

IN DNR State Forest Properties
Report of Continuous Forest Inventory (CFI)
Summary of years 2013-2017



Joey Gallion

Forest Resource Information/Forest Inventory Program Coordinator

ACKNOWLEDGMENTS

The author thanks the many individuals who contributed to the inventory and analysis of this project. Primary field crew and QA staff over the 2013-2017 field inventory cycle included Craig Blocker, Megan Crecelius, Joey Gallion, Greg Koontz, Derek Luchik, Marisa Magana, Sally Malone, Josh Nickelson, Sean Sheldon, Mark Webb, and Madeline Westbrook. Pre-field work personnel included Joey Gallion and Rebekah Price. Data-management personnel included Joey Gallion, with much advice from U.S. Forest Service staff Chuck Barnett, James Blehm, Bryan Blom, Kevin Nimerfro, Cassandra Olson, Larry Royer, Chip Scott, Jay Solomakos, and Jim Westfall. The report was reviewed by Jack Seifert.

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 3,941 plots located randomly across those lands (a total area of 156,042 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 2013-2017, a span that constitutes one entire cycle. With 20% of the plots measured annually, the 2017 plots were the same plots measured in 2012, thus the 2012 data were replaced with the 2017 data.

EXECUTIVE SUMMARY/HIGHLIGHTS

This is the sixth 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 156,042 total acres; 150,740 forested acres, with the balance in non-forest (i.e. campgrounds) and water.
- 94% of the forested acres are hardwoods.
- 78% of the forested acres are sawlog-sized stands.
- Forests contain 57.8 million live trees.
- Sugar maple trees and seedlings are more abundant than any other species, with American beech a close second (11.9 and 11.3 million trees, respectively).
- There is 336.6 million cubic feet of total live tree volume.
- There is 969 million board feet (Doyle) of sawlog volume.
- White oaks, followed by red oaks, are the species groups with the most sawlog volume.
- 61% of the sawlog volume is considered grade 1 or 2.
- Multiflora rose, Japanese honeysuckle and stiltgrass are the most common invasive species present.

FOREST COMPOSITION

Area

State Forest lands comprise approximately 156,042 acres located primarily in the southern third of Indiana. An estimated 150,740 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 ~5,000 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 (26,346 acres, 17%), white oak (21,918 acres, 14%), chestnut oak (15,693 acres, 10%), and yellow poplar (9,862 acres, 6%) (Table 1). Seventy-eight 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).

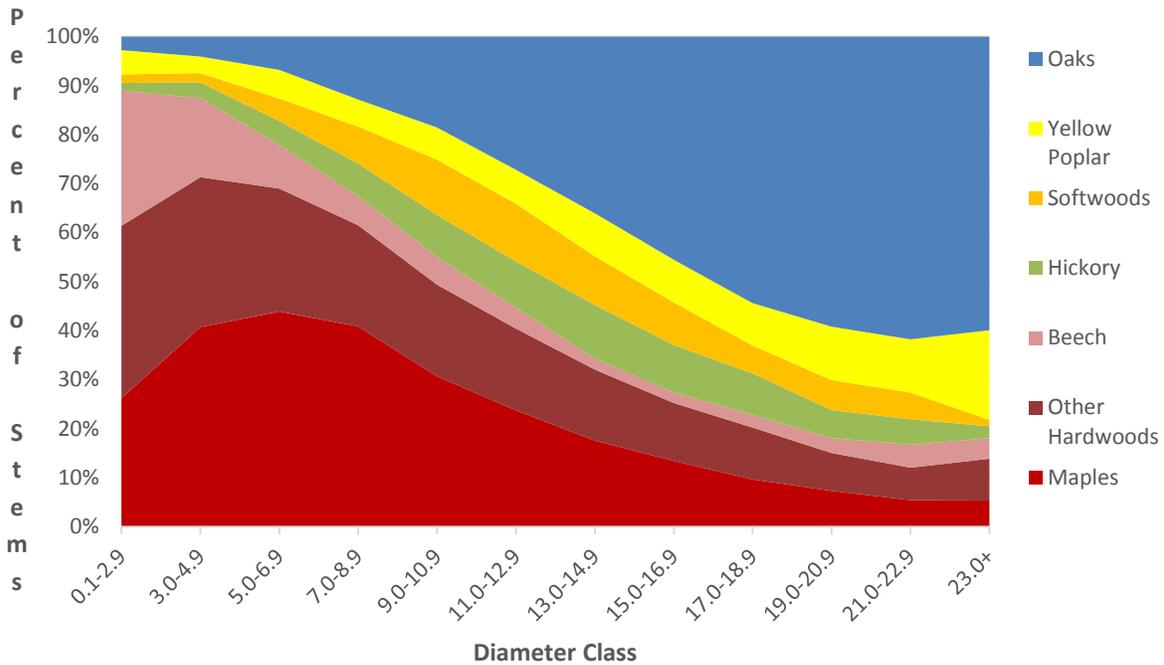
Number of Live Trees

It is estimated that there are 57.8 million live trees on State Forest lands. In terms of the total number of live trees, sugar maple and beech were the most abundant species, at 11.9 million and 11.3 million trees, respectively (Table 2). More than half of the number of trees were less than 3 inches d.b.h., with 41.9 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 3.0%

of all saplings 1 inch to less than 5 inches d.b.h. The lack of oak seedlings/saplings and abundance of maple seedlings/saplings suggests a future decline of oak/hickory forest types as mature stands senesce.

Figure 1

Number of Trees by Species and Diameter Class



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 336.6 million cubic feet. Hardwoods constituted 315.2 million cubic feet (cuft) or 94%. Oaks made up 144.9 million cuft or 43%. Maples were 48.5 million cuft or 14%. Yellow poplar was 45.8 million cuft or 13%. Hickories were 24.0 million cuft or 7% of the total volume (Table 3). Approximately 42.2 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.). 75.3 million cuft or 22% is 23 inches or greater d.b.h. (Table 3). It was estimated that 325.7 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).

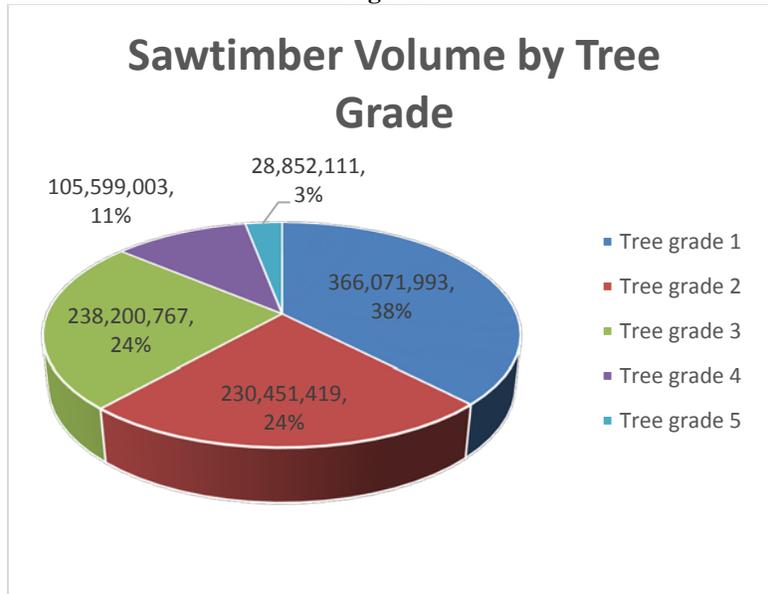
Volume of Sawtimber-sized Trees

The total net sawtimber volume was 969 million board feet Doyle scale (6,429 bdf/acre). Yellow poplar was the most voluminous species, with 164.9 million board feet (MMBF) or 17%, followed by white oak, chestnut oak, and black oak, with 160.9, 119.6, and 106.7 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 366.1 MMBF of the total net sawtimber volume was grade 1 and 230.5 and 238.2 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



CHANGE ATTRIBUTES AND ANCILLARY DATA ITEMS

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.

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 3.53 million cubic feet per year. Hardwoods actually grew 3.63 million cuft/yr. or 102% of the total growth, while cedar and pines lost 92,000 cuft/yr. Oaks constituted 1.19 million cuft or 34%, maples were 951,000 cuft or 27%, yellow poplar was 631,000 cuft or 18%, and hickories were 493,000 cuft or 14% 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) besides the pines mentioned above, were sassafras, scarlet oak, ashes, and elms.

Approximately 865,000 cuft or 24% of the growth is in pole-sized trees (trees <11 inches d.b.h.), with the remainder being sawlog-sized (11 inches and greater d.b.h.).

Looking at sawlog-sized volume growth, trees collectively grew an average of 11.5 million board feet Doyle annually. Hardwoods grew 11.4 million bdft/yr., while cedar and pines grew 111,000 bdft/yr. Oaks constituted

3.7 million bdft or 32%, yellow poplar was 2.6 million bdft or 22%, maples were 1.9 million bdft or 17%, and hickories were 1.4 million bdft or 12% of the total growth (Table 6). Species or species groups showing negative growth (a negative growth value would mean that mortality was larger than the gross growth) were Virginia and red pine, ashes, scarlet oak, and elms.

Mortality

The average annual volume mortality of all trees was 4.42 million cuft per year. Hardwoods accounted for 3.8 million cuft/yr. or 86% of the total mortality. Yellow poplar was 603,000 cuft or 13%, and four oak species were the next individual species with the most volume lost to mortality with chestnut oak losing 485,000 cuft, black oak losing 410,000 cuft, white oak losing 325,000 cuft, and Northern red oak losing 296,000 cuft collectively, and all of the oak species accounting for 1.65 million cuft or 37% of all mortality (Table 7).

Looking at sawlog-sized volume mortality, forests lost an average of 10.1 million board feet Doyle annually. Hardwoods accounted for 8.6 million bdft/yr. or 85%. Oaks constituted 4.9 million bdft or 49%, yellow poplar was 1.3 million bdft or 13%, ashes were 645,000 bdft or 6%, and maples were 557,000 bdft or 5% of the total mortality (Table 8).

Some of the high mortality is easily understood. The ash decline can be contributed to the emerald ash borer. Ash will continue to increase in mortality loss. The elms declined due to Dutch elm disease, and sassafras probably due to a combination of canker diseases that affect that species. Others, however, are more complex. Several possible factors such as intermittent droughts over the last 20 years (with the latest 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.

Removals

The average annual volume removals of all trees was 3.7 million cuft per year. Hardwoods accounted for 3.3 million cuft/yr. or 90% of the total removals. Yellow poplar was 761,000 cuft or 20%, followed by black oak at 606,000 cuft, white oak at 304,000 cuft, and sugar maple at 233,000 cuft (Table 9).

Looking at sawlog-sized volume removals, 12.0 million board feet Doyle was removed annually. Hardwoods accounted for 10.8 million bdft/yr., 4.3 million bdft or 36% of the removals were oaks, while yellow poplar and maples followed at 3.1 million bdft or 26% and 775,000 bdft or 6%, respectively (Table 10).

Standing Dead Trees

There were an estimated 1.8 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 278,000 stems. Yellow poplar was second, with 158,000 standing dead trees, with Virginia pine, chestnut oak, and white oak following with 153,000, 151,000, and 149,000 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 1.8 million standing dead trees, 972,000 had a diameter from 5-9 inches d.b.h., 590,000 were from 9-15 inches d.b.h., 163,000 were from 15-19 inches d.b.h., and the remaining 115,000 were 19 inches d.b.h. and greater (Table 11).

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 150,740 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 5,352 cumulative acres (about 3.5%) with invasive species present. Multiflora rose, Japanese (vine) honeysuckle, and stiltgrass are the most prevalent invasive species, covering approximately 1,639, 1,389, and 1,035 acres respectively.

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 2013-2017 data and the 2008-2012 data has been dropped from the total estimate calculations. 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 2012 through 2016 (last year’s report), 2013 through 2017 (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 (1/24th acre) circular subplot

with the offset 6.8-foot-radius (1/300th 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 4.0) will suffice and is readily available online at http://www.fia.fs.fed.us/library/field-guides-methods-proc/docs/core_ver_4-0_10_2007_p2.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 3,941 plots located randomly across those lands managed by the Division of Forestry (a total area of 156,042 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-percent inventory 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 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 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, 2013-2017.

Table 2.—Number of all live trees by species and diameter class, State Forest properties, 2013-2017.

Table 3.—Net volume of all live trees by species and diameter class, State Forest properties, 2013-2017.

Table 4.—Sawtimber volume of all live trees by species and diameter class, State Forest properties, 2013-2017.

Table 5.—Net growth of all live trees by species and diameter class, State Forest properties, 2013-2017.

Table 6.—Net growth of sawtimber by species and diameter class, State Forest properties, 2013-2017.

Table 7.—Mortality of all live trees by species and diameter class, State Forest properties, 2013-2017.

Table 8.—Mortality of sawtimber by species and diameter class, State Forest properties, 2013-2017.

Table 9.—Removals of all live trees by species and diameter class, State Forest properties, 2013-2017.

Table 10.—Removals of sawtimber by species and diameter class, State Forest properties, 2013-2017.

Table 11.—Number of standing dead trees 5 inches d.b.h. and greater by species and diameter class, State Forest properties, 2013-2017.

Table 1.—Area of forest land by forest type group and stand size class, State Forest properties, 2013-2017.

Estimate: Total-Area of forestland (acres)

Forest type	Stand-size	Large diameter	Medium diameter	Small diameter	Nonstocked
All	150,740	118,315	12,225	14,840	5,360
White oak / red oak / hickory	26,346	22,020	2,425	1,900	-
Mixed upland hardwoods	7,604	4,875	950	1,779	-
White oak	21,918	21,472	365	81	-
Chestnut oak	15,693	15,208	405	80	-
Yellow-poplar	9,862	7,609	1,224	1,029	-
Pine/Hardwood	3,413	2,682	530	201	-
Chestnut oak / black oak / scarlet oak	6,206	5,538	262	407	-
Sugar maple / beech / yellow birch	6,697	5,367	723	607	-
Hard maple / basswood	6,856	5,389	886	582	-
Northern red oak	5,672	5,510	81	81	-
Cherry / white ash / yellow-poplar	5,671	2,906	650	2,115	-
Other miscellaneous hardwood forest types	28,889	14,240	3,518	5,770	5,360
Miscellaneous softwood forest types	5,912	5,498	207	207	-

Table 2.—Number of all live trees by species and diameter class, State Forest properties, 2013-2017.

Estimate: Total-Number of all live trees on forestland (trees)

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	57,867,516	32,315,778	9,626,824	3,974,996	2,699,901	1,991,732	1,752,496	1,398,793	1,210,993	981,071	727,821	499,916	687,197
sugar maple	11,976,825	6,131,535	2,773,557	1,213,831	750,091	425,836	275,019	174,110	106,014	60,965	31,971	18,388	15,508
American beech	11,338,961	8,927,712	1,550,190	353,644	160,002	114,841	73,820	32,110	26,252	25,401	22,406	23,456	29,127
other hardwood species	5,616,819	3,899,865	879,748	231,030	153,896	108,418	90,930	69,456	58,595	45,739	30,185	16,568	32,378
red maple	4,807,327	2,276,925	1,153,595	524,685	342,935	176,551	136,313	68,062	52,475	28,247	20,239	8,778	18,521
yellow-poplar	3,115,260	1,582,036	325,834	233,298	149,663	130,986	121,380	122,574	105,016	84,533	79,420	54,335	126,185
sassafras	2,322,752	1,393,108	425,635	179,606	120,053	91,017	63,526	25,426	14,628	7,816	988	-	949
other oaks	2,005,755	472,388	219,479	95,400	112,076	104,495	130,447	122,727	147,009	172,495	130,561	114,723	183,950
redcedar and pine species	1,948,959	571,630	180,966	183,258	201,916	224,226	206,227	138,791	105,199	56,416	44,446	27,136	8,743
eastern hophornbeam	1,833,459	1,603,958	206,238	18,388	4,875	-	-	-	-	-	-	-	-
white oak	1,818,374	254,771	48,754	92,270	134,525	135,423	168,300	174,451	201,994	186,922	156,094	111,445	153,423
blackgum	1,716,241	970,574	362,964	195,130	79,599	43,829	25,179	13,699	13,654	6,791	1,946	973	1,903
chestnut oak	1,664,340	170,376	121,693	81,840	99,541	128,904	177,798	207,175	202,732	174,011	143,786	82,513	73,972
flowering dogwood	1,636,025	1,183,472	401,102	49,485	1,967	-	-	-	-	-	-	-	-
ash species	1,531,764	1,040,138	145,036	88,595	42,770	46,351	40,913	35,933	29,079	24,154	16,468	7,740	14,585
pignut hickory	1,207,128	305,687	204,058	114,778	104,270	118,053	100,975	79,157	68,929	55,220	27,152	17,345	11,503
American elm	1,020,545	573,511	264,768	88,882	56,406	18,591	7,694	6,802	1,977	983	929	-	-
other hickories	750,627	193,917	108,478	78,431	76,533	51,402	64,702	73,564	48,341	27,198	14,516	8,743	4,798
black cherry	667,956	339,405	108,519	61,156	45,882	34,024	32,259	17,630	9,662	7,740	3,859	1,992	5,829
other elms	609,031	363,595	122,134	57,283	34,771	8,773	10,813	3,820	3,889	1,992	0	973	988
black walnut	279,371	61,178	24,071	34,004	28,126	30,011	26,199	33,301	15,542	14,448	2,854	4,804	4,833

Table 3.—Net volume of all live trees by species and diameter class, State Forest properties, 2013-2017.

Estimate: Total-Volume of all live on forestland (cuft)

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	336,623,513	9,393,886	13,932,608	18,870,963	27,094,878	32,178,432	39,629,247	42,947,778	41,363,370	35,892,695	75,319,655
white oak	52,152,015	214,421	688,307	1,237,866	2,443,868	3,738,466	6,117,730	7,690,037	8,202,339	7,389,771	14,429,211
yellow-poplar	45,850,535	623,057	871,116	1,448,189	2,237,775	3,383,344	4,188,303	4,637,048	5,710,574	4,936,993	17,814,136
chestnut oak	39,182,094	184,003	462,859	1,130,112	2,444,505	4,191,498	5,786,416	6,598,356	7,029,021	5,088,829	6,266,492
sugar maple	32,205,597	3,151,390	4,130,751	4,239,793	4,547,687	4,326,388	3,796,488	2,897,389	2,002,309	1,425,801	1,687,599
black oak	29,998,115	83,342	188,190	350,917	789,615	1,155,258	2,420,716	3,723,996	4,134,177	5,085,350	12,066,553
redcedar and pine species	21,433,639	405,841	990,623	2,039,467	3,128,845	3,108,672	3,515,565	2,583,034	2,657,356	2,077,902	926,335
northern red oak	16,895,432	81,014	183,089	383,882	613,987	829,790	1,208,244	2,211,092	2,393,503	2,395,831	6,595,001
red maple	15,257,957	1,288,289	1,803,501	1,725,048	2,135,615	1,551,304	1,707,416	1,271,358	1,168,251	639,425	1,967,750
pignut hickory	15,039,708	263,352	550,999	1,149,247	1,656,153	1,956,200	2,513,673	2,655,316	1,697,242	1,403,306	1,194,219
American beech	12,851,604	810,289	809,650	1,059,944	1,134,116	729,385	863,445	1,148,446	1,332,156	1,732,463	3,231,710
other hardwood species	11,911,679	851,661	889,501	1,003,980	1,276,333	1,375,613	1,577,254	1,340,422	1,222,297	613,851	1,760,768
other hickories	9,037,093	185,447	409,726	508,759	1,087,252	1,818,565	1,686,810	1,321,075	877,052	692,878	449,529
ash species	7,511,008	194,701	203,154	420,939	616,561	864,924	975,095	1,075,141	947,360	554,601	1,658,532
American sycamore	6,777,246	79,714	94,473	197,254	374,779	459,939	772,051	809,452	655,379	709,859	2,624,347
other oaks	6,674,584	68,357	213,761	272,843	547,699	760,395	986,693	1,388,576	766,173	605,061	1,065,028
sassafras	3,893,575	359,002	554,871	758,569	849,099	519,912	432,720	314,202	45,519	-	59,681
black walnut	3,542,071	78,224	136,173	257,846	373,671	708,529	439,698	577,632	158,521	327,691	484,086
black cherry	3,043,954	120,672	204,523	289,077	436,766	361,436	319,071	323,593	215,334	150,252	623,230
elms	1,887,495	299,727	410,460	233,413	239,969	213,251	165,815	109,819	48,295	62,830	103,917
other maples	1,478,114	51,386	136,879	163,820	160,583	125,563	156,048	271,792	100,514	-	311,530

Table 4.—Sawtimber volume of all live trees by species and diameter class, State Forest properties, 2013-2017.

Estimate: Total-All live net sawtimber volume on forestland (bdf - IN Doyle)

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	969,175,293	2,416,494	52,756,545	77,921,442	113,429,523	135,792,812	143,261,575	132,214,907	311,381,995
white oak	160,861,323	-	4,966,118	9,036,014	16,977,883	23,457,090	26,433,128	25,644,949	54,346,141
yellow-poplar	164,888,728	-	4,624,735	8,678,993	12,693,447	15,706,928	21,387,091	19,314,645	82,482,889
chestnut oak	119,574,505	-	4,895,113	10,348,641	16,614,349	20,505,126	23,548,567	18,690,668	24,972,042
black oak	106,690,505	-	1,528,465	2,887,747	6,914,945	12,015,280	14,301,153	18,883,062	50,159,853
northern red oak	59,999,286	-	1,213,656	2,113,218	3,547,493	7,225,981	8,479,506	9,142,034	28,277,399
sugar maple	55,801,756	-	8,806,911	9,947,139	10,385,556	8,886,337	6,595,064	4,806,203	6,374,546
eastern white pine	32,194,446	328,827	1,110,028	2,126,805	4,930,636	5,321,316	7,400,179	7,695,156	3,281,500
pignut hickory	40,781,075	-	3,371,396	4,917,952	7,376,293	8,546,965	6,071,223	5,449,673	5,047,572
other hardwood species	36,557,224	-	4,169,315	4,803,520	6,071,219	5,962,150	4,758,194	2,216,392	8,576,433
American beech	32,433,389	-	2,185,314	1,725,047	2,428,016	3,381,825	4,398,987	5,922,594	12,391,607
red maple	26,160,890	-	3,647,497	3,213,046	4,177,845	3,566,017	3,419,530	2,172,633	5,964,322
ash species	21,328,182	-	1,075,878	1,955,552	2,618,964	3,148,458	3,246,057	2,068,670	7,214,603
Virginia pine	21,442,450	1,030,273	3,513,419	4,023,261	5,235,707	3,339,834	3,831,692	-	468,263
American sycamore	22,127,674	-	714,993	1,097,341	2,131,489	2,337,830	2,105,039	2,401,070	11,339,912
other oaks	18,906,827	-	1,036,003	1,709,477	2,730,919	4,319,981	2,635,619	2,248,210	4,226,617
shagbark hickory	15,685,579	-	1,558,255	3,104,075	3,178,932	2,718,017	2,213,268	2,085,490	827,542
other pines and redcedar	10,961,701	1,057,395	2,204,034	2,291,158	1,793,553	1,225,675	485,010	1,229,957	674,922
black walnut	9,060,338	-	755,459	1,717,051	1,245,539	1,808,813	531,950	1,173,339	1,828,187
black cherry	6,411,709	-	762,490	791,379	791,388	790,397	562,372	513,646	2,200,037
other hickories	7,307,705	-	617,468	1,434,025	1,585,351	1,528,791	857,944	556,517	727,611

Table 5.—Net growth of all live trees by species and diameter class, State Forest properties, 2013-2017.

Estimate: Total-Net growth of all live on forestland(cuft per year)

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	3,535,670	350,714	248,006	266,049	329,579	327,836	443,777	414,374	471,861	273,118	714,889
yellow-poplar	630,944	26,673	-1,277	31,025	55,062	65,990	59,860	46,503	88,956	89,865	199,260
white oak	617,316	3,155	-1,043	10,575	28,998	54,412	62,529	110,999	112,762	103,522	139,420
sugar maple	616,107	147,379	127,839	102,949	81,487	48,333	59,934	25,001	22,030	18,148	21,112
red maple	334,171	63,117	60,649	44,338	55,784	35,855	47,778	24,942	32,697	12,734	-10,371
pignut hickory	303,113	7,803	8,945	26,085	36,122	33,867	62,254	34,278	48,044	27,080	20,686
black oak	240,785	595	3,290	5,412	5,769	8,942	20,657	38,634	22,427	8,212	131,133
northern red oak	177,653	1,892	2,103	5,836	12,246	8,163	11,577	28,744	23,968	-9,705	102,319
American sycamore	154,368	2,420	2,537	6,556	10,373	12,552	21,157	21,148	22,011	17,930	38,924
chestnut oak	143,531	5,945	1,203	6,903	9,525	3,338	30,349	12,098	29,303	19,537	48,369
other hardwood species	126,570	32,024	12,861	14,967	6,287	13,505	43,902	3,998	22,299	-18,046	24,705
American beech	119,271	53,432	34,810	44,023	21,235	5,694	3,417	20,891	995	-7,996	-33,702
shagbark hickory	113,823	2,955	6,185	8,677	17,574	36,571	26,762	15,785	-10,623	7,732	4,412
black walnut	82,902	3,796	4,095	6,639	11,445	20,338	12,324	-5,888	4,433	19,134	8,611
other hickories	76,808	2,741	1,641	5,696	9,895	18,637	16,239	12,424	5,254	497	6,454
black cherry	45,817	1,136	3,187	4,822	10,360	-1,201	8,911	-789	6,219	3,857	13,530
other oaks	42,358	1,764	-299	2,253	8,043	3,590	2,366	10,953	8,476	3,235	3,560
other maples	1,342	2,090	6,576	-3,691	-1,107	-2,971	-3,754	12,294	331	0	6,000
scarlet oak	-24,293	134	842	-791	1,525	4,612	-9,773	-8,821	9,058	-34,078	13,278
elms	-28,711	5,579	11,284	2,999	-971	-13,894	-4,626	-4,271	1,033	-17,490	1,704
sassafras	-52,225	-6,988	-6,878	-5,126	6,613	1,796	-16,164	-1,138	2,294	823	674
redcedar and pine species	-92,088	-4,143	-19,743	-56,245	-30,716	-22,692	-9,580	24,199	38,714	35,865	-27,559
ash species	-93,893	-2,789	-10,800	2,148	-25,971	-7,598	-2,342	-7,611	-18,819	-7,739	2,372

Table 6.—Net growth of sawtimber by species and diameter class, State Forest properties, 2013-2017.

Estimate: Total-Net growth of sawtimber on forestland (bdft per year - DOYLE)

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	11,542,851	- 10,693	2,921,092	835,607	1,309,228	1,290,594	1,515,729	898,640	2,782,654
yellow-poplar	2,605,347	-	412,673	179,076	206,789	161,539	330,395	352,461	962,415
white oak	1,853,273	-	232,632	123,404	166,625	305,930	333,709	317,788	373,186
sugar maple	1,249,815	-	674,232	110,108	167,783	91,027	66,991	73,313	66,361
pignut hickory	952,527	-	211,806	95,906	180,324	108,968	168,940	101,603	84,980
black oak	778,800	-	85,698	19,878	58,943	113,090	55,710	11,652	433,829
red maple	661,339	-	330,119	88,683	115,724	86,971	90,264	39,858	-90,281
northern red oak	591,674	-	100,016	21,189	33,477	88,904	75,898	-48,810	321,001
other hardwood species	530,105	-	223,050	56,714	85,753	43,850	80,630	-70,478	110,587
American sycamore	528,222	-	62,213	30,887	59,399	74,521	63,273	67,846	170,083
chestnut oak	469,763	-	141,851	-14,060	67,791	4,754	58,298	34,106	177,023
American beech	421,968	-	160,628	13,930	58,735	61,840	9,841	-38,845	155,840
shagbark hickory	299,141	-	76,213	89,372	75,040	49,322	-36,481	28,209	17,466
eastern white pine	288,470	-4,947	-15,362	10,386	67,889	62,139	96,296	117,207	-45,139
black walnut	224,190	-	57,519	47,610	33,964	-18,986	13,918	65,409	24,756
other hickories	203,534	-	35,197	46,679	45,627	39,842	18,349	1,399	16,440
black cherry	163,382	-	85,690	-1,403	17,801	-3,260	14,479	12,014	38,061
other oaks	142,848	-	39,769	18,992	2,428	31,889	27,300	10,927	11,543
elm species	-74,522	-	30,016	-28,275	-12,755	-13,000	2,989	-58,683	5,187
scarlet oak	-80,505	-	21,239	9,644	-28,602	-31,834	29,377	- 126,504	46,175
ash species	-89,459	-	9,337	-9,599	11,707	-6,891	-62,931	-28,858	-2,227
other pines and redcedar	-177,064	-5,746	-53,446	-73,516	-105,214	39,977	78,484	37,027	-94,628

Table 7.—Mortality of all live trees by species and diameter class, State Forest properties, 2013-2017.

Estimate: Total-Mortality of all live on forestland (cuft per year)

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	4,425,434	151,705	253,572	311,180	404,581	469,229	471,804	487,762	397,060	465,380	621,458
yellow-poplar	602,860	28,601	58,814	37,073	45,075	44,633	69,967	67,797	42,864	42,401	113,583
chestnut oak	484,810	1,449	8,609	17,047	29,183	61,379	71,392	84,750	76,940	59,809	49,260
black oak	410,152	2,771	4,342	5,694	18,520	18,974	38,791	49,695	74,481	99,476	91,861
white oak	325,272	5,263	15,906	15,217	23,581	22,220	33,755	36,240	50,272	24,442	89,372
northern red oak	296,392	2,093	4,915	7,010	7,884	16,671	27,346	33,006	36,773	74,883	75,001
white ash	276,513	11,999	14,590	10,778	41,322	28,225	26,975	29,154	39,105	15,963	40,908
other hardwood species	275,183	16,183	30,097	28,938	40,825	29,650	-	45,815	-	32,332	-
Virginia pine	262,424	5,783	10,994	42,591	54,050	50,378	54,075	9,489	-	-	20,218
sugar maple	238,163	16,697	21,619	22,594	28,032	49,326	14,720	11,268	12,880	10,566	-
American beech	182,793	322	2,540	-	8,545	13,263	15,209	10,471	12,688	29,040	65,503
sassafras	171,898	24,730	26,143	29,581	11,787	12,546	25,219	8,881	-	-	-
eastern white pine	162,191	2,554	5,575	19,183	18,845	16,387	16,803	9,763	26,624	14,562	28,795
red maple	157,381	9,446	7,802	14,253	17,056	10,355	-	8,414	-	-	46,957
elms	108,671	10,476	5,304	8,390	10,218	27,513	7,513	7,000	-	19,781	-
hickories	99,789	1,395	5,082	1,732	6,855	16,357	6,664	29,115	24,432	-	-
scarlet oak	98,977	-	1,891	2,198	3,687	-	20,671	28,089	-	42,124	-
red pine	98,160	2,724	15,819	21,337	21,027	18,279	5,655	7,543	-	-	-
redcedar and pine species	68,347	5,605	5,221	15,970	8,376	11,776	14,560	-	-	-	-
other maples	49,508	603	-	7,784	7,139	8,469	10,140	-	-	-	-
other oaks	33,747	1,426	6,418	3,809	-	7,948	12,350	-	-	-	-
other ashes	22,203	1,583	1,891	-	2,574	4,882	-	11,271	-	-	-

Table 8.—Mortality of sawtimber by species and diameter class, State Forest properties, 2013-2017.

Estimate: Total-Mortality of sawtimber on forestland (bdft per year - DOYLE)

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	10,092,225	159,402	746,790	1,117,375	1,309,598	1,497,633	1,350,934	1,687,813	2,222,680
black oak	1,333,391	-	32,601	47,592	111,503	157,325	255,101	363,990	365,279
yellow-poplar	1,328,290	-	89,770	115,992	211,822	229,790	159,402	173,597	347,916
chestnut oak	1,311,741	-	60,400	154,774	182,498	265,085	232,748	217,930	198,305
northern red oak	1,008,610	-	16,199	42,004	79,286	106,774	128,128	282,147	354,072
white oak	915,349	-	47,890	55,050	92,839	108,463	162,383	84,689	364,036
Virginia pine	704,520	72,932	131,162	157,226	199,085	38,906	-	-	105,209
white ash	598,818	-	70,530	59,290	54,421	56,855	131,953	58,528	167,241
eastern white pine	511,553	30,169	35,352	47,287	55,278	35,594	112,544	61,647	133,682
other hardwoods	448,926	-	77,388	88,620	25,650	138,682	-	118,585	-
scarlet oak	310,210	-	7,511	-	59,520	89,079	-	154,100	-
sugar maple	269,869	-	33,725	119,169	40,685	34,396	41,893	-	-
red maple	229,909	-	30,420	12,549	-	-	-	-	186,940
American beech	224,758	-	7,899	33,411	-	33,088	43,168	107,192	-
red pine	183,100	33,914	48,220	52,447	19,147	29,372	-	-	-
elms	182,981	-	19,638	57,527	19,986	20,421	-	65,409	-
pignut hickory	158,405	-	14,103	31,629	19,181	93,492	-	-	-
other pines and redcedar	111,132	22,387	14,097	20,923	53,725	-	-	-	-
sassafras	85,756	-	9,885	-	50,266	25,605	-	-	-
shagbark hickory	83,613	-	-	-	-	-	83,613	-	-
other ashes	46,178	-	-	11,473	-	34,705	-	-	-
other oaks	45,118	-	-	10,411	34,707	-	-	-	-

Table 9.—Removals of all live trees by species and diameter class, State Forest properties, 2013-2017.

Estimate: Total-Removals of all live on forestland (cuft per year)

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	3,727,649	9,795	25,541	56,791	216,582	299,137	452,398	409,278	443,708	404,011	1,161,046
yellow-poplar	760,897	1,001	3,406	-	13,820	5,310	22,922	45,505	70,094	86,745	474,954
black oak	606,349	-	1,522	-	6,383	30,504	24,254	54,861	44,906	103,191	327,915
other hardwood species	360,906	2,261	6,033	4,317	28,544	33,860	81,390	41,077	46,718	30,659	55,356
white oak	304,779	-	-	-	3,259	13,669	20,112	21,544	48,503	71,742	116,169
sugar maple	233,448	3,029	8,338	3,266	27,075	39,694	38,154	12,591	50,588	-	-
chestnut oak	206,238	579	-	-	2,876	22,587	30,266	64,819	22,892	14,041	44,068
white ash	167,804	-	-	-	9,417	11,602	34,240	57,665	36,610	-	-
American beech	161,776	-	614	10,047	8,576	9,255	6,954	7,668	25,189	45,419	40,725
red maple	142,694	1,007	1,511	4,299	13,473	31,728	36,347	20,323	-	-	16,511
eastern white pine	140,545	-	-	6,649	3,192	31,048	34,596	16,702	20,108	26,976	-
pignut hickory	135,314	-	779	-	7,633	13,954	23,408	28,671	25,860	-	20,694
sassafras	130,192	1,269	2,294	1,777	24,407	11,077	20,668	12,121	28,207	11,903	-
northern red oak	128,538	-	-	2,292	8,657	4,329	22,459	9,958	11,736	-	64,653
redcedar and pine species	124,253	650	1,044	24,145	32,922	11,721	11,710	7,958	12,297	-	-
Virginia pine	123,915	-	-	-	26,349	28,799	44,920	7,815	-	13,337	-

Table 10.—Removals of sawtimber by species and diameter class, State Forest properties, 2013-2017.

Estimate: Total-Removals of sawtimber on forestland (bdft per year - DOYLE)

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	12,042,100	51,581	449,444	751,473	1,317,726	1,314,249	1,550,342	1,522,045	5,085,241
yellow-poplar	3,154,179	-	27,971	13,589	69,117	151,249	264,919	350,111	2,277,222
black oak	2,223,981	-	12,988	65,477	69,541	173,606	154,293	378,276	1,369,801
other hardwood species	1,035,998	-	55,418	78,579	217,482	133,515	156,106	105,389	289,510
white oak	988,059	-	6,682	33,500	55,249	65,504	157,749	248,523	420,852
chestnut oak	656,371	-	5,930	57,262	86,588	206,825	77,355	53,185	169,226
American beech	497,648	-	17,782	23,308	19,960	24,376	86,069	166,783	159,370
eastern white pine	492,985	10,571	7,395	90,029	117,420	63,758	86,453	117,360	-
sugar maple	463,222	-	53,625	96,657	106,528	38,840	167,571	-	-
white ash	439,262	-	17,490	27,304	93,402	177,546	123,520	-	-
northern red oak	425,394	-	17,637	10,859	65,209	32,161	40,905	-	258,622
Virginia pine	413,401	-	63,931	91,277	164,673	31,736	-	61,784	-
pignut hickory	384,942	-	15,638	34,940	67,812	92,219	90,643	-	83,691
red maple	299,235	-	24,037	69,721	91,600	56,930	-	-	56,947
sassafras	288,787	-	45,583	25,343	54,239	34,853	88,136	40,633	-
redcedar and pine species	278,636	41,010	77,338	33,628	38,908	31,130	56,624	-	-

Table 11.—Number of standing dead trees 5” d.b.h. and greater by species and diameter class, State Forest Properties, 2013-2017.

Estimate: Total-Number of standing dead trees 5"+ dbh on forestland (trees)

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	1,840,015	564,585	407,309	279,204	181,315	129,485	99,069	64,250	48,550	27,327	38,922
sassafras	278,607	144,297	68,044	39,853	13,713	4,895	6,818	988	-	-	-
yellow-poplar	158,491	52,535	39,932	18,522	13,618	7,734	7,775	6,796	2,922	3,914	4,744
Virginia pine	153,687	25,377	36,061	25,548	32,324	18,601	9,860	3,944	986	-	986
chestnut oak	151,663	15,654	20,350	26,385	24,348	19,315	18,406	9,676	7,797	4,858	4,874
white oak	149,063	27,125	29,317	20,516	12,618	17,641	13,599	8,766	9,714	986	8,781
eastern redcedar	120,675	67,769	27,458	17,702	2,922	3,851	-	-	-	-	973
sugar maple	110,013	42,874	30,354	17,455	5,809	8,707	983	1,898	949	983	-
other hardwoods	99,801	31,771	27,038	16,483	12,730	6,841	1,975	1,971	-	988	-
black oak	92,481	6,804	8,769	8,626	12,774	5,806	11,693	9,734	12,688	7,748	7,840
red pine	77,558	14,427	31,522	18,139	8,627	2,926	983	933	-	-	-
ashes	75,866	25,342	16,606	6,799	8,763	5,778	1,903	5,885	2,855	986	949
eastern white pine	62,071	15,594	11,603	16,457	4,843	3,932	3,838	983	4,820	-	-
red maple	50,659	21,453	8,834	10,703	4,782	1,957	949	973	-	-	1,008
elms	50,438	22,448	9,627	4,891	3,775	5,848	929	1,008	983	929	-
northern red oak	45,896	6,870	5,879	7,780	1,971	3,941	4,910	6,823	1,878	2,978	2,866
other oaks	39,035	6,862	11,685	6,862	2,955	2,950	5,747	988	983	-	-
black locust	34,858	18,990	6,963	3,969	3,952	983	-	-	-	-	-
black cherry	31,862	12,556	7,613	4,864	2,979	2,900	949	-	-	-	-
American beech	31,154	1,957	3,908	4,764	4,864	1,935	2,930	949	988	2,957	5,902
hickories	21,272	3,878	5,743	949	1,959	2,940	2,882	1,935	986	-	-
other softwoods	4,863	-	-	1,938	988	-	1,938	-	-	-	-