	9,056	-
Virginia pine	139,722	32,136	69,233	15,526	-	7,763	7,301	7,763	-	-	-
other softwoods	121,895	46,485	22,365	18,112	16,819	9,056	9,056	-	-	-	-
other ashes	169,200	48,665	42,914	34,266	36,225	-	7,131	-	-	-	-
black walnut	138,225	63,506	29,035	-	14,262	16,358	15,064	-	-	-	-