Indiana DNR State Forest Properties
Report of Continuous Forest Inventory (CFI)
Summary of years 2017-2021

Joey Gallion
Forest Resource Information/Forest Inventory Program Coordinator

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FOREWORD

This report provides an overview of forest-resource attributes for State Forest land managed by the DNR Division of Forestry. The findings come from the continuous annual inventory conducted by the Forest Resource Information (FRI) Section of the Indiana DNR Division of Forestry (DoF). The CFI inventory of DoF State Forest property is based on a sample of 3,921 plots located randomly across those lands (a total area of 159,146 acres), a sampling rate of approximately one plot for every 40 acres. 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, 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 the population (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) that are updated annually.

This report is a summary of the five years of plot installation and data collection for the years 2017-2021, a span that constitutes one entire cycle. With 20% of the plots measured annually, the 2021 plots were the same plots measured in 2016, thus the 2016 data were replaced with the 2021 data.

EXECUTIVE SUMMARY/HIGHLIGHTS

These are the annual reported results of the established continuous forest inventory (CFI). The goal of the first five years (2008-2012) 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 state forest properties are:

- There are 159,146 total acres; 152,730 forested acres, with the balance in non-forest (i.e., campgrounds) and water.
- 94% of the forested acres are hardwoods.
- 79% of the forested acres are sawlog-sized stands.
- Forests contain 61.3 million live trees.
- American beech trees and seedlings are more abundant than any other species, with sugar maple a close second (13.2 and 11.8 million trees, respectively).
- There is 346.5 million cubic feet of total live tree volume.
- There is 1.009 billion board feet (Doyle) of sawlog volume.
- White oaks, followed by red oaks and yellow poplar, are the species groups with the most sawlog volume.
- 70.3% of the sawlog volume is considered grade 1 or 2.
- Oaks constituted 4.7 million bdft Doyle or 49% of the sawlog volume (9.6 million bdft Doyle) lost via mortality annually. 9.6 million bdft Doyle annual mortality is less than 1% of the total 1.0 billion bdft Doyle standing volume.
- Japanese honeysuckle, stiltgrass and multiflora rose are the most common invasive species present.
- There are 10.43 million short tons of forest carbon stocks.

FOREST COMPOSITION

Area

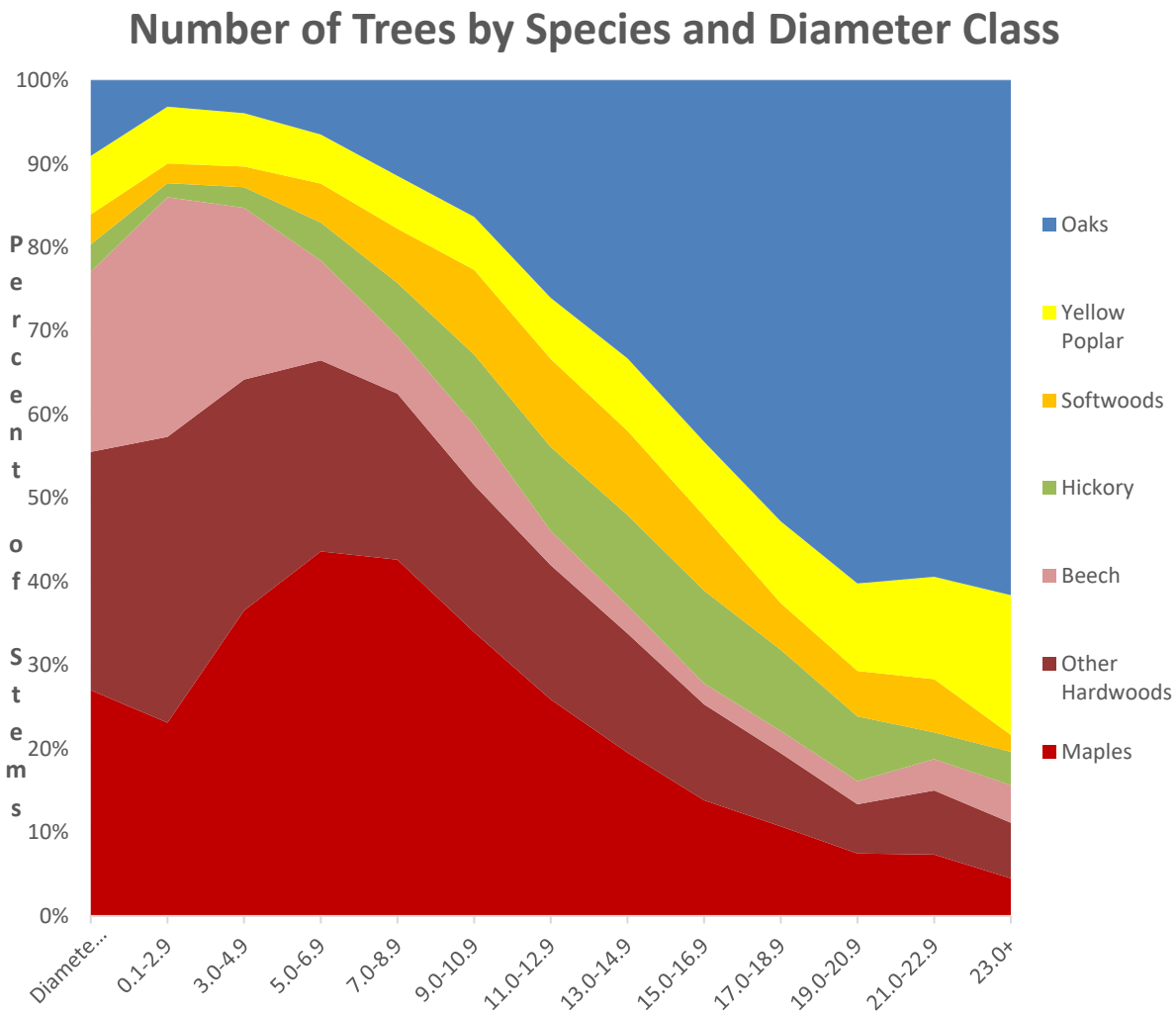
State forest lands comprise approximately 159,146 acres located primarily in the southern third of Indiana. An estimated 152,730 of these acres is considered forest land (land considered stocked with trees or seedlings that is at minimum 1 acre in size and 120 feet in width), with the remaining ~6,400 acres being non-forest (open fields, campgrounds, 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, state forests are predominantly hardwoods, with 94% of the total forest area classified as hardwood forest types. The primary hardwood forest types were white oak/red oak/hickory (26,782 acres, 18%), white oak (22,569 acres, 15%), chestnut oak (15,459 acres, 10%), and yellow poplar (11,111 acres, 7%) (Table 1). Seventy-nine percent of the area was considered sawlog-sized stands [large diameter or 11.0-inches diameter breast height (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.) (Table 1).

Number of Live Trees

It is estimated that there are 61.3 million live trees 1 inch d.b.h. and larger on state forest lands. In terms of the total number of live trees, beech and sugar maple were the most abundant species, at 13.2 million and 11.8 million trees, respectively (Table 2). More than half of the number of trees were less than 3 inches d.b.h., with 45.3 million being less than 5 inches d.b.h. An item of concern is the non-uniform distribution of the number of

stems by diameter class for different species (Figure 1). In this sample, all oak species combined represented about 3.3% of all saplings 1 inch to less than 5 inches d.b.h. Without significant management intervention, the lack of oak seedlings/saplings and over-abundance of maple and beech 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 346.5 million cubic feet (cuft). Hardwoods constituted 325.2 million cuft or 94%. Oaks made up 149.3 million cuft or 43%. Maples were 52.0 million cuft or 15%. Yellow poplar was 47.8 million cuft or 14%. Hickories were 26.4 million cuft or 8% of the total volume (Table 3). Approximately 42.5 million cuft or 12% 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.). 86.1 million cuft or 25% is 23 inches or greater d.b.h. (Table 3). It was estimated that 333.5 million 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 inches d.b.h. and greater, softwoods 9 inches d.b.h. and greater).

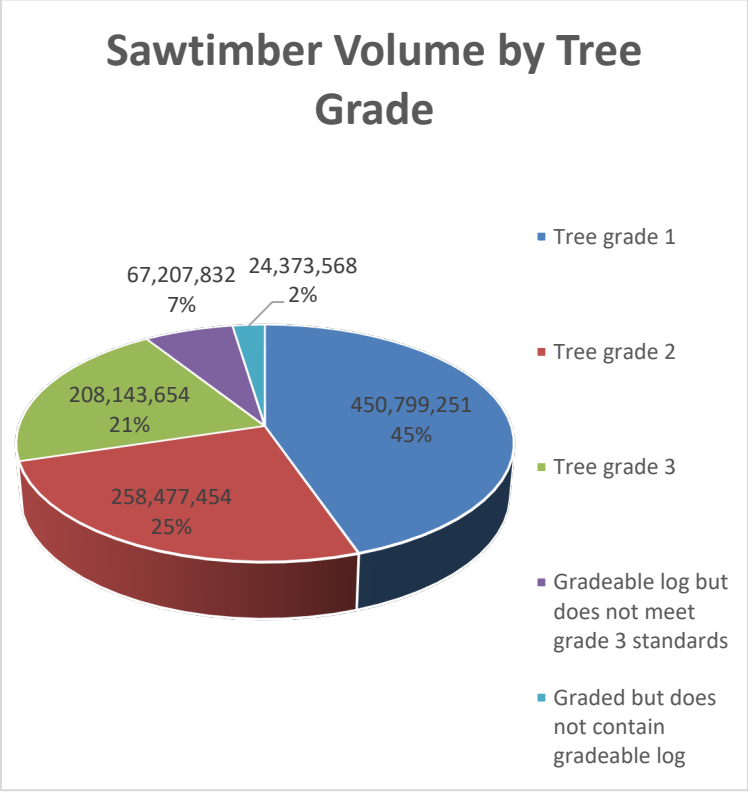
Volume of Sawtimber-sized Trees

The total net sawtimber volume was 1.009 billion board feet Doyle scale (6,606 bdft/acre). Yellow poplar and white oak were the most voluminous species, with 173.4 million board feet (MMBF) and 173.1 MMBF or 17% each, followed by chestnut oak and black oak, with 121.4 and 108.9 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 feet 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 450.8 MMBF of the total net sawtimber volume was grade 1 and 258.5 and 208.1 MMBF in grades 2 and 3, respectively (Figure 2). Ninety-nine percent of the sawtimber volume of trees had 0-10% cull deductions.

Figure 2



Standing Dead Trees

There were an estimated 1.7 million standing dead trees 5 inches d.b.h. and greater. The individual species with the largest number of standing dead trees was sassafras, with 265,500 stems. Ashes were second, with 172,100

standing dead trees, with Chestnut oak, white oak, and Virginia pine following with 160,200, 136,000, and 122,200 standing dead trees, respectively (Table 11). As with the number of live trees, the number of standing dead trees decreased as the diameter increased. Of the 1.7 million standing dead trees, 842,200 had a diameter from 5-9 inches d.b.h., 561,700 were from 9-15 inches d.b.h., 182,900 were from 15-19 inches d.b.h., and the remaining 118,100 were 19 inches d.b.h. and greater (Table 11).

CHANGE ATTRIBUTES

Change attributes are determined by looking at the same data at two different points in time. We continued to re-measure plots, beginning in 2013, and completed the total sample re-measure in 2017. Except for an occasional new install plot (due to land acquisition), the majority of plots are now being re-measured.

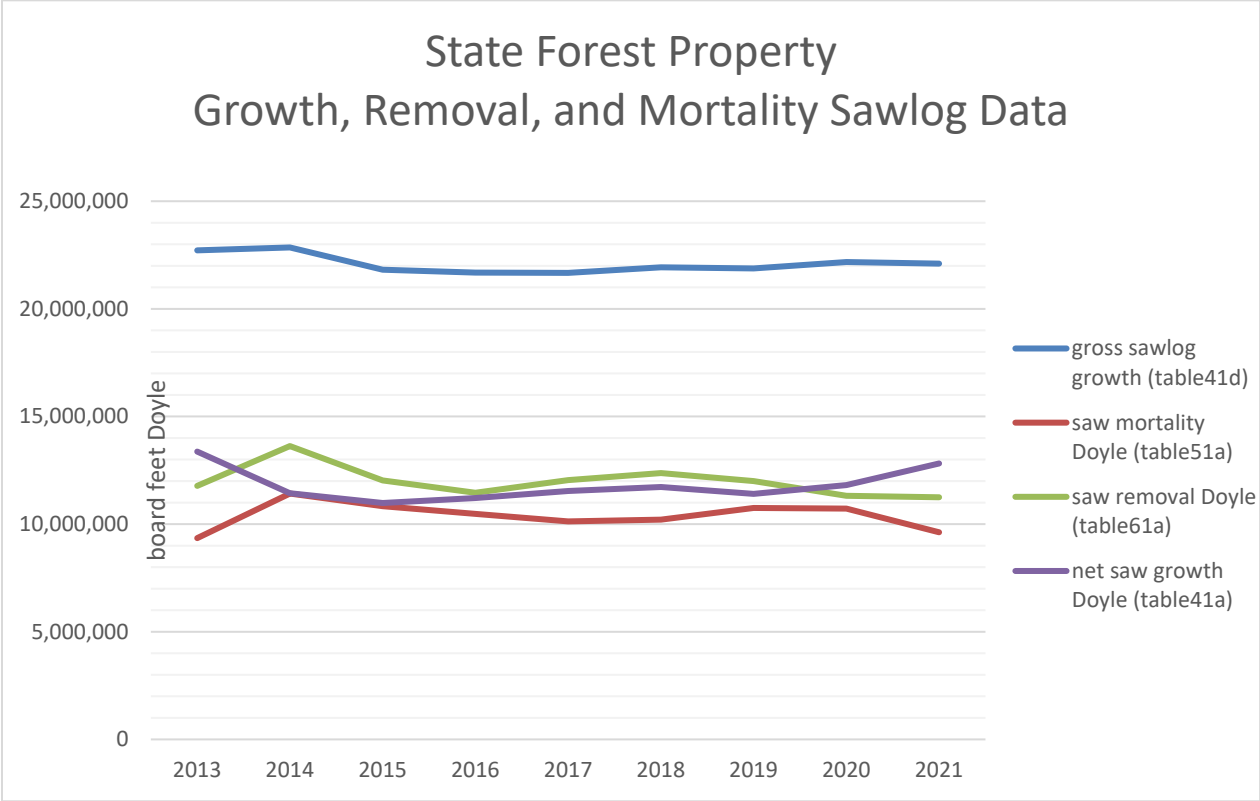
Growth

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 4.39 million cubic feet per year. Hardwoods grew 4.21 million cuft/year or 96% of the total growth, while cedar and pines merely netted 177,639 cuft/year. Oaks constituted 1.33 million cuft or 30%, maples were 1.14 million cuft or 26%, yellow poplar was 1.12 million cuft or 25%, and hickories were 520,800 cuft or 12% of the total growth (Table 5). Species or species groups showing negative growth (a negative growth value would mean that mortality was larger than the gross growth) included ashes, black cherry, elms, chestnut oak, and sassafras. Approximately 1.17 million cuft or 27% of the growth is in pole-size 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 22.1 million board feet Doyle annually. Hardwoods grew 20.5 million bdft/year, while cedar and pines grew 1.6 million bdft/year. Oaks constituted 9.1 million bdft or 41%, yellow poplar was 4.3 million bdft or 20%, maples were 2.5 million bdft or 11%, and hickories were 1.8 million bdft or 8% of the total growth (Table 6).

Historically sawlog growth was about 23 million bdft/year prior to the onset of EAB and the 2012 drought. Since then this increased mortality (discussed below) has diminished growth as depicted in Figure 3.

Figure 3



Mortality

The average annual volume mortality of all trees was 4.15 million cuft per year. Hardwoods accounted for 3.8 million cuft/year or 92% of the total mortality. Chestnut oak was 691,400 cuft or 17%, and white ash was 651,500 cuft or 16%. The next individual species with the most volume lost to mortality was black oak losing 369,000 cuft, white oak losing 329,600 cuft, and sugar maple losing 303,300 cuft,. Collectively, all oak species accounted for 1.69 million cuft or nearly 41% of all mortality (Table 7).

Looking at sawlog-sized volume mortality, forests lost an average of 9.6 million board feet Doyle annually. Hardwoods accounted for 8.8 million bdft/year or 91%. Oaks constituted 4.7 million bdft or 49%, ashes were 1.8 million bdft or 19%, maples were 639,300 bdft or 7%, and Virginia pine was 459,700 bdft or 5% of the total mortality (Table 8).

Mortality would actually be higher than reported; however, the DoF has made a concerted effort to salvage harvest recently deceased trees (especially ash, oak, and yellow poplar). 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. Other high mortalities, however, are more complex.

Several possible factors such as intermittent droughts over the last 20 years (with the latest severe drought 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.

Softwoods, planted in the past for quick soil stability of eroded and abandoned farm fields, are at or past their age of maturity and will continue to decline. 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 3.4 million cuft per year. Hardwoods accounted for nearly 3.0 million cuft/year or 87% of the total removals. Yellow poplar was 881,300 cuft or 26%. Oaks collectively were at 955,100 cuft or 28%, pines at 453,600 cuft or 13%, maples at 339,400 cuft or 10%, and ashes at 275,500 cuft or 8% (Table 9).

Looking at average sawlog-sized volume removals over the 5-year period, 11.2 million board feet Doyle was removed annually. Hardwoods accounted for 9.7 million bdft/year. Yellow poplar was 3.7 million bdft or 33% of the removals, oaks were 3.2 million bdft or 28%, ashes and maples followed at 865,600 bdft or 8% and 671,000 bdft or 6%, respectively (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 those species occupy. These area estimates are then expanded to the entire 152,730 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 5,651 cumulative acres (about 3.7%) with invasive species present. Japanese (vine) honeysuckle, stiltgrass, and multiflora rose are the most prevalent invasive species, covering approximately 1,748 (1.1%), 902 (0.6%), and 820 (0.5%) acres, respectively.

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

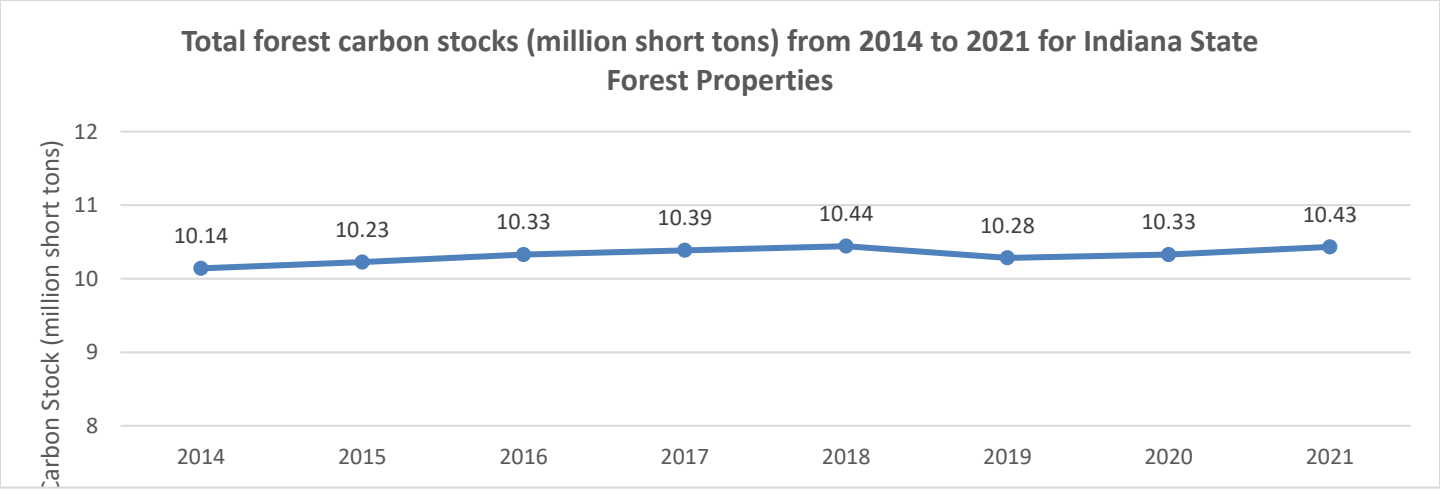
called photosynthesis, plants and photosynthetic algae and bacteria use energy from sunlight to combine CO_2 from the atmosphere with water to form carbohydrates. These carbohydrates are carbon-based sugars necessary for tree functioning and to make wood for growth. Every part of a tree stores carbon, 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 State 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 fairly consistent or perhaps even showing a slight steady increase since the inception of carbon measurements (2014) at just over 10.4 million short tons (Fig. 4).

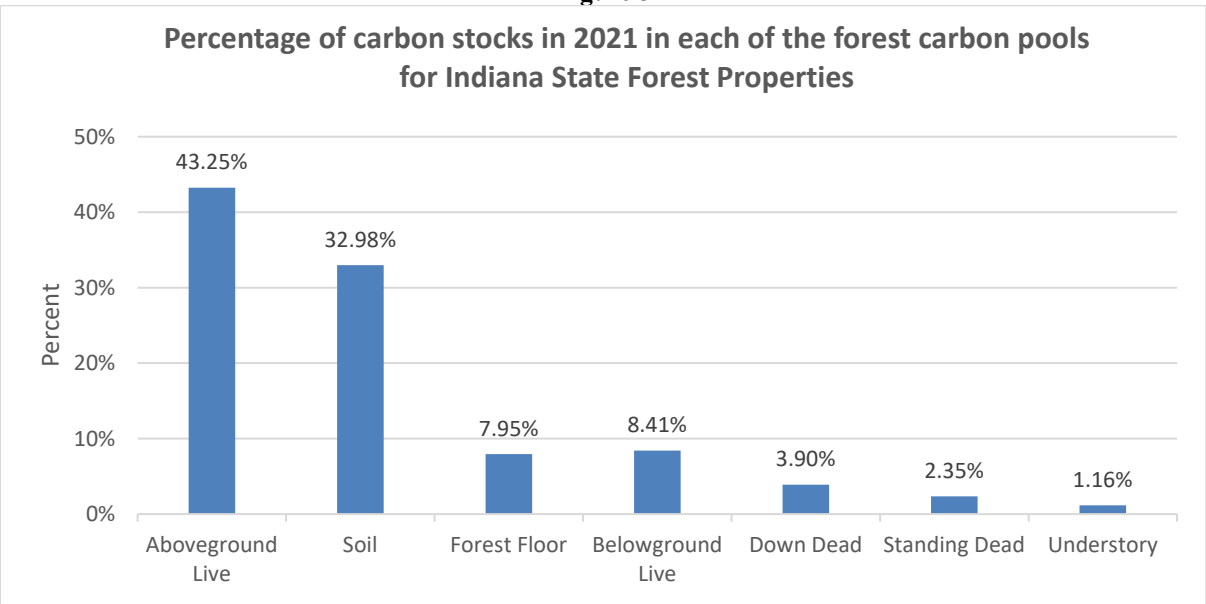
Figure 4



In 2021 about 43.25% of the forest carbon stocks on the Indiana State Forests are stored in the aboveground portion of live trees, which includes all live woody vegetation at least 1 inch in diameter (Fig. 5). The soil carbon pool, which consists of organic material in the mineral soil to a depth of 1 meter (excluding roots), is the second largest carbon pool, storing another 33.0% 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 5



For further discussion of carbon stocks on Indiana State Forests, explore the report titled Forest Carbon Assessment for Indiana State Forest Properties at https://www.in.gov/dnr/forestry/files/fw-carbon_assessment.pdf

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 State Forests is already yielding a baseline of resource information. Estimates from this baseline compare favorably to prior estimates available from the FIA program and previous inventories conducted on state forest properties. As estimates of state forest land resource attributes were either sampled at a lower plot intensity (FIA) or using inconsistent methodologies (stand-exams), estimates from Indiana's state forest land CFI program may be considered as a superior baseline. Change estimates (growth, mortality, and removals) have become statistically stronger as all plots have now been remeasured to provide reliable estimates.

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 Continuous Forest Inventory (CFI) system in 2007. The USDA Forest Service Forest Inventory and Analysis (FIA) program was chosen to mirror for several reasons. The Indiana 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 forest began in calendar year 2008. The plots were spaced such that approximately an equal number of plots per year per state forest property (an annual panel) would be completed. Annually, these panels can stand alone as an independent survey and therefore

some results of significant value can be analyzed and reported on an annual basis. In 2013, we began to re-measure the plots that were established and measured in 2008. Therefore, now all annual panels of plots (100% of the total sample) have been updated with 2017-2021 data, and the 2011-2016 data has been dropped from the total estimate calculations, however are still used in the change data (growth, removal, and mortality). Subsequent years will follow the same protocol.

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 managed 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 are striving 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 an extensive on-the-job training program. Once field staff members have a comfort level for what is expected of them, 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 percent 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 2014 through 2018 (last year's report), 2015 through 2019 (this year's report) and so on.

Field plots of the inventory consist of installing and measuring of the annual sample of field plots (panel) on each state forest. It was determined for desired CFI precision standards that the sampling intensity would be one plot for approximately every 40 acres. For efficiency, it was also determined that an entire compartment of a state forest property would be established and measured within the same panel. INCFI 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 ($1/24^{th}$ 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 9.1) will suffice and is readily available online at https://www.fia.fs.usda.gov/library/field-guides-methods-proc/docs/2021/core_ver9-1_9_2021_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 state forest property is based on a sample of 3,921 plots located randomly across those lands managed by the DoF (a total area of 159,146 acres), a sampling rate of

approximately one plot for every 40 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 has been 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 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, which was described above.

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 those from 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. This is not applicable in the CFI system on state forest properties, but could apply to the CFI system on the classified forest program.

- 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 earlier.

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 create bias in the estimates, if the portion of the population not being sampled differs from the portion being sampled. Fortunately, in CFI, unlike 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 may be able to obtain permission to access these plots (for the Classified Forest system), the hazardous conditions may have changed, or 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 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 of how to use EVALIDator has been attended.

APPENDIX

Table 1.—Area of forest land by forest type group and stand size class, State Forest properties, 2017-2021.

Table 2.—Number of all live trees by species and diameter class, State Forest properties, 2017-2021.

Table 3.—Net volume of all live trees by species and diameter class, State Forest properties, 2017-2021.

Table 4.—Sawtimber volume of all live trees by species and diameter class, State Forest properties, 2017-2021.

Table 5.—Net growth of all live trees by species and diameter class, State Forest properties, 2017-2021.

Table 6.—Total growth of sawtimber by species and diameter class, State Forest properties, 2017-2021.

Table 7.—Mortality of all live trees by species and diameter class, State Forest properties, 2017-2021.

Table 8.—Mortality of sawtimber by species and diameter class, State Forest properties, 2017-2021.

Table 9.—Removals of all live trees by species and diameter class, State Forest properties, 2017-2021.

Table 10.—Removals of sawtimber by species and diameter class, State Forest properties, 2017-2021.

Table 11.—Number of standing dead trees 5 inches d.b.h. and greater by species and diameter class, State Forest properties, 2017-2021.

Table 1.—Area of forest land (acres) by forest type group and stand size class, State Forest properties, 2017-2021.

Forest type	Stand-size	Large diameter	Medium diameter	Small diameter	Nonstocked
All	152,730	120,462	11,598	15,960	4,709
Other miscellaneous hardwood forest types	28,611	14,909	3,612	5,383	4,709
White oak / red oak / hickory	26,782	22,570	2,093	2,119	-
White oak	22,569	22,364	123	82	-
Chestnut oak	15,459	14,964	367	128	-
Yellow-poplar	11,111	8,102	1,181	1,828	-
Hard maple / basswood	7,542	6,062	960	521	-
Mixed upland hardwoods	7,188	4,668	1,106	1,414	-
Sugar maple / beech / yellow birch	6,657	5,433	734	491	-
Cherry / white ash / yellow-poplar	6,423	2,375	596	3,453	-
Chestnut oak / black oak / scarlet oak	6,323	5,723	306	294	-
Miscellaneous softwood forest types	5,918	5,554	241	123	-
Northern red oak	5,549	5,508	41	-	-
Pine/Hardwood	2,596	2,231	241	123	-

Table 2.—Number of all live trees (trees) by species and diameter class, State Forest properties, 2017-2021.

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	61,279,963	35,023,751	10,270,096	4,107,940	2,735,089	1,962,069	1,638,588	1,383,444	1,131,004	989,972	708,407	547,408	782,194
American beech	13,208,324	10,033,738	2,109,815	490,352	189,097	141,435	67,420	46,215	28,420	26,476	19,599	20,502	35,255
sugar maple	11,761,130	5,807,386	2,719,153	1,257,346	789,435	468,896	289,195	185,494	100,534	71,617	33,664	21,616	16,795
other hardwood species	6,111,827	4,339,275	942,065	246,801	149,533	97,503	85,568	77,604	55,204	40,272	18,341	27,443	32,215
red maple	4,716,160	2,243,687	1,035,008	529,286	370,024	189,931	131,632	82,925	51,178	31,561	16,620	18,629	15,679
yellow-poplar	4,295,401	2,391,539	655,734	241,078	173,371	124,629	119,584	119,984	100,553	96,918	74,121	67,141	130,750
sassafras	2,532,639	1,624,431	464,291	155,812	98,547	81,521	58,018	29,479	10,797	7,804	979	-	960
redcedar and pine species	2,195,326	815,555	254,066	191,597	177,567	198,837	172,720	139,616	100,794	55,268	38,601	34,775	15,928
other oaks	2,192,385	683,506	243,542	97,333	106,656	94,179	106,270	116,065	132,128	150,583	132,708	112,782	216,628
eastern hophornbeam	1,994,302	1,797,028	172,802	19,583	3,904	984	-	-	-	-	-	-	-
white oak	1,870,974	321,651	61,327	93,711	113,316	125,577	160,571	162,080	183,070	187,439	165,404	115,355	181,473
blackgum	1,613,970	847,004	347,633	194,805	109,622	39,599	30,083	17,710	12,670	9,842	974	1,941	2,087
ash species	1,498,565	1,179,956	111,308	58,633	31,313	27,515	17,564	16,957	19,442	7,662	15,518	4,827	7,871
chestnut oak	1,475,358	98,085	98,588	75,593	92,626	100,747	159,893	182,056	173,964	184,580	128,399	97,038	83,790
flowering dogwood	1,406,959	1,039,464	320,632	43,928	2,935	-	-	-	-	-	-	-	-
pignut hickory	1,229,823	357,098	168,590	108,997	94,838	112,196	103,294	75,537	75,595	61,366	36,230	13,683	22,400
American elm	944,702	454,971	310,204	86,106	49,492	24,532	8,747	4,805	2,957	1,977	911	-	-
other hickories	778,414	233,706	85,031	77,984	78,131	52,363	61,187	74,040	50,148	34,579	18,621	3,913	8,715
black cherry	606,983	305,740	85,243	57,660	42,452	35,175	35,857	19,008	7,887	8,092	3,937	2,004	3,927
other elms	509,547	330,039	61,158	57,025	29,006	12,672	9,784	3,972	2,903	2,003	-	-	986
black walnut	337,172	119,896	23,906	24,310	33,225	33,776	21,198	29,896	22,760	11,934	3,780	5,757	6,735

Table 3.—Net volume (cuft) of all live trees by species and diameter class, State Forest properties, 2017-2021.

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	346,455,552	9,616,822	14,176,541	18,730,496	25,378,783	32,067,921	37,113,759	43,568,355	40,241,073	39,411,133	86,150,668
white oak	55,071,670	220,414	590,857	1,151,037	2,378,556	3,531,171	5,635,372	7,721,510	8,720,482	7,680,516	17,441,753
yellow-poplar	47,858,355	633,138	1,023,613	1,374,353	2,144,718	3,355,200	3,936,773	5,287,440	5,349,912	6,103,894	18,649,314
chestnut oak	38,842,568	173,665	446,825	875,554	2,196,238	3,676,317	4,919,647	6,976,025	6,360,062	5,928,819	7,289,417
sugar maple	34,410,005	3,242,362	4,358,437	4,770,574	4,825,837	4,684,465	3,559,789	3,403,103	2,121,483	1,725,499	1,718,456
black oak	30,603,088	70,283	179,675	287,851	683,932	1,059,498	1,982,602	3,390,847	4,250,007	4,621,440	14,076,953
redcedar and pine species	21,242,555	414,690	860,270	1,779,084	2,526,373	3,146,368	3,355,783	2,514,413	2,337,309	2,636,748	1,671,516
northern red oak	17,764,255	73,640	186,377	324,617	430,049	814,313	1,122,069	1,851,259	2,192,672	2,448,650	8,320,610
pignut hickory	16,742,076	253,902	494,174	1,102,656	1,692,516	1,842,223	2,724,210	2,981,174	2,246,803	1,096,337	2,308,082
red maple	16,175,402	1,283,278	1,954,853	1,835,665	2,092,493	1,904,916	1,712,638	1,376,491	969,792	1,334,042	1,711,234
American beech	14,029,795	1,083,963	937,552	1,337,889	1,050,554	1,023,763	918,157	1,186,908	1,149,853	1,491,854	3,849,302
other hardwood species	11,782,209	848,314	1,008,871	896,055	1,232,084	1,656,513	1,415,750	1,360,336	450,190	1,203,612	1,710,484
other hickories	9,641,644	189,167	428,320	527,921	1,011,354	1,827,519	1,712,372	1,641,718	1,171,491	304,200	827,583
American sycamore	7,444,276	92,659	120,252	211,043	338,019	545,834	731,298	941,661	490,461	1,066,385	2,906,663
other oaks	7,025,092	89,000	186,371	275,626	460,094	696,746	1,122,888	1,178,752	891,416	817,617	1,306,584
ash species	4,231,019	130,558	147,671	262,345	267,124	409,822	647,476	348,626	876,614	361,579	779,203
black walnut	3,870,725	55,668	165,282	301,246	323,455	648,858	661,445	474,664	188,453	394,125	657,529
sassafras	3,536,642	300,517	435,697	663,891	786,266	595,717	325,794	329,733	56,211	-	42,816
black cherry	2,879,045	114,285	187,644	306,125	500,207	376,538	247,763	319,088	230,786	151,298	445,312
elms	1,876,527	284,816	357,956	306,287	263,314	202,687	167,560	146,300	35,246	-	112,361
other maples	1,428,607	62,504	105,843	140,679	175,600	69,453	214,375	138,307	151,831	44,517	325,499

Table 4.—Sawtimber volume (bdft - Doyle) of all live trees by species and diameter class, State Forest properties, 2017-2021.

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	1,009,001,760	1,995,796	47,944,110	76,995,721	105,076,981	137,448,734	138,710,533	144,909,632	355,920,254
yellow-poplar	173,360,889	-	4,231,706	8,547,099	11,794,785	17,815,265	20,042,832	24,227,652	86,701,550
white oak	173,142,782	-	4,764,724	8,536,560	15,577,663	23,474,391	27,983,487	26,732,860	66,073,097
chestnut oak	121,363,344	-	4,336,629	8,933,095	14,121,034	21,397,890	21,271,306	21,701,768	29,601,623
black oak	108,917,279	-	1,320,400	2,580,821	5,657,329	10,785,336	14,496,429	17,128,837	56,948,127
northern red oak	65,685,994	-	870,494	2,060,114	3,274,977	6,026,598	7,745,315	9,334,051	36,374,446
sugar maple	59,373,589	-	9,049,808	10,874,780	9,555,789	10,344,623	7,176,245	6,284,196	6,088,149
pignut hickory	47,765,341	-	3,398,502	4,590,599	7,950,946	9,724,602	8,005,099	4,256,907	9,838,686
other hardwood species	35,588,901	-	3,871,022	5,483,096	5,391,543	5,910,079	2,069,345	4,312,406	8,551,411
eastern white pine	34,600,501	219,266	828,644	1,787,778	4,748,837	4,954,387	6,067,034	10,268,127	5,726,429
American beech	32,615,090	-	2,001,052	2,424,528	2,508,307	3,521,680	3,763,151	4,344,362	14,052,012
red maple	26,839,754	-	3,481,452	3,745,371	3,991,465	3,660,865	2,951,173	3,969,521	5,039,907
American sycamore	24,943,740	-	633,474	1,297,399	1,998,093	2,970,557	1,389,666	3,748,360	12,906,193
other oaks	20,535,092	-	852,664	1,485,767	3,040,189	3,725,908	3,060,106	3,037,312	5,333,148
Virginia pine	19,931,644	887,883	2,218,292	4,386,209	4,776,938	3,196,040	3,661,587	329,072	475,623
shagbark hickory	17,164,625	-	1,349,327	3,031,521	3,492,969	3,388,787	2,918,593	578,469	2,404,960
other pines and redcedar	11,786,311	888,648	2,153,708	2,533,553	1,658,316	1,453,905	568,951	800,201	1,729,029
ash species	11,741,484	-	460,621	918,211	1,784,349	1,085,970	2,995,640	1,345,476	3,151,216
black walnut	9,992,396	-	646,557	1,545,859	1,866,228	1,389,873	636,437	1,411,027	2,496,414
other hickories	7,742,091	-	646,184	1,452,549	1,300,753	1,861,316	1,172,760	584,608	723,922
black cherry	5,910,916	-	828,852	780,814	586,470	760,665	735,380	514,421	1,704,313

Table 5.—Net growth (cuft per year) of all live trees by species and diameter class, State Forest properties, 2017-2021.

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	4,392,567	561,894	297,618	306,682	371,040	394,919	433,937	342,418	471,626	544,536	839,648
yellow-poplar	1,117,393	-	-	55,148	40,597	39,065	78,152	90,498	82,460	139,955	140,766
white oak	685,678	-	-	4,549	2,345	10,867	34,193	53,162	95,152	112,017	107,040
sugar maple	657,304	-	-	184,140	126,512	117,741	101,450	66,502	55,660	24,350	-22,081
red maple	464,786	-	-	84,512	63,734	46,214	59,335	42,309	48,162	37,730	28,612
pignut hickory	358,655	-	-	7,707	7,799	28,665	42,918	46,880	65,179	49,683	46,556
American beech	341,394	-	-	117,065	45,074	56,203	23,981	24,411	20,002	28,713	16,423
black oak	299,548	-	-	1,850	5,858	6,822	9,893	11,117	8,926	7,329	105,182
northern red oak	281,014	-	-	1,814	4,830	6,001	-4,562	-6,288	8,346	20,555	31,325
American sycamore	181,514	-	-	6,274	5,958	8,100	7,963	15,665	20,098	27,531	12,035
redcedar and pine species	177,639	-	-	20,862	-12,115	-13,622	208	19,837	43,363	6,401	32,712
other hardwood species	117,115	-	-	41,537	18,722	5,039	12,162	23,411	25,097	-5,311	-8,800
shagbark hickory	110,475	-	-	4,463	6,545	8,107	14,387	32,839	29,124	23,772	-21,512
other oaks	70,538	-	-	6,386	5,756	1,766	12,066	8,361	17,182	1,125	19,412
black walnut	67,413	-	-	1,552	6,934	7,965	8,553	10,732	12,915	-8,193	4,365
other hickories	51,631	-	-	3,542	1,950	5,072	10,946	13,781	-2,988	14,048	6,318
other maples	16,852	-	-	4,806	1,205	-3,111	1,856	-6,146	5,217	3,394	3,944
sassafras	-2,866	-	-	2,140	-13,036	-7,646	5,979	18,165	-6,944	6,910	1,941
chestnut oak	-2,929	-	-	1,953	3,068	-3,193	-11,287	-19,702	-6,525	24,946	-9,050
elms	-13,152	-	-289	15,086	-748	2,994	-2,147	269	-11,232	-5,314	-13,535
black cherry	-22,683	-	-	2,594	451	9,348	10,421	351	-5,867	-12,890	8,775
ash species	-564,751	-	-	-6,087	-23,818	-25,716	-45,429	-51,235	-69,389	-154,334	-18,804

Table 6.—Total growth (bdft per year - DOYLE) of sawtimber by species and diameter class, State Forest properties, 2017-2021.

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	22,099,796	110,813	3,179,557	2,013,020	2,463,872	2,890,180	2,845,583	2,844,953	5,751,820
yellow-poplar	4,339,883	-	439,720	337,206	393,435	493,702	526,598	596,945	1,552,277
white oak	2,920,943	-	258,787	177,476	294,141	437,332	469,254	440,855	843,098
chestnut oak	2,128,282	-	261,516	166,108	258,783	330,260	336,539	333,749	441,328
black oak	2,044,684	-	115,258	62,029	140,123	246,048	298,652	310,250	872,324
northern red oak	1,601,569	-	89,503	66,794	95,259	143,855	184,605	212,494	809,059
sugar maple	1,528,971	-	612,598	254,696	192,445	169,196	115,093	98,673	86,269
pignut hickory	1,183,641	-	243,334	116,384	188,477	217,152	162,845	80,985	174,464
eastern white pine	889,892	18,872	15,201	36,794	109,620	91,941	220,731	259,859	136,874
red maple	882,055	-	284,878	127,812	110,291	95,173	80,520	100,841	82,540
other hardwood species	861,894	-	247,926	147,565	118,085	104,558	43,781	103,784	96,196
American beech	683,736	-	163,022	80,510	61,069	99,346	62,113	64,611	153,065
American sycamore	561,215	-	40,889	38,520	56,858	89,477	30,938	81,259	223,273
Virginia pine	449,735	46,465	56,990	103,276	118,279	57,980	58,260	7,681	806
other oaks	432,449	-	43,760	35,752	66,446	83,105	62,483	63,381	77,521
shagbark hickory	397,201	-	58,318	80,293	81,587	74,319	52,015	10,288	40,381
other pines and redcedar	281,724	45,477	35,646	46,635	36,820	40,097	25,058	18,543	33,447
ash species	239,715	-	30,681	21,735	43,087	28,358	54,397	12,764	48,693
black walnut	224,782	-	30,773	48,364	38,026	26,154	13,439	32,237	35,788
other hickories	210,487	-	49,318	37,894	34,057	44,835	22,065	5,453	16,865
black cherry	171,758	-	66,087	16,009	17,376	14,204	26,195	10,301	21,585
elm species	65,181	-	35,352	11,166	9,608	3,088	-	-	5,967

Table 7.—Mortality (cuft per year) of all live trees by species and diameter class, State Forest properties, 2017-2021.

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	4,151,596	190,716	246,501	290,148	327,126	432,367	468,132	622,435	401,363	253,650	700,488
chestnut oak	691,406	-	-	5,706	7,601	22,251	57,513	90,365	102,856	90,849	119,232
white ash	651,525	-	-	15,875	30,126	33,482	48,021	60,215	83,932	148,875	37,104
black oak	369,037	-	-	3,928	1,292	1,712	11,853	15,308	43,348	80,667	-
white oak	329,625	-	-	7,407	13,067	13,402	17,053	24,671	18,136	44,299	51,255
sugar maple	303,299	-	-	23,889	21,119	26,220	23,996	41,707	17,410	37,381	59,797
other hardwood species	261,437	-	-	21,333	20,162	23,956	26,522	32,979	7,797	50,821	20,701
yellow-poplar	246,919	-	-	27,231	31,962	36,081	8,200	29,605	47,807	-	-
northern red oak	200,655	-	-	2,452	1,465	5,522	19,740	34,925	26,414	26,702	24,604
Virginia pine	180,457	-	-	3,132	13,922	20,403	33,211	19,538	22,215	36,299	11,623
sassafras	120,322	-	3,034	19,747	32,063	29,904	15,772	-	15,574	-	-
black cherry	114,000	-	-	7,700	5,552	4,914	6,498	6,092	15,082	19,063	-
elms	92,779	-	318	11,374	15,896	10,584	11,973	5,102	16,444	7,072	13,725
eastern white pine	96,521	-	-	2,719	3,126	7,384	11,306	24,866	8,089	9,027	25,975
red maple	95,236	-	3,847	21,239	23,886	13,370	6,252	15,860	-	-	-
hickories	87,398	-	-	1,933	4,010	-	-	-	16,099	18,584	37,347
scarlet oak	69,873	-	-	300	1,203	-	-	8,297	8,353	27,633	-
American beech	67,751	-	-	4,110	769	3,458	8,750	6,208	-	-	-
redcedar and pine species	58,296	-	-	5,679	12,921	19,664	7,720	3,471	5,650	-	-
other ashes	54,530	-	-	4,131	2,675	2,753	9,101	4,698	6,009	25,163	-
other maples	32,556	-	-	492	2,924	9,315	3,647	8,462	6,917	-	-
other oaks	27,973	-	-	338	756	5,774	-	-	-	-	-

Table 8.—Mortality (bdft per year - DOYLE) of sawtimber by species and diameter class, State Forest properties, 2017-2021.

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	9,618,544	79,060	585,025	1,011,255	1,284,480	1,899,277	1,330,769	863,658	2,565,019
chestnut oak	1,907,540	-	111,197	197,450	289,018	285,387	404,561	294,631	325,296
white ash	1,705,637	-	71,911	128,803	229,506	404,361	125,195	54,286	691,574
black oak	1,129,233	-	24,317	38,030	123,675	254,900	-	90,840	597,471
white oak	861,643	-	30,691	60,513	50,066	134,225	164,682	145,786	275,681
northern red oak	585,540	-	34,241	87,813	76,650	85,993	86,095	57,192	157,556
sugar maple	578,677	-	47,414	92,929	48,269	89,124	151,160	-	149,782
other hardwoods	509,272	-	54,179	99,605	69,501	163,810	64,646	57,530	-
Virginia pine	459,683	34,944	81,579	60,854	80,975	147,453	53,878	-	-
yellow-poplar	317,223	-	16,730	76,589	127,484	-	-	-	96,420
black cherry	289,699	-	12,149	13,878	39,051	54,787	-	-	169,834
eastern white pine	281,984	11,319	25,964	72,483	27,631	33,085	111,503	-	-
scarlet oak	234,385	-	-	20,787	23,951	88,243	-	-	101,405
American beech	187,249	-	8,177	15,679	-	-	-	163,393	-
elms	112,658	-	6,498	-	44,336	20,630	41,193	-	-
shagbark hickory	127,856	-	-	-	-	-	127,856	-	-
other ashes	121,874	-	17,000	10,961	16,354	77,560	-	-	-
pignut hickory	59,719	-	-	-	-	59,719	-	-	-
red pine	57,186	20,283	17,773	-	19,130	-	-	-	-
sassafras	44,087	-	25,204	-	18,883	-	-	-	-
red maple	34,882	-	-	34,882	-	-	-	-	-
other pines and redcedar	12,514	12,514	-	-	-	-	-	-	-

Table 9.—Removals (cuft per year) of all live trees by species and diameter class, State Forest properties, 2017-2021.

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	3,416,159	57,156	67,012	88,770	142,888	242,685	302,294	264,386	409,664	291,575	1,003,389
yellow-poplar	881,285	2,773	8,468	10,506	3,798	23,366	31,197	21,586	42,541	35,330	574,235
black oak	381,470	657	-	2,142	-	4,136	31,243	41,666	39,368	85,654	81,763
other hardwood species	311,831	8,414	10,262	4,124	12,561	31,031	20,378	9,485	32,766	23,912	82,087
white ash	267,514	1,515	1,071	5,939	20,823	36,259	34,003	50,432	36,272	-	80,001
white oak	239,751	-	3,334	-	5,170	8,090	26,491	7,237	46,247	56,509	31,957
chestnut oak	209,890	-	716	1,751	5,488	6,924	31,323	36,512	37,657	-	16,817
sugar maple	198,895	20,135	15,526	16,025	24,919	25,984	13,852	18,075	10,700	-	33,165
eastern white pine	163,435	494	-	1,284	7,867	14,532	15,594	17,419	57,163	29,422	19,660
Virginia pine	157,404	1,860	3,938	5,765	15,611	31,712	45,053	-	-	13,559	-
red maple	140,482	11,781	11,507	7,951	11,067	25,393	8,021	10,989	11,759	-	30,060
redcedar and pine species	132,794	4,694	9,356	17,755	17,410	3,435	24,205	7,477	40,276	-	-
American beech	97,332	2,477	811	5,673	4,985	10,210	-	11,186	12,542	32,650	15,597
pignut hickory	82,760	-	1,004	6,326	3,144	5,783	6,799	10,502	28,343	-	20,858
northern red oak	78,003	-	-	-	3,983	-	-	11,970	-	14,539	17,187
sassafras	73,310	2,354	1,020	3,530	6,061	15,832	14,134	9,851	14,031	-	-

Table 10.—Removals (bdft per year - DOYLE) of sawtimber by species and diameter class, State Forest properties, 2017-2021.

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	11,247,181	49,030	338,658	625,519	968,518	902,595	1,702,682	1,292,707	5,367,472
yellow-poplar	3,742,555	-	17,808	72,511	95,287	109,777	159,263	142,258	3,145,652
black oak	1,352,911	-	6,517	10,491	107,872	157,579	140,165	315,040	615,247
other hardwood species	874,385	-	28,203	82,954	76,185	81,108	194,904	135,879	275,150
white ash	836,651	-	29,363	85,263	93,049	129,574	122,429	-	376,972
white oak	742,861	-	17,322	39,508	101,709	22,103	185,673	195,554	180,993
chestnut oak	660,876	-	10,950	26,048	115,892	113,302	184,061	83,116	127,507
eastern white pine	639,853	-	17,884	42,160	52,990	66,100	244,104	128,037	88,577
Virginia pine	510,200	14,617	80,268	98,241	164,393	35,301	54,566	62,816	-
sugar maple	365,982	-	49,121	62,522	38,534	55,596	35,189	-	125,020
redcedar and pine species	354,795	34,413	45,888	9,747	63,308	29,248	172,191	-	-
red maple	305,079	-	10,979	55,756	39,578	30,726	35,466	-	132,575
northern red oak	277,139	-	-	-	-	38,413	-	110,240	128,486
pignut hickory	258,786	-	6,437	14,591	19,721	33,769	99,912	-	84,355
American beech	198,571	-	10,351	25,728	-	-	42,724	119,768	-
black cherry	126,537	-	7,567	-	-	-	32,034	-	86,936

Table 11.—Number of standing dead trees (trees) 5” d.b.h. and greater by species and diameter class, State Forest Properties, 2017-2021.

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	1,704,996	478,402	363,831	250,351	184,217	127,110	111,946	70,988	47,405	26,619	44,128
sassafras	265,462	123,551	72,364	38,030	12,799	9,889	6,859	986	986	-	-
ashes	172,089	42,661	26,719	17,655	24,612	18,611	11,583	17,635	4,817	1,986	5,811
chestnut oak	160,176	13,773	15,593	23,533	31,432	20,746	17,585	11,795	9,836	9,834	6,050
white oak	135,966	25,067	26,814	15,850	15,725	10,934	11,941	10,999	7,833	2,937	7,868
Virginia pine	122,174	12,918	31,996	25,766	25,881	13,752	8,914	2,946	-	-	-
eastern redcedar	119,246	66,057	25,704	18,701	2,943	4,867	-	-	-	-	974
yellow-poplar	101,277	19,535	26,915	14,684	8,741	7,804	12,880	3,066	1,964	984	4,704
sugar maple	91,540	33,503	19,634	12,981	9,749	6,742	2,937	960	2,080	984	1,970
other hardwoods	86,089	32,881	17,578	16,807	7,935	4,982	1,965	1,970	-	986	984
black oak	74,485	7,765	3,936	5,778	6,821	5,880	13,685	11,817	5,871	5,055	7,878
red pine	70,077	11,094	29,091	17,071	8,957	1,959	1,905	-	-	-	-
eastern white pine	49,972	8,051	11,102	11,715	2,947	5,100	2,956	2,913	5,186	-	-
elms	46,652	17,412	14,617	3,819	5,873	1,018	1,929	1,018	966	-	-
red maple	41,619	19,778	11,979	4,960	1,944	1,939	-	-	-	-	1,018
northern red oak	37,405	3,928	2,953	2,105	4,927	4,902	5,871	2,937	3,903	1,969	3,912
black locust	32,905	15,045	7,965	4,985	3,926	984	-	-	-	-	-
other oaks	29,447	4,830	8,893	6,872	984	1,963	2,954	986	984	-	979
black cherry	28,923	12,820	4,142	3,961	2,003	2,924	2,080	-	-	-	993
American beech	21,815	5,915	1,959	4,058	3,073	993	1,954	-	993	1,885	986
hickories	14,656	1,822	3,878	-	1,959	1,121	2,930	960	1,986	-	-
other softwoods	3,023	-	-	1,018	986	-	1,018	-	-	-	-