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Michigan's Forest Resources in 2001

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Michigan's Forest Resources in 2001

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The North Central Research Station's Forest Inventory and Analysis (NCFIA) program began fieldwork for the sixth forest inventory of Michigan in 2000, in partnership with the Michigan Department of Natural Resources. This inventory initiates the new annual inventory system in which one-fifth of the field plots (considered one panel) in the State are measured each year. A complete inventory consists of measuring and compiling the data for all plots (or five panels). Once all panels have been measured, each will be remeasured approximately every 5 years. For example, in Michigan, the field plots measured in 2001 will be remeasured in 2006.

In 2001, NCFIA continued the annual inventory effort with the second panel of the sixth Michigan forest inventory. Reports of previous inventories of Michigan are dated 1935, 1955, 1966, 1980, and 1993. This sixth inventory of Michigan's forest resources will be completed in 2004. However, because each year's sample is a systematic sample of the State's forest and because timely information is needed about Michigan's forest resources, estimates have been prepared from data gathered during the first two years of the inventory. Data presented in this report represent 40 percent of the field plots (or two panels) for a complete inventory and are a combination of the first year's panel from 2000 and the second year's panel from 2001. Earlier reports for the 2000 panel (Leatherberry 2002) have also been published. The results presented are estimates based on sampling techniques; estimates were compiled assuming the 2000 and 2001 data represent one sample. As additional annual inventories are completed, the precision of the estimates will increase and additional data will be released.

Data from new inventories are often compared with data from earlier inventories to determine trends in forest resources. However, for the comparison to be valid, the procedures used in the two inventories must be similar. As a result of our ongoing efforts to improve the efficiency and reliability of the inventory, several changes in procedures and definitions have been made since the last inventory of Michigan in 1993 (Leatherberry and Spencer 1996). While these changes will have little impact on statewide estimates of forest area, timber volume, and tree biomass, they may have significant impacts on plot classification variables such as forest type and stand-size class. Some of these changes make it inappropriate to directly compare portions of the 2001 data with those published for earlier inventories.

RESULTS

Area

There are 36.4 million acres of land in Michigan. Forest land totals 19.4 million acres, or 53 percent, of the State's total land area (table 1). Forest land has three components: 1) Timberland[1]—forest land that is not restricted from harvesting by statute, administrative regulation, or designation and is capable of growing trees at a rate of 20 cubic feet per acre per

[1] Timberland may not be equivalent to the area actually available for commercial timber harvesting or other access. The actual availability of land for various uses depends upon owner decisions that consider economic, environment, and social factors.

year; 2) Reserved forest land—land that is restricted from harvesting by statute, administrative regulation, or designation (i.e., national parks and lakeshores, and Federal wilderness areas); and 3) Other forest land—land that is not capable of growing trees at a rate of 20 cubic feet per acre per year.

Timberland area in Michigan totals approximately 19 million acres, accounting for 98 percent of forest land area in Michigan (table 2). Since the first statewide inventory of Michigan's forest resources in 1935, timberland area has hovered around 19 million acres (fig. 1). The general stability in timberland area for most of the 20th century can be attributed to forest management activities dedicated to reforestation. For example, between 1933 and the start of World War II, the Civilian Conservation Corps (CCC) planted about 500 million trees in Michigan. Also, the significant amount of public ownership of forest in Michigan helped maintain a stable base of timberland area. However, between 1966 and 1980, the area of timberland in Michigan declined to a historical low of 17.5 million acres. Much of the decline in timberland area was related to increased tillage and the pasturing of livestock on marginal timberland. During the 1980s and early 1990s, the area of timberland rebounded to 18.6 million acres. The increase came predominantly from abandoned cropland and pasture, and marginal forest land that were productive enough to be reclassified as timberland (Schmidt *et al.* 1997). Between 1993 and 2001, Michigan's timberland area increased to an estimated 19 million acres. The increase in timberland area between 1993 and 2001 should be viewed with the caveat that the 2001 estimate of timberland area is based on a partial inventory and therefore has a higher sampling error than inventories since 1955 as is shown in figure 1. The 2001 estimate indicates that timberland area has increased since 1993. An increase in timberland area is noteworthy considering that suburban development and second homes continue to expand into rural areas. Also, resort communities or enclaves, including golf courses, continue to expand into timberland areas. Timberland that converted to other land uses is apparently supplanted by land, some of it agricultural land, that reverted back to forest.

In Michigan, private owners hold 61 percent of the timberland area (table 2). Private owners hold timberland for a variety of reasons. Among private owners, family forest landowners predominate, and for them recreation and esthetic enjoyment are important reasons for owning timberland in Michigan (Leatherberry *et al.* 1998). Although

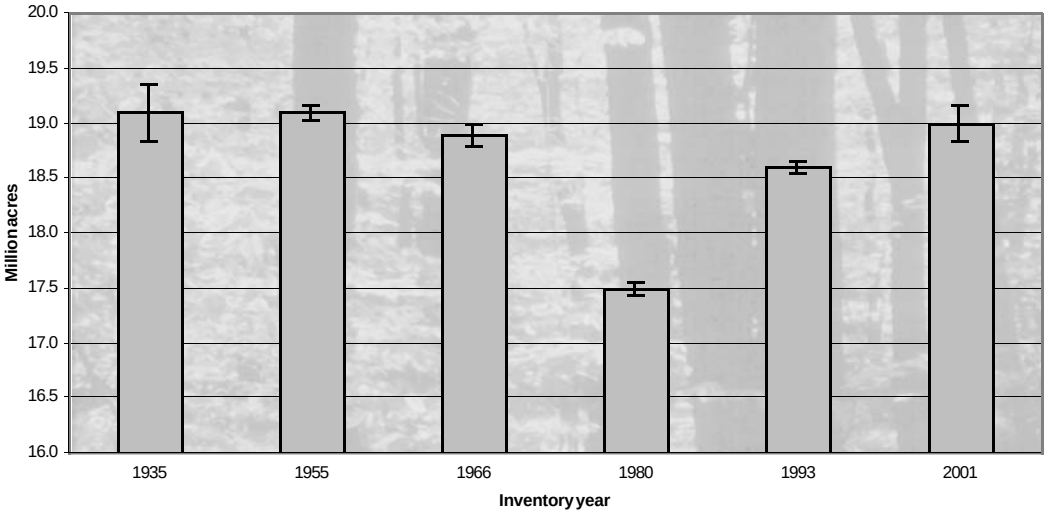

Figure 1. — Area of timberland, Michigan, 1935-2001. (Note: The sampling errors associated with each inventory estimate are represented by the vertical lines at the top of its bar.)

family forest landowners predominate, corporations hold considerable timberland in Michigan. Timberland owned by family and corporate owners, as well as public timberland, provides recreation opportunities, timber products, wildlife habitat, watershed protection, and other environmental benefits. The conservation and restoration of the pine resource in Michigan is an example of how timberland owners in Michigan provide environmental benefits. Before the extensive logging of the late 1800s and early 1900s, pines were an important component of the State's forests. Logging largely decimated the pine resource. However, some pockets where pines survived logging were placed in public ownership. Places such as Hartwick Pines State Park and Estivant Pines are remnant old-growth pine forest. Extensive pine restoration programs were carried out on private and public land. About one-fourth of the timberland area that is in the softwood type groups was planted, and nearly 61 percent of that was planted on public ownerships (table 2). The restoration of the pine resource in Michigan ensures a level of biological diversity that may not exist otherwise.

Hardwood forests occupy about three-fourths of the State's timberland area (table 3). The maple/beech/birch forest type group is the most extensive forest type in Michigan, occupying an estimated 37 percent of the State's timberland area (fig. 2). The aspen/birch type occurs on about 18 percent of timberland area. The oak/hickory and the elm/ash/ cottonwood type groups, when combined, occupy about 20 percent of Michigan's timberland area. The white pine/red pine/jack pine group and the spruce/fir group combined cover about one-fourth of the timberland area, accounting for virtually all the area that is in the softwood forest type groups.

Forest stands are affected by natural and human-caused events that often result in change in stand-size characteristics of the forest. Stand-size class is a measure of the average diameter of the dominant trees in a stand. There are three stand-size classes: sawtimber, poletimber, and sapling/seedling. The area classified as sawtimber—stands with a plurality of stocking in trees more than 11.0 inches in diameter at breast height (d.b.h., 4.5 feet above ground level) for deciduous species and 9.0 inches d.b.h. for conifers—accounted for 38 percent (7.2 million acres) of the timberland area in 2001, a decline from 46 percent (8.6 million acres) in 1993. Conversely, the proportion of area in poletimber-size trees increased from 30 percent (5.5 million acres) in 1993 to 39 percent (7.4 million acres) in 2001. The proportion of area in sapling-seedling-size stands stayed about the same (fig. 3).

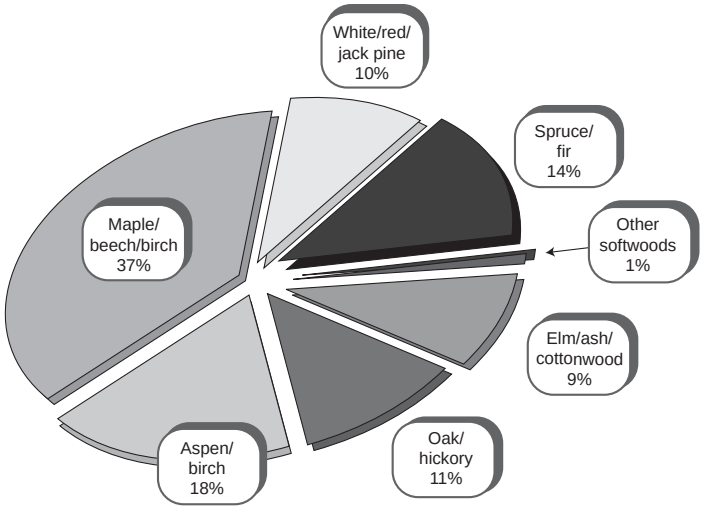

Figure 2. — *Area of forest land by forest type group, Michigan, 2001.*

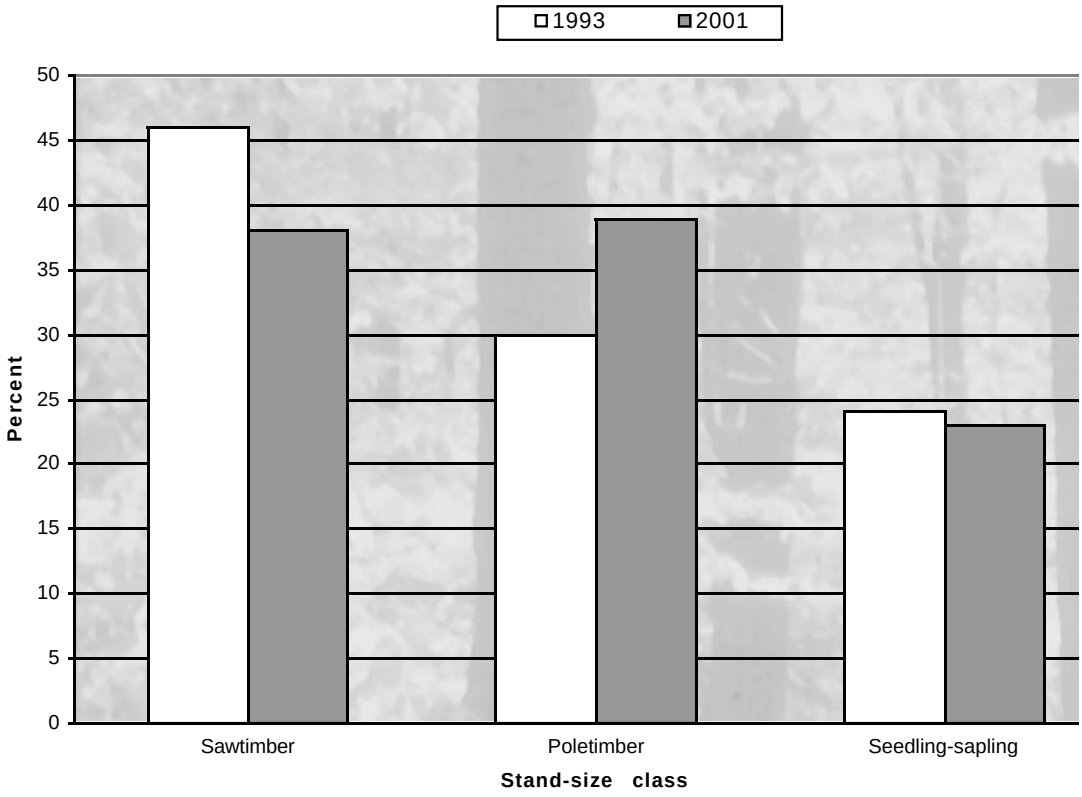

Figure 3. — Stand-size class as a percentage of total timberland area, Michigan, 1993 and 2001.

A trend that warrants observation is the apparent change in stand-size class in the aspen/birch type group (table 3). Between 1993 and 2001, the area of sawtimber-size trees in the aspen/birch group declined from 32 percent of total area to 18 percent. Ensuing panels of the sixth Michigan inventory will provide more reliable information for more definitive conclusions about changes in stand-size class.

Volume

Total net volume of all live trees on forest land in Michigan is 29.8 billion cubic feet, which equates to 1,537 cubic feet per acre of forest land (table 4). About 6 of every 10 cubic feet of live volume are on privately owned forest land. Slightly more than two-thirds (20.1 billion cubic feet) of net volume of all live trees is contained in hardwoods, with 28 percent in maple trees. Net volume is computed from a 1-foot stump to a 4-inch top diameter outside bark for live trees at least 5 inches diameter at breast height (d.b.h.).

Growing-stock volume on timberland is a measure that has traditionally been used to ascertain wood volume useful for commercial purposes. Growing-stock volume is the amount of solid wood on timberland in commercial trees 5.0 inches d.b.h. and over from 1 foot above ground (stump) to a minimum 4-inch top diameter with deductions made for poor form or defect. Growing-stock volume excludes rough, rotten and dead trees and noncommercial tree species. Michigan's growing-stock volume totals 27.2 billion cubic feet, representing 94 percent of the total live volume (table 5). Six percent of volume of all live trees on timberland is in live cull trees—1.8 billion cubic feet. Cull volume is often used for commercial purposes. For instance, rough trees are sometimes used for making pallets or for chipping. Dead trees are also used for commercial purposes—they are an important source of firewood. Salvable dead trees contain 903.5 million cubic feet of wood volume. Salvable dead trees are important to wildlife species, such as cavity nesting birds.

Growing-stock volume increased between 1993 and 2001, from 26.6 to 27.2 billion cubic feet (table 6). Total growing-stock volume has increased in every inventory since 1955. Fully two-thirds of total growing-stock volume is now in hardwood species. However, it appears that the trend in increasing hardwood growing-stock volume since 1935 has abated (fig. 4).

Softwood growing-stock volume has increased in every inventory since 1955 (fig. 5). Between 1993 and 2001, the volume of softwood growing stock increased from 7.5 billion cubic feet to 9 billion cubic feet.

Maples account for the largest part of growing-stock volume at 28 percent of total growing-stock volume (table 7). Other species with significant growing-stock volume are eastern white and red pines (12 percent), followed by aspen and cottonwood (11 percent), oaks (10 percent), and other eastern softwoods (10 percent).

Sawtimber volume is a subset of growing-stock volume. It is the volume of the saw log portion of live sawtimber measured in board feet. Sawtimber volume is generally measured with the International 1/4-inch rule. Sawtimber volume in Michigan totals 78.3 billion board feet (table 8). About two-thirds of sawtimber volume is in hardwood trees. Of total hardwood sawtimber volume, nearly 60 percent is in trees with diameters less than 17 inches. Thirty-eight percent of hardwood sawtimber volume is in maples. Forty-five percent of the 30.1 billion board feet of softwood sawtimber volume is in eastern white and red pines.

Biomass

Live aboveground tree biomass in Michigan's timberland area was estimated to be 758.5 million dry tons in 2001 (an average of 40 dry tons per acre of timberland). All live aboveground tree biomass is estimated for growing-stock trees, non-growing-stock trees, and all live 1- to 5-inch trees (table 9). Eighty-three percent of the tree biomass is in growing-stock

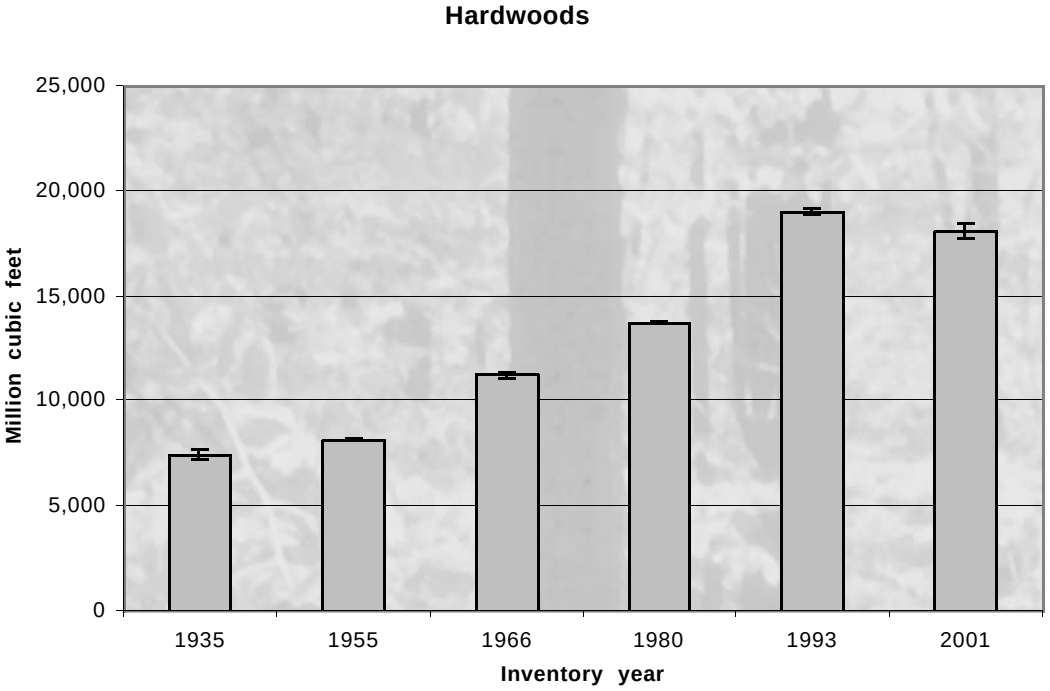

Figure 4. — Hardwood growing-stock volume, Michigan, 1935-2001. (Note: The sampling errors associated with each inventory estimate are represented by the vertical lines at the top of its bar.)

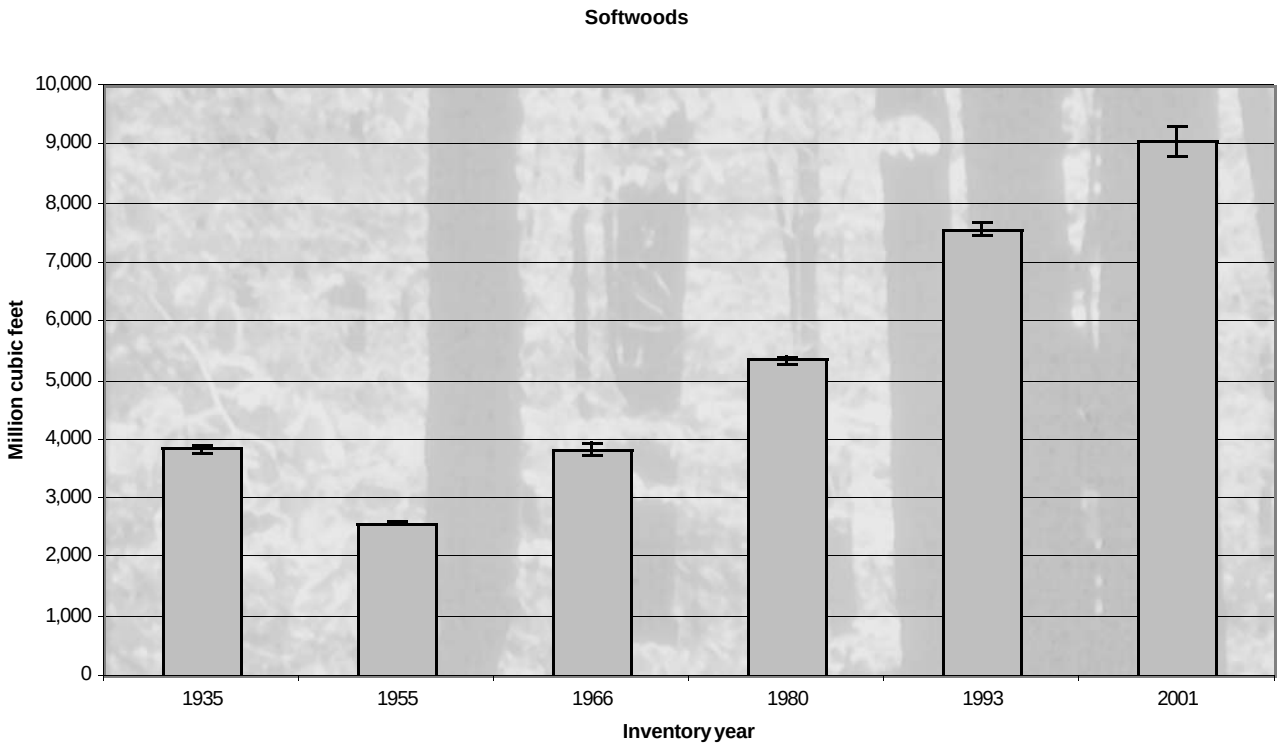

Figure 5. — *Softwood growing-stock volume, Michigan, 1935-2001. (Note: The sampling errors associated with each inventory estimate are represented by the vertical lines at the top of its bar.)*

trees, with an additional 7 percent in non-growing-stock trees, and the remaining 10 percent in trees less than 5 inches d.b.h. Seventy-six percent (573 million dry tons) of all live aboveground tree biomass is in hardwood species. Biomass estimates are increasing in importance for analyses of questions about carbon sequestration, wood fiber availability for fuel, and assessing fuel loads in forest stands.

Forest Health

Some of the information presented about pathogens and insects affecting Michigan's forests were obtained from the National Forest Health Monitoring Program (FHM) at: http://www.na.fs.fed.us/spfo/fhm/index.htm.

Michigan faces several major forest health concerns. The introduction of exotic organisms is a serious health threat to the State's native forest ecosystems. The introduction of the emerald ash borer (*Agrilis planipennis*), native to China, Korea, Japan, and Far East Russia is threatening Michigan's ash resource. The emerald ash borer probably found its way to Michigan in wooden crating or other shipping material. The small, green metallic beetles have killed thousands of ash trees throughout southeast Michigan, mostly in Wayne, Oakland, Macomb, Monroe, Washtenaw, St. Clair, and Livingston Counties. Evidence suggests that the insect has been active in Michigan since at least 1997. All varieties of ash trees appear susceptible, including white ash, green ash, and black ash, as well as several horticultural varieties. Forest health managers and researchers are working to identify the extent of the infestation and to devise a strategy aimed at slowing the spread of the insect.

Gypsy moth (*Lymantria dispar*) populations have begun an upward trend statewide. This follows a long period of population decline that began in the early 1990s and culminated in 2001 when, for the first time in over a decade, aerial surveys detected no defoliation in the State. Since then, egg mass numbers have been

increasing steadily and defoliation is expected to be locally heavy in some northern Lower Peninsula counties.

The forest tent caterpillar (FTC) (*Malacosoma disstria*) defoliated 1.3 million acres in 2002. A little more than half of these acres were partially affected stands with a component of susceptible tree species. The FTC is a native leaf-feeding caterpillar. FTC prefers to eat aspen and oak leaves in the Upper Peninsula although it also readily consumes paper birch, green and white ash, basswood, and willow leaves. Sugar maple is readily consumed only in the northern Lower Peninsula. Epidemics occur about every 10-15 years in the Great Lakes region and last for 2-4 years. FTC can defoliate trees for several years with little ill effect. This is especially true for years with average or above average rainfall. Parasites were abundant in this year's populations, signaling a likely significant population reduction in these areas next year.

Beech bark disease was detected in the spring of 2000 and is established in the western Lower Peninsula and in the eastern Upper Peninsula. The interaction of an exotic scale insect (*Cryptococcus fagisuga*) and a native and exotic canker-causing fungus (*Nectria* sp.) causes beech bark disease. Once infected by the fungus, trees usually decline and trunks may break at canker sites.

The eastern larch beetle (*Dendroctonus simplex*) is epidemic in several areas of the eastern and the south central Upper Peninsula. This bark beetle is killing tamarack in stands ranging in size from a cluster of a few trees to stands of 100 acres. Because many infested trees enter the fall with apparently healthy crowns, mortality is often overlooked until trees fail to leaf out the following spring. Upon closer inspection, these "green" trees are completely girdled with beetle galleries. Both native tamarack and exotic larch species are susceptible to this beetle. Apparently healthy trees can be attacked and killed by the bark beetle. However, many infestations are associated with stressed trees. Stresses from the drought of 2000-2001 and repeated defoliation by the larch casebearer (*Coleophora laricella*) are likely predisposing factors contributing to the current epidemic. The larch casebearer is an exotic insect that was introduced to the Lake States in the early 1900s. It derives its name from the “case” it constructs from a mined-out needle. Defoliation for two or more consecutive years can cause tree decline and mortality. Populations generally collapse after a single year of damage thanks to two parasites imported from Europe.

Incidence of the vascular disease oak wilt continues to increase in several areas around the Upper Peninsula and the northern Lower Peninsula of Michigan. To slow the overland spread of oak wilt, harvesting restrictions are being exercised on State land. Forest stands with oak trees are not being cut between April 15 and July 15 in areas where the risk of oak wilt is high. These dates mark the period when the sap-feeding beetles responsible for spreading oak wilt are most active. These small (1/4-inch long) beetles are attracted to fresh tree wounds and transmit spores to oak trees that have been damaged during logging operations.

The jack pine budworm (*Choristoneura pinus pinus*) is considered the most significant pest of jack pine. Stands older than 45 years that are growing on very sandy sites and suffering from drought or other stresses are very vulnerable to damage. Tree mortality and top kill resulting from budworm defoliation creates fuel for intense wildfires. Harvesting and other management activities can prevent budworm-caused tree mortality and reduce the threat of damaging wildfires while providing suitable conditions for jack pine regeneration. A buildup of jack pine budworm populations began in the eastern Upper Peninsula in 2000. It is expected that this epidemic will spread westward affecting most of the Upper Peninsula jack pine resource in the next 3-4 years.

In the Lower Peninsula, jack pine budworm numbers have declined from 2001 levels. This is likely the tail end of an outbreak that began in 1997. Stands that were defoliated previously and show signs of heavy population buildup are at risk of mortality.

The red-headed pine sawfly (*Neodiprion lecontei*) is an important defoliator of young red and jack pines. Heaviest infestations are in pines growing under stress, particularly those at the edges of hardwood forests, on poor soils, and amid heavy competitive vegetation. In general, it infests and damages trees less than 15 feet tall. Moderate to heavy defoliation stunts height growth of infested trees, and forking may result from top kill. Complete defoliation usually kills the tree. Building sawfly populations were detected in many areas of the eastern Upper Peninsula and the northern Lower Peninsula.

Summary

Data from the first two panels of Michigan's sixth forest resources inventory indicate the directions of change in the State's forest resources. Timberland area has increased slightly since 1993. Although total growing-stock volume has increased, hardwood growing-stock volume appears to have decreased. Michigan's forests are affected by a number of pathogens and insects. The introduction of exotic organisms, such as the emerald ash borer, is the most serious health threat to Michigan's native forest ecosystems. These findings are presented to suggest trends in Michigan forest resources. As additional data become available under the annual inventory system, a clearer picture of the direction of Michigan's forest will emerge. Additional data related to the two most recent inventories of Michigan (1993 and 2001) are available at: www.ncrs.fs.fed.us/4801/fiadb/index.htm.

APPENDIX

Inventory Methods

Since the 1993 inventory of Michigan, several changes have been made in NCFIA inventory methods to improve the quality of the inventory as well as meet increasing demands for timely forest resource information. The most significant difference between inventories is the change from periodic inventories to annual inventories. Historically, NCFIA periodically inventoried each State on a cycle that averaged about 12 years. However, the need for timely and consistent data across large geographical regions, combined with national legislative mandates, resulted in NCFIA's implementation of an annual inventory system. Michigan was one of the first States in the North Central region, and in the Nation, to be inventoried with this new system, beginning with the 2000 inventory.

With an annual inventory system, about one-fifth of all field plots are measured each year. After 5 years, an entire inventory cycle will be completed. After the first 5 years, NCFIA will report and analyze results as a moving 5-year average. For example, NCFIA will be able to generate a report based on inventory results for 2000 through 2005 or for 2001 through 2006. While there are great advantages for an annual inventory, one difficulty is reporting on results in the first 4 years. With the 2001 annual measurements, 40 percent of all field plots have been measured. Sampling error estimates for the 2001 inventory results are area of forest land, 0.60 percent; area of timberland, 0.64 percent; volume of growing stock on timberland, 1.26 percent; and volume of sawtimber on timberland, 1.71 percent. After two panels of the sixth Michigan inventory, sampling error estimates are higher than those for the last periodic inventory completed in 1993 (i.e., 0.34 percent for timberland area and 0.67 percent for growing-stock volume) because of the smaller sample sizes. As we complete ensuing measurements, we will have additional confidence in our results due to the increased number of field plots measured. As each measurement year is completed, the precision of estimates will improve.

Other significant changes between inventories include the implementation of new remote sensing technology, the implementation of a new field plot design, and the gathering of additional remotely sensed and field data. The advent of remote sensing technology since the previous inventory in 1993 has allowed NCFIA to use computer-assisted classifications of Multi-Resolution Land Characterization (MRLC) data and other available remote sensing products to stratify the total area of the State and to improve the precision of estimates. Inventories in Michigan before 1993 used manual interpretation of aerial photos to stratify the sample.

New algorithms were used in 2000 and 2001 to assign forest type and stand-size class to each condition observed on a plot. These algorithms are being used nationwide by FIA to provide consistency among States and will be used to reassign the forest type and stand-size class of every plot measured in the 1993 inventory when it is updated. This will be done so that changes in forest type and stand-size class will more accurately reflect actual changes in the forest and not changes in how values are computed. The list of recognized forest types, grouping of these forest types for reporting purposes, models used to assign stocking values to individual trees, definition of nonstocked, and names given to the forest types changed with the new algorithms. As a result, comparisons between the published 2001 inventory results and those published for the 1993 inventory may not be valid. For additional details about algorithms used in both inventories, please contact NCFIA.

Sampling Phases

The 2001 Michigan survey was based on a three-phase inventory. The first phase used classified satellite imagery to stratify the State and aerial photographs to select plots for measurement. The second phase entailed measurement of the traditional FIA suite of mensurational variables, and the third phase focused on a suite of variables related to the health of the forest.

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

Phase 1

The 2001 inventory used a computer assisted classification of satellite imagery. FIA used the imagery to form two initial strata—forest and nonforest. Pixels within 60 m (2 pixel widths) of a forest/nonforest edge formed two additional strata—forest/nonforest and nonforest/forest. Forest pixels within 60 m on the forest side of a forest/nonforest boundary were classified into a forest edge stratum. Pixels within 60 m of the boundary on the nonforest side were classified into a nonforest edge stratum. The estimated population total for a variable is the sum across all strata of the product of each stratum's estimated area and the variable's estimated mean per unit area for the stratum.

Phase 2

Phase 2 of the inventory consisted of the measurement of the annual sample of field plots in Michigan. Current FIA precision standards for annual inventories require a sampling intensity of one plot for approximately every 6,000 acres. FIA has divided the entire area of the United States into nonoverlapping hexagons, each of which contains 5,937 acres (McRoberts 1999). An array of field plots was established by selecting one plot from each hexagon based on the following rules: (1) if a Forest Health Monitoring (FHM) plot (Mangold 1998) fell within a hexagon, it was selected; (2) if no FHM plot fell within a hexagon, the existing NCFIA plot from the 1990 inventory nearest the hexagon center was selected; and (3) if neither FHM nor existing NCFIA plots fell within the hexagon, a new NCFIA plot was established in the hexagon (McRoberts 1999). This array of plots is designated the Federal base sample and is considered an equal probability sample; its measurement in Michigan is funded by the Federal government. The State of Michigan provided additional funds to intensify the sampling of phase 2 plots. Instead of a single intensity survey (one plot for approximately every 6,000 acres) a triple intensity survey is being conducted (one plot for approximately every 2,000 acres). The 2000/2001 annual inventories collected data from 4,685 phase 2 field plots.

The total Federal base sample of plots was systematically divided into five interpenetrating, non-overlapping subsamples or panels. Each year the plots in a single panel are measured, and panels are selected on a 5-year, rotating basis (McRoberts 1999). For estimation purposes, the measurement of each panel of plots may be considered an independent systematic sample of all land in a State. Field crews measure vegetation on plots forested at the time of the last inventory and on plots currently classified as forest by trained photointerpreters using aerial photos or digital ortho-quads.

Phase 3

NCFIA has two categories of field plot measurements—phase 2 field plots (standard FIA plots) and phase 3 plots (forest health plots)—to optimize our ability to collect data when available for measurement. Both types of plots are uniformly distributed both geographically and temporally. Phase 3 plots are

measured with the full suite of forest health monitoring vegetative and health variables (Mangold 1998) collected as well as the full suite of measures associated with phase 2 plots. Phase 3 plots must be measured between June 1 and August 30 to accommodate the additional measurement of nonwoody understory vegetation, ground cover, soils, and other variables. The 2000/2001 annual inventories collected data from 157 phase 3 plots.

The new national FIA plot design (fig. 6) was first used for data collection in Michigan in 2000, the first annual inventory year. This design was also used in the 2000 and 2001 inventories and will be used in subsequent years. The national plot design requires mapping forest conditions on each plot. Due to the small sample size (20 percent) each year, precision associated with change factors such as mortality will be relatively low. Consequently, we will not report change estimates in Michigan until at least four annual panels have been measured, and even then we anticipate that estimates of change will be limited in detail. When the complete annual inventory has been implemented in 2004, the full range of change data will be available.

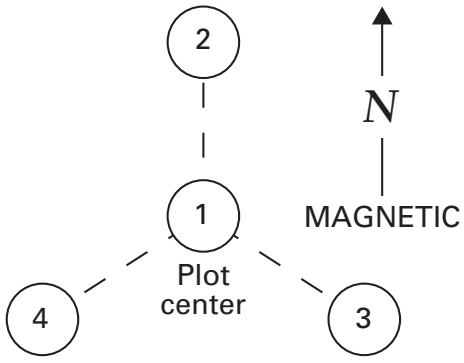

Figure 6. — Current NCFIA field plot design.

The overall plot layout for the new design consists of four subplots. The centers of subplots 2, 3, and 4 are located 120 feet from the center of subplot 1. The azimuths to subplots 2, 3, and 4 are 0, 120, and 240 degrees, respectively. The center of the new plot is located at the same point as the center of the previous plot if a previous plot existed within the sample unit. Trees with a d.b.h. 5 inches and larger are measured on a 24-foot-radius (1/24 acre) circular subplot. All trees less than 5 inches d.b.h. are measured on a 6.8-foot-radius (1/300 acre) circular microplot located 12 feet east of the center of each of the four subplots. Forest conditions that occur on any of the four subplots are recorded. Factors that differentiate forest conditions are changes in forest type, stand-size class, land use, ownership, and density. Each condition that occurs anywhere on any of the subplots is identified, described, and mapped if the area of the condition meets or exceeds 1 acre in size.

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

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TABLE TITLES

TABLES

Table 1. -- Area of forest land by forest type group and owner category, Michigan, 2000 - 2001

(In thousand acres)

Forest type group	Owner category			
	All owners	Public	Private	Unidentified owner
Softwood type groups				
White / red / jack pine group	1,991.3	1,403.0	588.3	--
Spruce / fir group	2,685.0	1,219.0	1,466.0	--
Exotic softwood group	158.3	14.8	143.5	--
All softwood types	4,834.5	2,636.7	2,197.8	--
Hardwood type groups				
Oak / pine group	6.5	3.6	2.9	--
Oak / hickory group	2,226.7	849.3	1,377.4	--
Elm / ash / cottonwood group	1,671.4	290.4	1,381.0	--
Maple / beech / birch group	7,090.2	2,233.0	4,857.3	--
Aspen / birch group	3,454.9	1,590.2	1,864.7	--
All hardwood types	14,449.7	4,966.4	9,483.3	--
Nonstocked	108.6	30.5	78.2	--
All forest types	19,392.9	7,633.6	11,759.3	--

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

Table 2. -- Area of timberland by major forest type group, stand origin, and owner category, Michigan, 2000 - 2001

(In thousand acres)

Major forest type group and stand origin	Owner category			
	All owners	Public	Private	Unidentified owner
Softwood type groups				
Natural	3,549.7	1,838.1	1,711.6	- -
Planted	1,205.7	734.4	471.3	- -
All softwood types	4,755.3	2,572.5	2,182.8	- -
Hardwood type groups				
Natural	13,918.4	4,601.1	9,317.3	- -
Planted	212.0	131.1	80.9	- -
All hardwood types	14,130.4	4,732.2	9,398.2	- -
Nonstocked	103.4	25.3	78.2	- -
All groups	18,989.2	7,330.0	11,659.2	- -

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

Table 3. -- Area of timberland by forest type group and stand-size class, Michigan, 2000 - 2001

(In thousand acres)

Forest type group	All stands	Stand-size class			
		Sawtimber	Poletimber	Sapling-seedling	Non-stocked
Softwood type groups					
White / red / jack pine group	1,976.1	851.1	761.8	363.2	- -
Spruce / fir group	2,620.9	599.3	1,193.7	828.0	- -
Exotic softwood group	158.3	69.7	48.8	39.9	- -
All softwood types	4,755.3	1,520.1	2,004.2	1,231.0	- -
Hardwood type groups					
Oak / pine group	6.5	0.2	6.3	- -	- -
Oak / hickory group	2,208.6	1,396.3	487.1	325.2	- -
Elm / ash / cottonwood group	1,623.0	551.9	669.6	401.5	- -
Maple / beech / birch group	6,915.6	3,118.9	2,834.2	962.5	- -
Aspen / birch group	3,376.8	620.6	1,390.3	1,365.9	- -
All hardwood types	14,130.4	5,687.8	5,387.5	3,055.1	- -
Nonstocked	103.4	- -	- -	- -	103.4
All forest types	18,989.2	7,207.9	7,391.8	4,286.1	103.4

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

Table 4. -- Net volume of all live trees on forest land by species group and owner category, Michigan, 2000 - 2001

(In thousand cubic feet)

Species group	Owner category			
	All owners	Public	Private	Unidentified owner
Softwoods				
Other yellow pines	149,242	8,781	140,461	- -
Eastern white and red pines	3,484,210	2,087,252	1,396,959	- -
Jack pine	537,745	399,575	138,170	- -
Spruce and balsam fir	1,739,245	757,134	982,111	- -
Eastern hemlock	833,971	382,462	451,509	- -
Other eastern softwoods	2,925,758	1,292,679	1,633,079	- -
Total softwoods	9,670,171	4,927,882	4,742,289	- -
Hardwoods				
Select white oaks	774,973	228,610	546,363	- -
Select red oaks	1,576,496	612,485	964,011	- -
Other white oaks	2,389	68	2,321	- -
Other red oaks	672,814	254,255	418,559	- -
Hickory	173,667	27,429	146,237	- -
Yellow birch	671,887	302,102	369,785	- -
Hard maple	4,358,421	1,509,507	2,848,914	- -
Soft maple	3,962,985	1,218,337	2,744,648	- -
Beech	528,325	203,352	324,974	- -
Tupelo and blackgum	13,266	3,374	9,892	- -
Ash	1,273,958	264,143	1,009,814	- -
Cottonwood and aspen	3,231,508	1,227,881	2,003,627	- -
Basswood	814,484	329,134	485,350	- -
Yellow-poplar	69,435	10,296	59,139	- -
Black walnut	32,368	3,408	28,959	- -
Other eastern soft hardwoods	1,848,164	580,006	1,268,158	- -
Other eastern hard hardwoods	37,348	748	36,600	- -
Eastern noncommercial hardwoods	87,561	20,299	67,262	- -
Total hardwoods	20,130,050	6,795,436	13,334,614	- -
All species groups	29,800,221	11,723,319	18,076,903	- -

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

Table 5. -- Net volume of all live trees and salvable dead trees on timberland by class of timber and softwood/hardwood categories, Michigan, 2000 - 2001

(In thousand cubic feet)

Class of timber	All species	Softwood species	Hardwood species
Live trees			
Growing-stock trees			
Sawtimber			
Saw log portion	12,727,025	5,073,758	7,653,267
Upper stem portion	3,649,723	718,135	2,931,587
Total	16,376,748	5,791,893	10,584,854
Poletimber	10,845,744	3,264,862	7,580,883
All growing-stock trees	27,222,492	9,056,755	18,165,737
Cull trees			
Rough trees [1]			
Sawtimber size	1,101,637	186,875	914,762
Poletimber size	600,280	126,894	473,387
Total	1,701,917	313,769	1,388,148
Rotten trees [1]			
Sawtimber size	90,431	18,816	71,616
Poletimber size	18,525	4,240	14,285
Total	108,956	23,055	85,901
All live cull trees	1,810,874	336,824	1,474,049
All live trees	29,033,366	9,393,579	19,639,787
Salvable dead trees			
Sawtimber size	452,424	181,278	271,146
Poletimber size	451,046	145,728	305,318
All salvable dead trees	903,471	327,006	576,464
All classes	29,936,836	9,720,585	20,216,251

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

[1] Includes noncommercial species.

Table 6. -- Net volume of growing stock on timberland by forest group and softwood/hardwood species categories, Michigan, 2000 - 2001

(In thousand cubic feet)

Forest type group	All species	Softwood species	Hardwood species
Softwood type groups			
White / red / jack pine group	3,185,748	2,873,215	312,533
Spruce / fir group	3,602,364	3,105,912	496,452
Exotic softwood group	201,861	184,169	17,692
All softwood types	6,989,973	6,163,295	826,678
Hardwood type groups			
Oak / pine group	7,694	1,491	6,203
Oak / hickory group	3,286,443	259,200	3,027,244
Elm / ash / cottonwood group	2,076,774	274,006	1,802,768
Maple / beech / birch group	11,331,274	1,584,871	9,746,403
Aspen / birch group	3,523,524	770,768	2,752,756
All hardwood types	20,225,709	2,890,336	17,335,374
Nonstocked	6,810	3,124	3,686
All forest types	27,222,492	9,056,755	18,165,737

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

Table 7. -- Net volume of growing stock on timberland by species group and diameter class, Michigan, 2000 - 2001

(In thousand cubic feet)

Species group	All classes	Diameter class (inches at breast height)									
		5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Softwoods											
Other yellow pines	137,496	20,678	31,482	37,458	22,397	9,008	11,799	4,676	--	--	--
Eastern white and red pines	3,397,607	259,045	546,751	610,954	494,739	392,514	297,492	244,833	172,064	320,731	58,483
Jack pine	505,008	110,602	158,779	115,431	78,008	29,248	11,802	1,138	--	--	--
Spruce and balsam fir	1,654,066	498,549	476,406	289,423	180,509	102,824	50,271	27,818	20,885	7,380	--
Eastern hemlock	715,130	18,915	44,731	69,833	89,801	94,608	106,870	89,197	78,832	114,340	8,002
Other eastern softwoods	2,647,448	470,218	628,706	550,491	390,609	256,360	157,618	73,007	53,043	53,947	13,450
Total softwoods	9,056,755	1,378,007	1,886,855	1,673,589	1,256,064	884,562	635,852	440,669	324,824	496,398	79,935
Hardwoods											
Select white oaks	691,637	37,639	68,509	85,782	107,581	89,445	72,595	70,168	55,265	85,122	19,531
Select red oaks	1,480,659	44,749	88,498	167,302	217,822	198,183	248,300	172,994	132,242	175,089	35,481
Other white oaks	2,389	68	--	--	422	--	1,899	--	--	--	--
Other red oaks	619,723	18,719	45,690	68,297	88,212	97,618	80,085	62,629	68,576	74,330	15,565
Hickory	167,910	10,970	14,240	19,405	35,575	16,951	24,165	12,044	17,914	16,647	--
Yellow birch	524,318	41,669	72,468	68,598	78,824	70,388	64,074	38,298	32,040	48,982	8,977
Hard maple	3,985,669	398,522	629,895	751,033	660,498	565,295	376,215	261,106	136,604	186,816	19,684
Soft maple	3,585,681	412,684	621,922	688,138	568,548	427,728	310,906	224,997	137,680	179,411	13,667
Beech	424,103	29,688	42,799	56,416	57,695	52,180	57,355	40,832	26,936	60,203	--
Tupelo and blackgum	12,413	1,553	1,874	3,264	1,584	1,749	986	1,403	--	--	--
Ash	1,205,335	177,704	201,498	204,902	178,263	151,417	122,281	70,225	51,295	38,673	9,077
Cottonwood and aspen	3,033,841	369,105	469,772	544,122	517,520	465,584	305,969	174,861	94,645	86,087	6,176
Basswood	770,898	36,099	85,298	132,838	165,688	142,902	96,891	45,198	33,950	18,247	13,787
Yellow-poplar	66,436	951	2,843	3,158	6,369	13,489	13,912	7,997	4,321	8,928	4,467
Black walnut	31,648	1,954	4,378	3,010	6,594	5,447	1,073	3,056	3,651	2,484	--
Other eastern soft hardwoods	1,529,426	217,778	304,504	309,710	260,507	178,108	100,707	69,850	35,549	36,176	16,537
Other eastern hard hardwoods	33,652	4,948	8,868	7,052	2,355	1,474	4,865	--	1,469	2,622	--
Total hardwoods	18,165,737	1,804,800	2,663,055	3,113,027	2,954,056	2,477,958	1,882,279	1,255,659	832,137	1,019,815	162,950
All species	27,222,492	3,182,807	4,549,910	4,786,617	4,210,120	3,362,520	2,518,131	1,696,328	1,156,961	1,516,214	242,885

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

Table 8. -- Net volume of sawtimber on timberland by species group and diameter class, Michigan, 2000 - 2001

(In thousand board feet) [1]

Species group	All classes	Diameter class (inches at breast height)							
		9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Softwoods									
Other yellow pines	423,028	177,882	110,181	46,287	62,915	25,763	--	--	--
Eastern white and red pines	13,552,939	3,014,800	2,487,033	2,025,422	1,569,845	1,321,366	949,444	1,833,684	351,345
Jack pine	1,155,501	552,270	384,411	149,912	62,649	6,259	--	--	--
Spruce and balsam fir	3,526,149	1,442,660	930,926	552,018	278,436	157,976	120,478	43,654	--
Eastern hemlock	3,415,462	338,633	435,026	472,081	553,478	477,830	434,596	654,754	49,064
Other eastern softwoods	8,004,011	2,752,293	1,983,272	1,334,028	843,606	400,270	297,529	311,750	81,264
Total softwoods	30,077,090	8,278,538	6,330,849	4,579,748	3,370,928	2,389,465	1,802,047	2,843,843	481,672
Hardwoods									
Select white oaks	2,289,390	--	437,709	388,447	330,467	329,542	265,945	426,292	110,987
Select red oaks	5,405,280	--	883,681	864,000	1,130,322	814,978	640,371	881,535	190,393
Other white oaks	10,105	--	1,659	--	8,446	--	--	--	--
Other red oaks	2,256,466	--	359,825	429,795	368,981	298,345	334,298	380,591	84,631
Hickory	522,577	--	131,007	68,055	104,999	53,974	84,452	80,090	--
Yellow birch	1,655,386	--	344,996	329,871	313,208	192,444	164,843	260,032	49,992
Hard maple	10,000,621	--	2,728,891	2,524,636	1,757,736	1,259,285	674,196	950,382	105,494
Soft maple	8,348,321	--	2,314,205	1,885,069	1,432,506	1,067,818	670,793	905,885	72,045
Beech	1,454,926	--	254,683	247,031	283,172	207,900	139,700	322,440	--
Tupelo and blackgum	25,170	--	6,433	7,598	4,576	6,563	--	--	--
Ash	2,805,505	--	739,755	672,704	565,871	334,549	249,250	195,358	48,019
Cottonwood and aspen	7,544,335	--	2,197,779	2,116,474	1,445,954	845,568	468,807	437,021	32,732
Basswood	2,353,686	--	697,392	644,949	454,252	218,109	167,675	93,455	77,854
Yellow-poplar	286,511	--	27,144	61,081	66,077	38,916	21,840	47,098	24,355
Black walnut	105,159	--	28,516	25,323	5,129	14,892	18,443	12,856	--
Other eastern soft hardwoods	3,069,461	--	1,059,412	779,922	459,919	330,274	172,688	178,216	89,028
Other eastern hard hardwoods	59,588	--	9,900	6,615	22,328	--	7,195	13,550	--
Total hardwoods	48,192,487	--	12,222,988	11,051,569	8,753,944	6,013,157	4,080,497	5,184,802	885,531
All species	78,269,577	8,278,538	18,553,837	15,631,318	12,124,872	8,402,621	5,882,545	8,028,644	1,367,203

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

[1] International 1/4-inch rule.

Table 9. -- All live aboveground tree biomass on timberland by owner category, softwood/hardwood species category, and tree biomass component, Michigan, 2000 - 2001

(In dry tons)

Owner category and softwood/hardwood category	All components	Tree biomass component						
		All live 1-5 inch trees	Growing-stock trees			Non-growing-stock trees		
			Total	Boles	Stumps, tops, and limbs	Total	Boles	Stumps, tops, and limbs
Public								
Softwoods	91,356,057	10,643,416	77,713,906	61,183,400	16,530,506	2,998,736	2,265,179	733,557
Hardwoods	185,896,693	18,523,685	153,973,487	111,527,435	42,446,052	13,399,520	9,789,792	3,609,728
Total	277,252,750	29,167,101	231,687,393	172,710,835	58,976,557	16,398,256	12,054,971	4,343,285
Private								
Softwoods	93,896,533	12,269,375	77,619,341	59,285,425	18,333,917	4,007,817	2,974,471	1,033,347
Hardwoods	387,303,983	35,919,007	318,907,699	231,062,482	87,845,217	32,477,278	23,773,645	8,703,633
Total	481,200,517	48,188,381	396,527,040	290,347,906	106,179,134	36,485,095	26,748,116	9,736,979
All ownerships								
Softwoods	185,252,590	22,912,790	155,333,247	120,468,825	34,864,422	7,006,553	5,239,650	1,766,904
Hardwoods	573,200,676	54,442,692	472,881,186	342,589,917	130,291,269	45,876,798	33,563,438	12,313,361
Total	758,453,266	77,355,482	628,214,433	463,058,741	165,155,691	52,883,352	38,803,087	14,080,264

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

Leatherberry, Earl C.; Brand, Gary J.

2003. **Michigan's forest resources in 2001.** Resour. Bull. NC-224. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station. 23 p.

Results of the 2001 annual forest inventory of Michigan show an estimated 19.4 million acres of forest land in the State. The estimate of total all live tree volume on forest land is 29.8 billion cubic feet. Nearly 19 million acres of forest land in Michigan is classified as timberland. The estimate of growing-stock volume on timberland is 27.2 billion cubic feet. All live aboveground tree biomass on timberland is estimated at 758 million dry tons. Michigan faces several major forest health concerns. Recently introduced exotic organisms are a serious health threat to Michigan's native forest ecosystems. Other forest health concerns are gypsy moth infestations, oak wilt, and damage caused by the forest tent caterpillar.

KEY WORDS: Annual inventory, forest land, forest type, growing-stock volume, Michigan

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