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Forest Statistics for Michigan's Northern Lower Peninsula Unit, 1993

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This report includes the most commonly used U.S. Department of Agriculture, Forest Service, Forest Inventory and Analysis (FIA) statistics. Additional forest resource data can be provided to interested users. Persons requesting additional information from the raw inventory data are expected to pay the retrieval costs. These costs range from less than $100 for a relatively simple request to more than $2,000 for a complex retrieval involving the services of a Forest Inventory and Analysis computer programmer. Requests will be filled so as to minimize the impact on the Forest Inventory and Analysis Work Unit.

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FOREWORD

Forest Inventory and Analysis (FIA) is a continuing endeavor as mandated by the Renewable Resources Research Act of 1978. Prior inventories were mandated by the McSweeney-McNary Forest Research Act of 1928. The objective of FIA is to periodically inventory the Nation's forest land to determine its extent, condition, and volume of timber, growth, and removals. Up-to-date resource information is essential to frame forest policies and programs. USDA Forest Service regional experiment stations are responsible for conducting these inventories and publishing summary reports for individual States. The North Central Forest Experiment Station is responsible for forest inventory and analysis in Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, and Wisconsin.

Fieldwork for the fifth forest inventory of Michigan's Northern Lower Peninsula Unit was begun in September of 1992 and completed in August of 1993. Reports of the four previous inventories of Michigan's timber resource are dated 1935, 1955, 1966, and 1980.

More accurate survey information was obtained during this survey than otherwise would have been feasible because of intensified field sampling. Sampling intensity was doubled, providing more reliable data at the county level. Such sampling was made possible through the cooperation, assistance, and additional funding provided by the Michigan Department of Natural Resources (MiDNR), the Michigan State Legislature, and Michigan forest industries. To aid in determining current timber removals, MiDNR also surveyed primary wood-using plants in the State. Aerial photographs used were black and white, infrared taken in 1986 at a scale of 1:15,840 (nominal). These photographs were purchased by the MiDNR and loaned to the USDA Forest Service.

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HIGHLIGHTS

NOTE: *Data from new forest 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 inventory's efficiency and reliability, we have made several changes in procedures and definitions since the last Michigan inventory in 1980. Because some of these changes make it inappropriate to directly compare the 1993 data with those published for 1980, data from the 1980 inventory have been re-processed using the current procedures. Forest inventories completed before 1980 have not been adjusted to reflect current FIA inventory methodology and techniques. Comparisons between inventories should be general and used solely for analyzing trends.*

All area and volume data are as of January 1, 1993. The time period used for growth, mortality, and removals was January 1, 1980, to December 31, 1992. The area of census water in 1980, 367,500 acres, does not include major portions of the Great Lakes. In 1990, the U.S. Bureau of the Census included these areas which increased the area of census water to 8,317,200 acres. ***The data in this report are subject to change when inventory data for the entire State have been compiled. It is expected, however, that any such changes will be minor.***

GENERAL

Michigan's Northern Lower Peninsula Unit (fig. 1) is comprised of 33 counties. This region of the State is rich with resources that support a network of social, economic, and ecological processes that are forest dependent. For instance, there are 29 State Parks that provide quality outdoor recreational experiences for millions of visitors per year. The USDA Forest Service, the National Park Service, and the Michigan Department of Natural Resources provide forested areas where people may pursue more primitive or remote recreation activities. For example, some of the region's rivers provide wilderness-like floating opportunities. Also, nestled in the forest are ski areas and world class golf courses. These, and other forest-based recreation resources, support a robust tourism industry.

The forest products industry has a long history in this region. The 1880's and 1890's were a time of unprecedented exploitation of forest resources. Most of the lumber produced went to construct the cities and towns of the Upper Midwest. The region's white and red pine timber resource was virtually exhausted. Over the years pines were replanted, and much of the rest of the land returned naturally to forest. However, many of the original pine stands were replaced with aspen, birch, and maples. The forest resource of the Unit presently supports an industry that operates on a sustaining basis. In 1990 nearly half of Michigan's saw-log production—297 million board feet[1]—was harvested in the Unit (Hackett and Pilon 1993).

The forests of the Northern Lower Peninsula are vital to the region. The forest contains a variety of both deciduous and coniferous forest species, which results in regionally unique ecosystems that contribute to biodiversity. For example, the Kirtland's warbler, which winters in the Bahamas and is on the federal endangered species list, returns to the region's jack pine forest to nest and raise its young. Also, the eastern elk, which was indigenous to the region in pre-European settlement times but extinct by the 1870's, has been reestablished. Today the Northern Lower Peninsula has the largest herd east of the Mississippi River.

Earl C. Leatherberry is a Resource Analyst with the Forest Inventory and Analysis Unit, North Central Forest Experiment Station, St. Paul, Minnesota.

[1] *International 1/4-inch rule.*

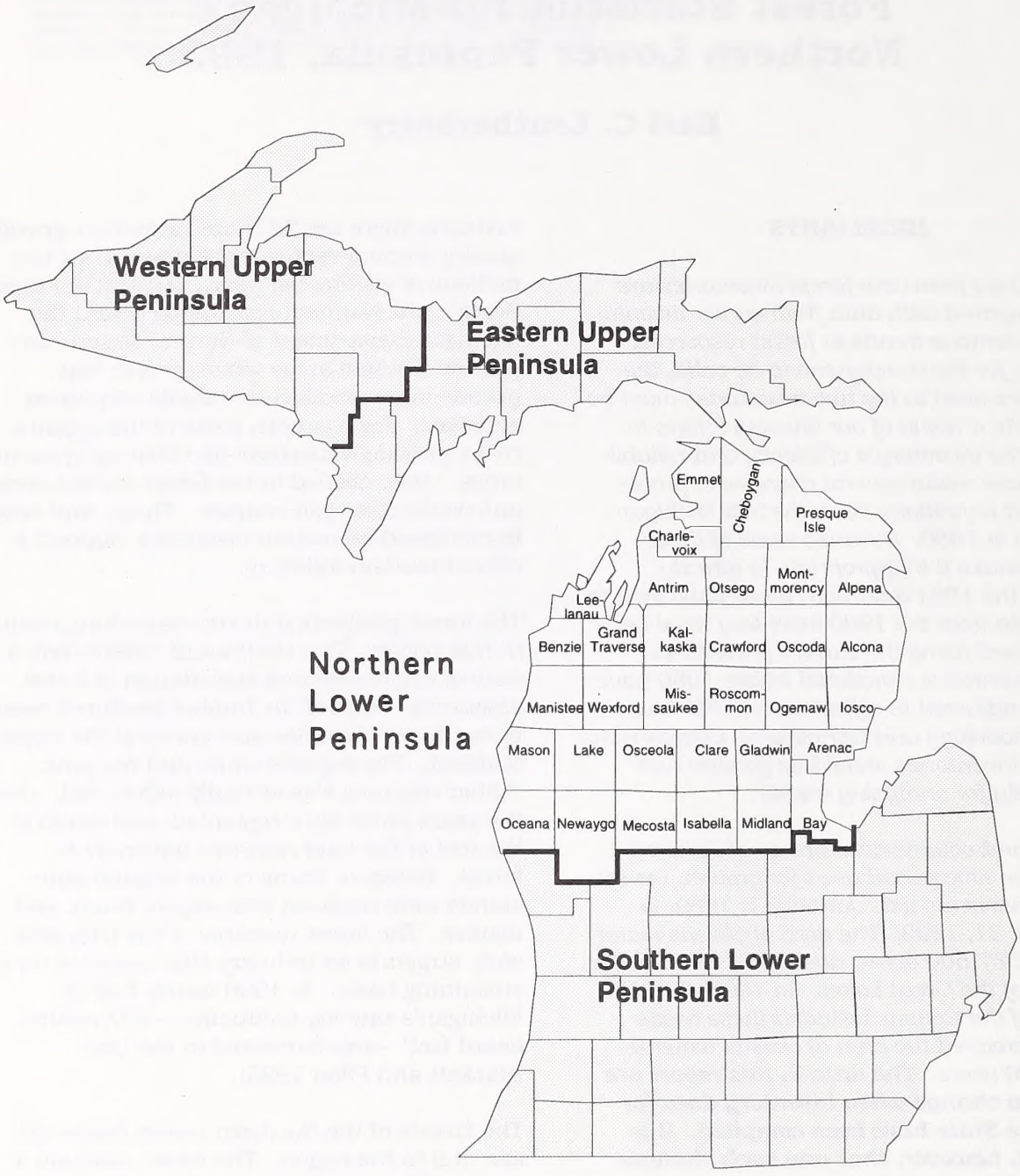

Figure 1.—*Northern Lower Peninsula Survey Unit, 1993.*

This report presents in highlight form some major findings from the 1993 inventory of Michigan's Northern Lower Peninsula Forest Inventory Unit, with comparisons to 1980, the year of the previous inventory.

Area

- In 1993, forest land accounted for 7.4 million acres (65 percent of the Unit's land area). Virtually all forest land (97 percent—7.2 million acres) was classified as timberland. Most of the remaining forest land was classified as reserved timberland.

- Previous inventories of the Northern Lower Peninsula showed modest declines in forest area. However, between the 1980 and 1993 inventories, total area of forest land increased by 452,500 acres or 6 percent. Much of this increase came from land that was previously cropland and pasture in 1980, but supported enough trees to qualify as forest land in 1993.

- Between inventories, timberland area increased by 515,800 acres—nearly 8 percent. This increase occurred largely because previously unproductive forest land and nonforest land were found to be marginally productive in 1993. Also, some forest land classed as reserved timberland in 1980 was reclassified as timberland.

- The 171.2 thousand acres of reserved timberland amounts to 2 percent of the Unit's forest land area. Between inventories reserved timberland area declined by 10,800 acres. This decline was due principally to the reclassification of forest land. In the 1980 inventory, some forest land areas were under review for classification as reserved timberland and were temporarily classified as reserved. Between inventories, it was determined that some of this forest land would not be permanently classified as reserved.

- Cheboygan County contains nearly 340,000 acres of timberland—more timberland than in any other county in the Unit. The timberland area in Cheboygan County declined by nearly 28,000 acres between inventories. The neighboring southern counties of Montmorency and Otsego also declined in timberland area. Montmorency lost 7,500 acres and Otsego lost 21,300 acres of timberland. The decline in timberland area is primarily due to land development pressures spreading south and east from Lake Michigan. Gladwin County was the only other county to decline in timberland area between inventories, losing 6,500 acres.

- Farmers and other private individuals owned 3.7 million acres of timberland—slightly more than half of the timberland in the Unit. Miscellaneous private corporations owned more than a half million acres of timberland, or 8 percent of the Unit's total.

- Forty-one percent of the Unit's timberland area is publicly owned; the largest portion is owned by the State—27 percent of all timberland. Twelve percent of the Unit's timberland area is within the Huron-Manistee National Forest. About 1 percent of timberland is owned by other public agencies, primarily county and municipal governments (fig. 2).

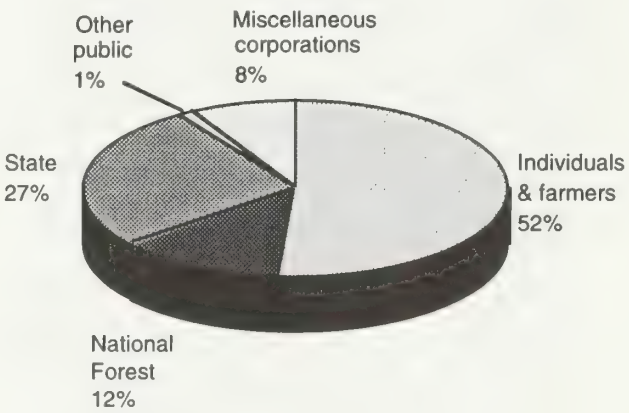

Figure 2.—*Area of timberland by ownership class, Northern Lower Peninsula, 1993.*

- The timberland area of the Unit is largely comprised of hardwood forest types. The maple-birch forest type continues to dominate timberland area, occupying 2.1 million acres (29 percent) of the timberland area, compared to 1.7 million acres (26

percent) in 1980 (fig. 3). The aspen type occupied 20 percent of the Unit's timberland area in 1993, the oak-hickory type amounted to 16 percent, and the elm-ash-soft maple type accounted for another 8 percent.

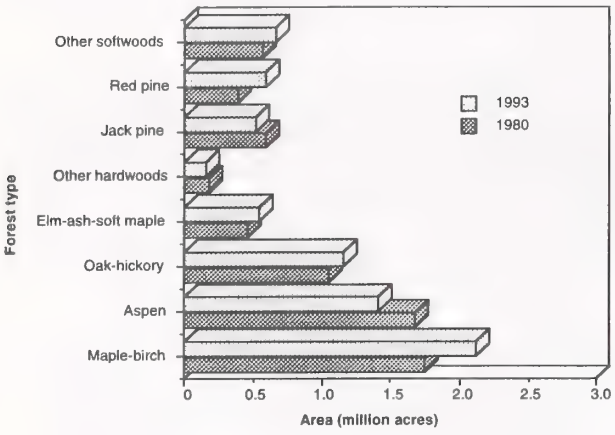

Figure 3.—*Area of timberland by major forest type's, Northern Lower Peninsula, 1980 and 1993.*

- Red pine is the dominate softwood forest type, occupying 8 percent of the Unit's timberland area. The jack pine and northern white-cedar forest types occupy 7 and 6 percent of the Unit's timberland area, respectively.

- In contrast to the expanding timberland area between inventories, some hardwood types declined in area by more than 10 percent—aspen (16 percent), paper birch (15 percent), and balsam poplar (11 percent). Among softwoods, the jack pine and black spruce forest types declined.

- Of the forest types that declined between inventories, the aspen type had the largest loss—267,500 acres. Much of the loss in the aspen type is undoubtly the result of plant succession, as mature and overmature aspen stands die and are replaced by shade tolerant understory species.

- In 1993, 42 percent (3 million acres) of the timberland was covered with sawtimber-size stands, representing a substantial increase from 1980 when only 24-percent (1.6 million acres) was in the sawtimber stand-size class. Between inventories, area in poletimber stands declined by 21 percent (665,800 acres). The increase in sawtimber-size stands and the corresponding decline in poletimber-size stands show the continuing maturation of forest stands in the Unit. The area in sapling-seedling stands declined by 15 percent (298,600 acres) between inventories as more area was growing larger trees (fig. 4).

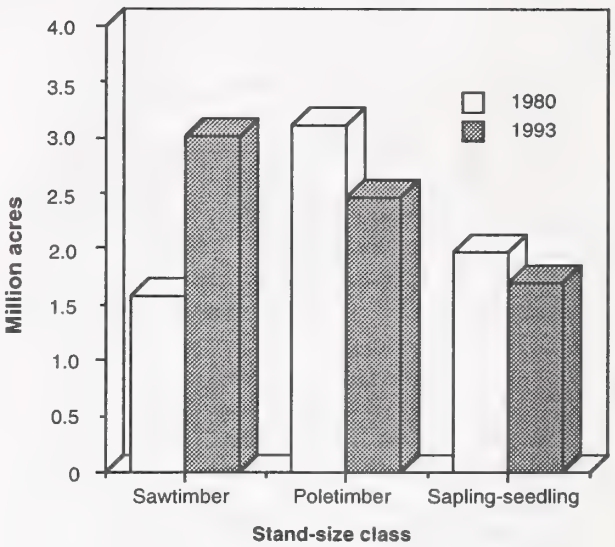

Figure 4.—*Area of timberland by stand-size class, Northern Lower Peninsula, 1980 and 1993.*

Volume

- Growing-stock volume on timberland increased 45 percent between inventories, from nearly 7 billion cubic feet in 1980 to more than 10 billion cubic feet in 1993. Average growing-stock volume per acre in 1993 was 1,406 cubic feet, compared to 1,041 cubic feet in 1980.

- Between inventories, sawtimber volume increased by 80 percent—from 14.1 billion board feet in 1980 to 25.3 billion board feet in 1993. The select red oak species group represented the largest volume of sawtimber, with 3.3 billion board feet in 1993. The red pine, hard maple, soft maple, and bigtooth aspen groups each contained more than 2 billion board feet of sawtimber volume in 1993.

- Softwood growing-stock volume totaled 2.8 billion cubic feet in 1993, compared to 1.8 billion cubic feet in 1980. Sixty percent (1.7 billion cubic feet) of this volume is in two species—red pine and northern white-cedar (fig. 5). Between inventories, the growing-stock volume of red pine and white pine increased by 131 percent and 76 percent, respectively. Also, the growing-stock volume of northern white-cedar increased by 30 percent. Jack pine growing-stock volume declined by 11 percent.

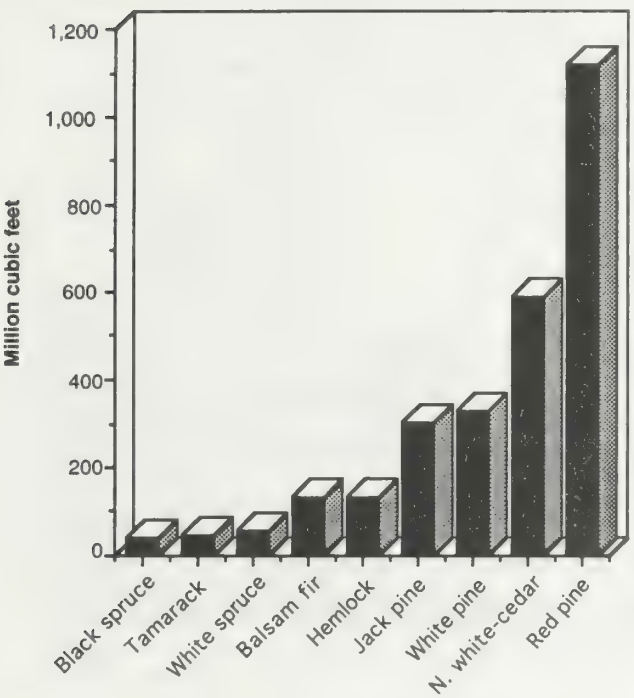

Figure 5.—*Growing-stock volume of softwoods by major species groups, Northern Lower Peninsula, 1993.*

- Hardwood growing-stock volume totaled 7.3 billion cubic feet in 1993, compared to 5.2 billion cubic feet in 1980. Fifty-three percent of hardwood growing stock is in maples (2.3 billion cubic feet) and oaks (1.6 billion cubic feet) (fig. 6).

- Between inventories, hardwood growing-stock volume increased by 41 percent. Volume of soft and hard maples increased by about 61 percent, and volume of select red oaks increased by 43 percent. Growing-stock volume of aspens increased by 27 percent between inventories.

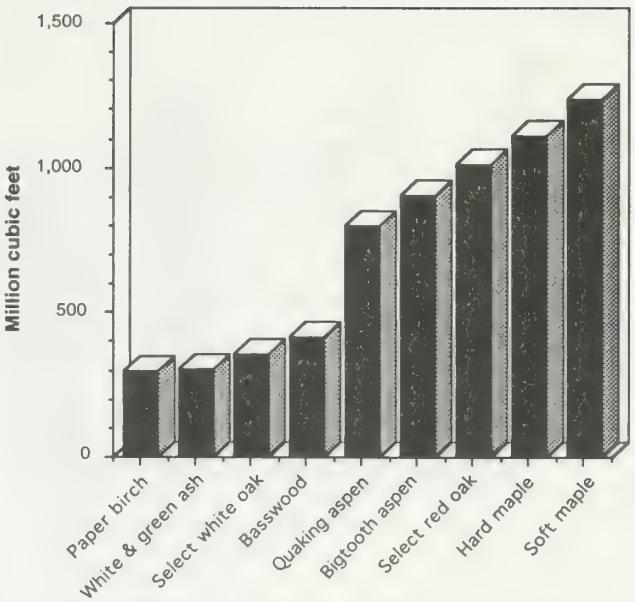

Figure 6.—*Growing-stock volume for hardwoods by major species groups, Northern Lower Peninsula, 1993.*

- About 5 percent (479 million cubic feet) of the Unit's growing-stock volume is in trees more than 21 inches in diameter. Select red oaks account for 24 percent of the growing-stock volume in trees of this size. Select red oaks, white pine, and soft maple combined, account for 51 percent of the volume in trees more than 21 inches in diameter. The larger and generally older trees have an aesthetic appeal not associated with smaller trees. Red oak, with its symmetrical shape and brilliant fall foliage, is especially attractive. Also, the larger trees and older stands of oak provide acorns, which are important food for a variety of wildlife.

- Growing-stock volume of all four major species groups—pines, other softwoods, soft hardwoods, and hard hardwoods—increased from 1980 to 1993 (fig. 7).

- More than half (55 percent) of the growing-stock volume in the Unit is on timberland owned by farmers and other private owners. Public ownership accounted for 37 percent of all growing-stock volume, and forest industry and other private corporations accounted for the remaining 8 percent of volume.

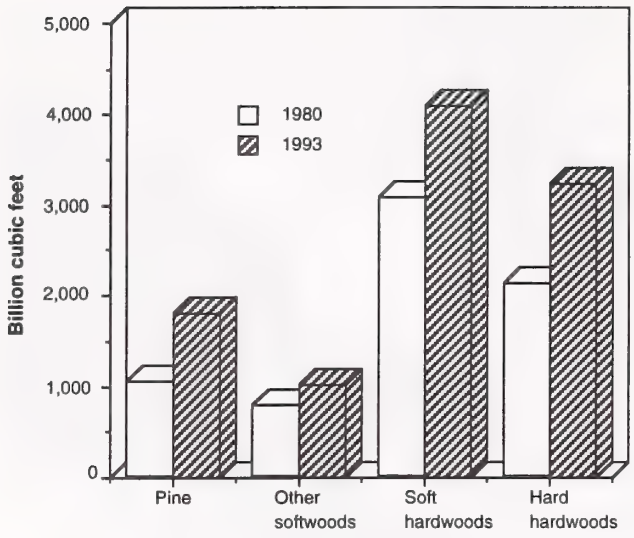

Figure 7.—*Net volume of growing stock by four major species groups, Northern Lower Peninsula, 1980 and 1993.*

- The State of Michigan, principally through the Department of Natural Resources, administers 24 percent of the Unit's growing-stock volume and 30 percent of the Unit's pine volume.

- In addition to the 10.1 billion cubic feet of growing stock in the Unit, there are 784.7 million cubic feet of wood that is unusable for some industrial products because of rot, poor form, or other defects. These standing cull trees, while not suitable for some timber products, do have some commercial or economic value. For example, they can be used for pallet lumber and fuelwood. Also, they can provide valuable cavities for dens and nests as well as other wildlife habitat.

TIMBER GROWTH, REMOVALS, AND MORTALITY

Growth

- In the Northern Lower Peninsula, average net annual growth was 315.1 million cubic feet between 1980 and 1992.

- Growing-stock average net annual growth between 1980 and 1992 was 3.1 percent of inventory.

- Softwoods accounted for 103.3 million cubic feet (33 percent) of the average net annual growth of growing stock between 1980 and 1992. Hardwoods accounted for 211.8 million cubic feet (67 percent). Red pine, with 55.4 million cubic feet, led all species in average net annual growth during the period. Select red oaks, hard maple, soft maple, bigtooth aspen, and quaking aspen all averaged more than 23 million cubic feet of growing-stock net growth each year.

- The soft hardwoods (see Appendix, Definition of Terms) experienced an average of 119 million cubic feet of growing-stock growth per year from 1980 through 1992, leading all major species groups (fig. 8).

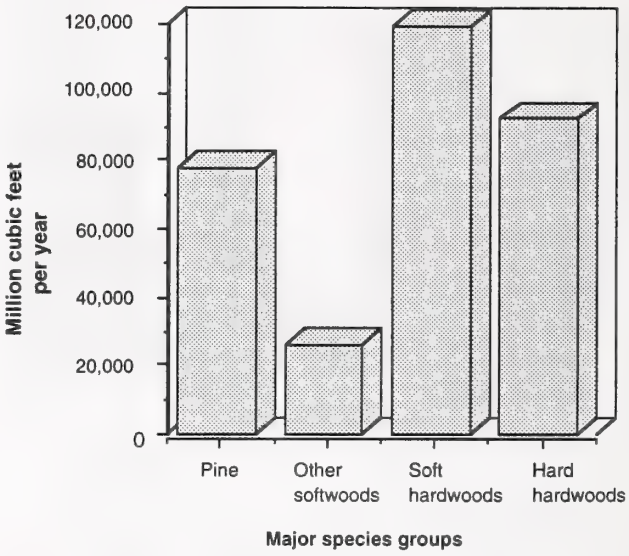

Figure 8.—*Average net annual growth of growing stock by major species groups, Northern Lower Peninsula, 1980-1992.*

- Sawtimber averaged 1.1 billion board feet of net annual growth during the period 1980 to 1992. Red pine led all species in average net annual sawtimber growth, with 151.2 million board feet from 1980 through 1992, followed by select red oaks (129.9 million board feet), soft maple (121.0 million board feet), and bigtooth aspen (115.9 million board feet).

Removals

- Annual growing-stock removals averaged 102.1 million cubic feet from 1980 through

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Below is the correct Figure 10 for page 7 of Resource Bulletin NC-157 "Forest Statistics for Michigan's Northern Lower Peninsula Unit, 1993" by Earl C. Leatherberry.

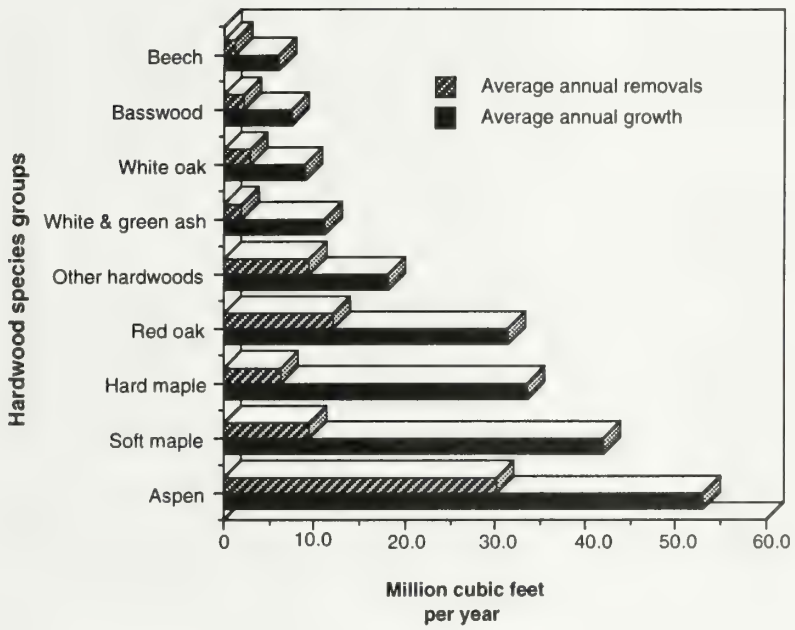

Figure 10.—*Comparison of hardwood growing-stock growth with removals by species group, Northern Lower Peninsula, 1980-1992.*

1992. Over the period, annual growing-stock removals averaged 1 percent of total volume, and about a third of the annual net growth volume.

- Average net annual removals of softwood growing stock were 26.5 million cubic feet and represented 26 percent of average annual softwood growth from 1980 through 1992 (fig. 9). About two-thirds of the removals was from red pine and jack pine. And, average annual removals of jack pine exceeded average annual growth by nearly 60 percent.

- Average net annual removals of hardwood growing stock were 75.6 million cubic feet per year, and represented 36 percent of average annual hardwood growth (211,841 million cubic feet per year) from 1980 through 1992 (fig. 10). Aspen accounted for 40 percent of the hardwood removals, followed by red oak with 16 percent.

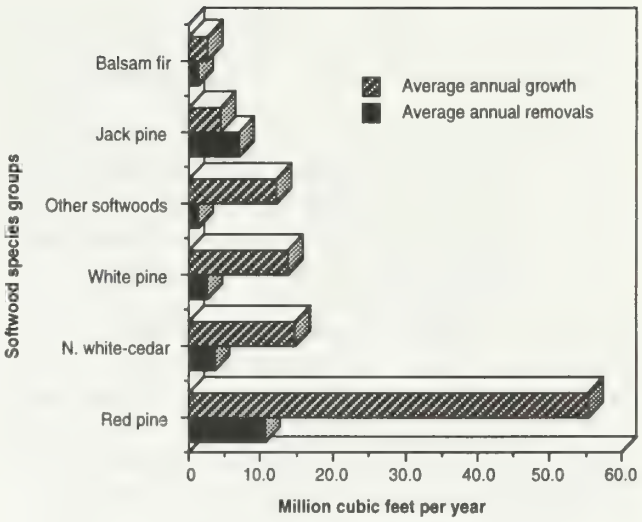

Figure 9.—*Comparison of softwood growing stock growth with removals by species group, Northern Lower Peninsula, 1980-1992.*

Mortality

- Mortality of growing stock averaged 69.6 million cubic feet per year from 1980 through 1992. Average annual mortality of sawtimber was 143 million board feet during the period.

- Aspen and jack pine accounted for half of the average growing-stock mortality volume between inventories. As noted earlier, in 1993, 15 percent of the aspen stands were more than 71 years old and were highly susceptible to mortality from disease and other damaging agents.

- Butternut, a minor species in the Unit and growing at the edge of its native range, had average annual gowing-stock mortality that was 7 percent of total growing-stock inventory. Butternut is being killed by an unknown fungus that causes multiple branch and stem cankers that eventually girdle infected trees (Ostry *et al.* 1994).

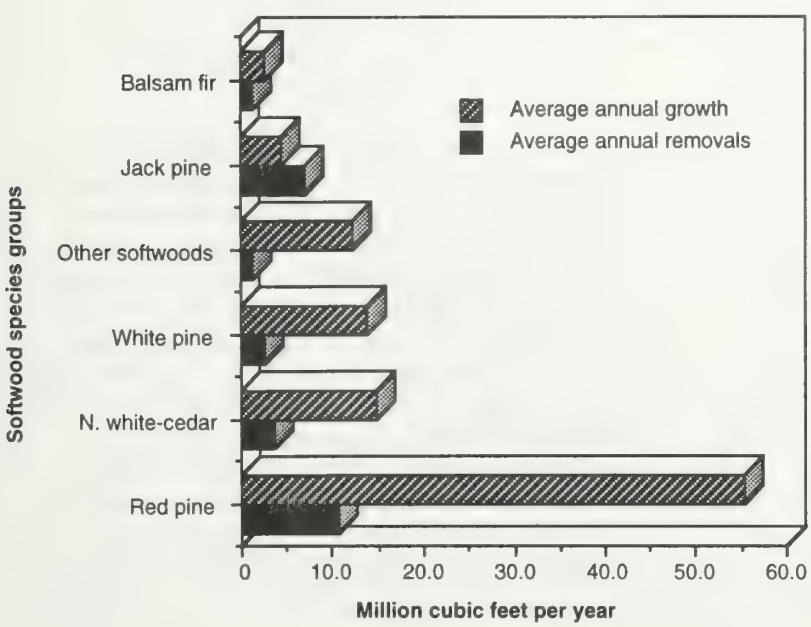

Figure 10.—*Comparison of hardwood growing-stock growth with removals by species group, Northern Lower Peninsula, 1980-1992.*

APPENDIX

ACCURACY OF THE SURVEY

Forest Inventory and Analysis (FIA) information is based on a sampling procedure designed to provide reliable statistics at the State and Survey Unit levels. Consequently, the reported figures are estimates only. A measure of reliability of these figures is given by sampling errors. The level of sampling error utilized by FIA means the chances are two out of three that if a 100-percent inventory had been taken, using the same methods, the results would have been within the limits indicated.

For example, the estimated growing-stock volume in the Northern Lower Peninsula Unit in Michigan in 1993, 10,147.7 million cubic feet, has a sampling error of ± 1.15 percent (± 116.7 million cubic feet). Based on this sampling error, growing-stock volume from a 100-percent inventory would be expected to fall between 10,031.0 and 10,264.4 million cubic feet (10,147 ± 116.7), there being a one in three chance that this is not the case. The following tabulation shows the sampling errors for Michigan's Northern Lower Peninsula Forest Inventory:

Item	Unit totals	Sampling error
Growing stock	(Million cubic feet)	(Percent)
Volume (1993)	10,147.7	1.15
Average annual growth (1980-1992)	315.1	1.45
Average annual removals (1980-1992)	102.1	6.94
Sawtimber	(Million board feet)	
Volume (1993)	25,342.5	1.54
Average annual growth (1980-1992)	1,066.0	1.71
Average annual removals (1980-1992)	241.5	8.20
Timberland area (1993)	(Thousand acres) 7,217.5	.46

As survey data are broken down into sections smaller than Survey Unit totals, the sampling error increases. For example, the sampling error for timberland area in a particular county is higher than that for total timberland area in the Unit. This tabulation shows the sampling errors for Unit totals. To estimate sampling error for data smaller than Unit totals, use the following formula:

$$E = \frac{(SE)\ \sqrt{\text{(Unit total area or volume)}}}{\sqrt{\text{(Volume or area smaller than Unit total)}}}$$

where:

E = sampling error in percent
SE= Unit total error for area or volume

For example, to compute the error on the area of timberland in the maple-birch type for the Unit, proceed as follows:

1. Total area of timberland in the maple-birch forest type in the Unit from table 3 = 2,126,200 acres;
2. Total area of all timberland in the Unit from table 3 = 7,217,500 acres;
3. Unit total error for timberland area from the above tabulation = 0.46 percent. Using the above formula:

$$E = \frac{(0.46)\ \sqrt{(7{,}217{,}500)}}{\sqrt{(2{,}126{,}200)}} = \pm\ 0.85 \text{ percent.}$$

County Data

A standard FIA inventory is designed to provide sampling errors of no more than 3 percent per million acres of timberland. Thus, this Unit's 7,217.5 million acres of timberland would require a sampling error of 1.12 percent to meet national FIA standards. The State of Michigan funded the collection of additional field data to substantially reduce this sampling error. The goal was to provide a sampling error of less than 10 percent for total timberland area by county. The sampling error within a county depends on county size and total area of timberland. To provide for a sampling error of less than 10 percent for total

timberland area by county, a minimum acreage level of about 35,000 acres was required. The 33 counties in the Northern Lower Peninsula are heavily forested which, in combination with the intensified sample size provided by the Michigan Department of Natural Resources (MiDNR), resulted in sampling errors for each county of below 5 percent.

COMPARING THE FIFTH INVENTORY OF THE NORTHERN LOWER PENINSULA WITH THE FOURTH INVENTORY

A new volume estimation procedure was developed for the Lake States. We used this procedure to compute the 1993 volumes and to re-compute the 1980 volume for growth calculations. Although the adjustment will differ by species, the re-computed 1980 volumes will generally be greater than those shown in the original 1980 report.

Past surveys used only growing-stock trees to determine stand-size class. Current survey procedures require that stand-size class be determined on the basis of all live trees. Therefore, direct comparisons of current inventory data to old inventory data by stand-size class may be misleading.

The basic building block for estimating forest area and timber volume has been changed from the Survey Unit (as utilized during the 1980 inventory) to the county (current methodology). In the past, statistics were developed at the Unit level and prorated back to the county on the basis of photo-interpretation results. Direct development of county-level data helps users interested in more precise local data, but can make the outcome of comparisons with past estimates uncertain.

SURVEY PROCEDURES

The 1993 survey of Michigan's Northern Lower Peninsula used a growth model enhanced, two-phase sample design. Using this sampling scheme and associated estimators is similar to sampling with partial replacement, in that a set of randomly located plots is available for remeasurement and a random set of new plots is established and measured. A significant feature of the new design is stratification for disturbance on the old sample and use of a growth model to improve regression estimates made on old undisturbed forest plots (fig. 11). Detailed descriptions of the sampling and estimation procedures are presented by Hansen (1990). The growth model used in the survey design for Michigan's Northern Lower Peninsula was the Lake States Stand and Tree Evaluation and Modeling System (STEMS) (Belcher *et al.* 1982).

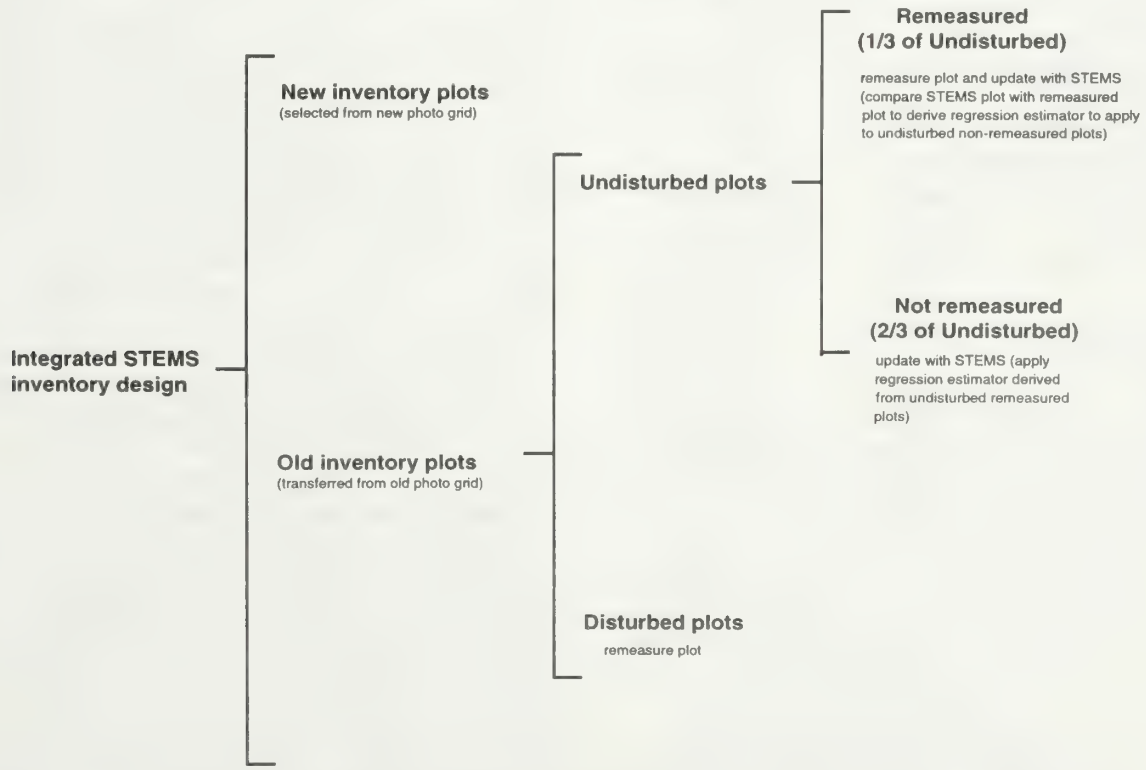

Figure 11.—*Overview of the sample design for the Northern Lower Peninsula's 1993 survey.*

Major Steps in the New Survey Design

1. Aerial photography (Phase 1)

In this phase, two sets of random points were located on current aerial photographs. The first set was new photo plots while the second set was relocated old ground plot locations from the 1980 inventory. Locations of the plots used in the 1980 inventory were transferred to the new photographs. The photographs were then assembled into township mosaics, and a systematic grid of 121 one-acre photo plots (each plot representing approximately 190.4 acres) was overlaid on each township mosaic. Each photo plot was examined by aerial photogrammetrists and classified stereoscopically as to its land use. If trees were present, forest type and stand-size/density classes were recorded. All of the 1980 ground plot locations were also examined for disturbance (logging, fire, catastrophic mortality, etc.). After this examination, all the old "disturbed" sample locations and one-third of the old "undisturbed" forested plots were sent to the field for survey crews to verify the photo classification and to take further measurements. All photo plot locations for the 1993 inventory were examined and classified as shown in the following tabulation:

Photo land class	Photo plots
Timberland	39,312
Reserved forest land	650
Other forest land	—
Questionable	1,024
Nonforest with trees	1,850
Nonforest without trees	17,471
Water	1,851
All classes	62,158

2. Plot measurements (Phase 2)

On plots classified as timberland, wooded pasture, or windbreak (at least 120 feet wide), a ground plot was established, remeasured, or modeled. Old plots sent to the field for remeasurement that could not be relocated were replaced with a new plot at the approximate location of the old one. Each ground plot consisted of a 10-point cluster covering 1 acre. At each point, trees 5.0 inches or more in diameter at breast height (d.b.h.) were sampled on a 37.5 basal area factor variable-radius plot, and trees less than 5.0 inches d.b.h. were sampled on a 1/300-acre fixed-radius plot. The measurement procedure for both the new and old sample locations was as follows:

a. New inventory plots

A random sample of the new photo plots was selected for field measurement. Ground plots were established, and measures of current classification such as land use, forest type, and ownership, as well as size and condition of all trees on the plot, were recorded. These locations were monumented for future remeasurement.

b. Old inventory plots

These plots were originally established, monumented, and measured as part of the 1980 field inventory. Procedures for these old plots were different from those for the new plots. Old plots were classed as "undisturbed" or "disturbed" in the aerial photo phase of the sampling process. All disturbed plots, and a one-third sample of the undisturbed forested plots, were remeasured to obtain estimates of current condition and changes since the last inventory. All trees measured on these plots in 1980 were remeasured or otherwise accounted for, and all new trees were identified and measured.

All sample plots that were forested at the time of the 1980 inventory and determined to be undisturbed until the 1993 inventory were projected to the current time (1993) using STEMS. This procedure gives projected estimates of current volume and growth for undisturbed plots. Comparison of the projected and observed values on the one-third sample of the undisturbed forest plots that were remeasured provided local calibration data to adjust the projected values of the undisturbed plots that were not remeasured. The adjustment procedure is a modified version of the method described by Smith (1983).

Undisturbed forested plots that were not remeasured played a crucial role in the new survey design. These plots, after careful examination comparing past and current aerial photography, were determined to be undisturbed and had conditions that could be simulated by STEMS. The STEMS growth model was used to "grow" the old plot and tree data to produce an estimate of current data.

Thus, these plots were treated as ground plots, even though they were never visited. The plot record for each modeled plot was sent to the field for verification of current ownership information.

All old plots classified as disturbed were sent to the field for remeasurement to assess and verify changes since the last inventory. Disturbance referred to any change on a plot that was detected on aerial photos and that the STEMS growth processor could not predict, such as catastrophic mortality, cutting, seedling stands, and/or land use change.

The estimation procedure for computing statistics from this sampling design was more complicated than the simple two-phase estimation procedure used in the past. In fact, this procedure yielded two independent samples, one coming from the new photo points and the other from the old photo points that were remeasured or modeled. The following tabulation summarizes the distribution of all ground plots for the new inventory design by type of plot:

Ground land use class	Old plots remeasured	Old plots updated	New plots	Total plots
Timberland	1,604	1,285	679	3,568
Reserved forest land	36	6	110	152
Other forest land	9	1	3	13
Nonforest with trees	155	50	53	258
Nonforest without trees	332	1,183	318	1,833
Water	34	125	56	215
Total	2,170	2,650	1,219	6,039

3. Area estimates

Area estimates were made using two-phase estimation methods. In this type of estimation, a preliminary estimate of area by land use is made from the aerial photographs (Phase 1) and corrected by the plot measurements (Phase 2). A complete description of this estimation method is presented by Loetsch and Haller (1964). All area estimates were based on what existed as of January 1, 1993, in the Northern Lower Peninsula of Michigan.

4. Volume estimates

Estimates of volume per acre were made from the trees measured or modeled on the 10-point plots. Estimates of volume per acre were multiplied by the area estimates to obtain estimates of total volume. Volume estimates were based on what existed as of January 1, 1993, in the Northern Lower Peninsula of Michigan. Net cubic foot volumes were based on a modification of the method presented by Hahn (1984) for use in the Lake States. For the Northern Lower Peninsula inventory, the merchantable height equation presented was used in conjunction with Hahn's Board Foot Volume Equation (adapted from Stone's equation, Hahn 1984) to estimate gross volume. This estimate was then corrected by species for variation in bark and cull volume to yield an estimate of net volume (Hahn 1984).

The Forest Service reports all board foot volume in International 1/4-inch rule. In Michigan, the Scribner log rule is commonly used. Scribner log rule conversion factors were derived from full tree measurements taken throughout the Lake States (Michigan, Wisconsin, and Minnesota) and an equation developed by Wiant and Castenaeda (1977). Factors, or multipliers, that can be used to convert board foot International volumes to the Scribner rule are shown in the following tabulation:

D.b.h. (inches)	Scribner rule conversion factor	
	Softwoods	Hardwoods
9.0-10.9	0.7830	—
11.0-12.9	.8287	0.8317
13.0-14.9	.8577	.8611
15.0-16.9	.8784	.8827
17.0-18.9	.8945	.8999
19.0-20.9	.9079	.9132
21.0-22.9	.9168	.9239
23.0-24.9	.9240	.9325
25.0-26.9	.9299	.9396
27.0-28.9	.9321	.9454
29.0+	.9357	.9544

5. Growth and mortality estimates

On remeasured plots, estimates of growth and mortality per acre come from the remeasured diameters of trees and from observation of trees that died between inventories. Growth reported as the average net annual growth between the two inventories (1980 and 1992) was computed from data on remeasurement plots and modeled plots using methods presented by VanDeusen *et al.* (1986). Mortality was also reported as average annual for the remeasurement period. On new plots, where trees were not remeasured, estimates of growth and mortality were obtained by using STEMS to project the growth and mortality of trees for 1 year. Growth and mortality estimates for old undisturbed plots that were updated were derived in the same manner as remeasured plots. The STEMS growth model was adjusted to meet local conditions, using data from the undisturbed remeasurement plots. As with volume, total growth and mortality estimates were obtained by multiplying the per acre estimates by area estimates. Current annual growth for 1992 was computed by using the adjusted STEMS model to grow all current inventory plots for 1 year. All growth and mortality estimates were based on growth and mortality through December 31, 1992, in the Northern Lower Peninsula of Michigan.

6. Average annual removals estimates

Average annual growing-stock and sawtimber removals (1980 to 1992) were estimated only from the remeasured plots; new plots were not used to estimate removals. These estimates are obtained from trees measured in the last survey and cut or otherwise removed from the timberland base. All removal estimates were based on removals through December 31, 1992, in the Northern Lower Peninsula of Michigan. Because remeasurement plots make up about one-half of the total ground plots, average annual removals estimates have greater sampling errors than volume and growth estimates.

Tree and Log Grades

On approximately one-third of the sample plots in Michigan's Northern Lower Peninsula, all sawtimber sample trees were graded for quality and assigned either a tree grade (hardwoods) or a log grade (softwoods). Tree and log grades were based on the evaluation of external characteristics as indicators of quality. The volume yield by grade for this sample was used to distribute the volume of the ungraded sample trees by species group. Hardwood sawtimber trees were graded according to "Hardwood tree grades for factory lumber" (Hanks 1976). The best 12-foot section of the lowest 16-foot hardwood log was used for grading. Hardwood sawtimber trees that did not meet minimum tree grade specifications for grades 1 through 3 were assigned grade 4 according to Forest Service standard specifications for hardwood construction logs described in "A guide to hardwood log grading" (Rast *et al.* 1973). Red pine and jack pine sawtimber trees were graded based on specifications described in "Forest Service log grades for southern pines" (Campbell 1964). White pine and other softwood sawtimber trees were graded according to specifications described in the circular "Log grades" (Ostrander and Brisbin 1971). For all softwoods, the first merchantable 16-foot log, or shorter lengths down to 12 feet, was used for grading.

Hardwood Tree Grades for Factory Lumber [a]

Grade factor	Tree grade 1	Tree grade 2	Tree grade 3
Length of grading zone (feet)	Butt 16	Butt 16	Butt 16
Length of grading section [b] (feet)	Best 12	Best 12	Best 12
D.b.h., minimum (inches)	16[c]	13	11
Diameter, minimum inside bark at top of grading section (inches)	13[c] 16 20	11[d] 12	8
Clear cuttings (on the three best faces):[e]			
Length, minimum (feet)	7 5 3	3 3	2
Number on face (maximum)	2	2 3	f
Yield in face length (minimum)	5/6	4/6	3/6
Cull deduction (including crook and sweep, but excluding shake) maximum within grading section (percent)	9	9[g]	50

[a](Hanks 1976)

[b] Whenever a 14- or 16-foot section of the butt 16-foot log is better than the best 12-foot section, the grade of the longer section will become the grade of the tree. This longer section, when used, is the basis for determining the grading factors.

[c] In basswood and ash, diameter inside bark (d.i.b.) at top of grading section must be 12 inches and dbh must be 15 inches.

[d]Grade 2 trees can be 10 inches d.i.b. at top of grading section if otherwise meeting surface requirements for small grade 1's.

[e]A clear cutting is a portion of a face free of defects, extending the width of the face. A face is one-fourth of the surface of the grading section as divided lengthwise.

[f]Unlimited.

[g] Fifteen percent crook and sweep or 40 percent total cull deduction are permitted in grade 2, if size and surface of grading section qualify as grade 1. If rot shortens the required clear cuttings to the extent of dropping the butt log to grade 2, do not drop the tree's grade to 3 unless the cull deduction for rot is greater than 40 percent.

Forest Service Standard Specifications for Hardwood Construction Logs (tie and timber logs) [a, b]

Position in tree	Butts and uppers
Min. diameter, small end	8 inches +
Min. length without trim	8 feet +
Clear cuttings	No requirements
Sweep allowance	One-fourth small end d.i.b. for each 8 feet of length. One-half d.i.b. for logs 16 feet long.
Sound surface defects:	
Single knots	Any number, if no knot has an average diameter above the callus in excess of one-third of the log diameter at point of occurrence.
Whorled knots	Any number, if the sum of knot diameters above the callus does not exceed one-third of the log diameter at point of occurrence.
Holes	Any number not exceeding knot specifications as long as they do not extend over 3 inches into contained tie or timber.
Unsound defects :	
Surface	Same requirements as for sound defects if they extend into included timber. No limit if they do not.
Interior	None permitted except one shake not more than one-third the width of contained tie or timber, and one split, not over 5 inches.

[a] These specifications are minimum for the class. If, from a group of logs, factory logs are selected first, thus leaving only nonfactory logs from which to select construction logs, then the quality range of the construction logs so selected is limited, and the class may be considered a grade. If selection for construction logs is given first priority, it may be necessary to subdivide the class into grades.

[b] Rast *et al.* (1973).

Log Grades for Jack Pine and Red Pine[a]

Grade 1: Logs with three or four clear faces on the 16-foot grading section.[b]
Grade 2: Logs with one or two clear faces on the 16-foot grading section.
Grade 3: Logs with no clear faces on the 16-foot grading section.

After the tentative grade is established from above, the log will be reduced one grade for each of the following defects, except that no log can be reduced below grade 3. Net scale after deduction for defect must be at least 50 percent of the gross contents of the log.

1. **Sweep**. Degrade any tentative grade 1 or 2 log one grade if sweep amounts to 3 or more inches and equals or exceeds one-third of the diameter inside bark at the small end.
2. **Heart rot**. Degrade any tentative grade 1 or 2 log one grade if conk, punk knots, massed hyphae, or other evidence of advanced heart rot is found anywhere on the log.

[a] Campbell (1964).

[b] A face is one-fourth of the circumference in width extending full length of the log. Clear faces are those free of: knots measuring more than 1/2-inch in diameter, overgrown knots of any size, and holes more than 1/4-inch in diameter. Faces may be rotated to obtain the maximum number of clear ones.

Eastern White Pine Sawlog Grade Specifications [a]

Grading Factor	Log Grade 1	Log Grade 2	Log Grade 3	Log Grade 4
1. Minimum Scaling Diameter (inches)	14 [b]	6	6	6
2. Minimum Log Length (feet)	10 [c]	8	8	8
3. Maximum Weevil Injury (number)	None	None	2 Injuries [d]	No Limit
4. Minimum Face Requirements	Two full length or four 50% [e] good faces (in length addition, log knots on balance of faces shall not exceed size limits of grade 2 logs.	NO GOOD FACES REQUIRED Maximum diameter of log knots on three best faces: SOUND RED KNOTS not to exceed 1/6 scaling diameter and 3 inch maximum. DEAD OR BLACK KNOTS including overgrown knots not to exceed 1/12 scaling diameter and 1 1/2 inch maximum.	SOUND RED Knots not to exceed 1/3 scaling diameter and 5 inch maximum. DEAD OR BLACK KNOTS including overgrown knots not to exceed 1/6 scaling diameter and 2 1/2 inch maximum.	Includes all logs not qualifying for No.3 or better and have at least 1/3 of their gross volume in sound wood suitable for manufacture into standard lumber.
5. Maximum sweep or crook allowance (%)	20	30	40	66 2/3
6. Maximum total scaling deduction (%)	50	50	50	66 2/3

AFTER THE TENTATIVE LOG GRADE IS ESTABLISHED FROM FACE EXAMINATION, THE LOG WILL BE REDUCED IN GRADE WHENEVER THE FOLLOWING DEFECTS ARE EVIDENT.

7. Conks, punk knots, and pine borer damage on bark surface [f].
   Degrade one grade if present on one face.
   Degrade two grades if present on two faces.
   Degrade three grades if present on three or more faces.

8. Log end defects: red rot, ring shake, heavy stain and pine borer damage outside the heart center of log[f].
   Consider log as having a total of 8 quarters (4 on each end) and degrade as indicated.
   Degrade one grade if present in 2 quarters of log ends.
   Degrade two grades if present in 3 or 4 quarters of log ends.
   Degrade three grades if present in 5 or more quarters of log ends.

a. (Ostrander and Brisbin 1971)

b 12 and 13 inch logs with four full length good faces are acceptable.

c 8 foot logs with four full length good faces are acceptable.

d 8 foot Number 3 logs limited to one weevil injury.

e Minimum 50% length good face must be at least 6 feet.

f Factors 7 and 8 are not cumulative (total degrade based on more serious of the two). No log to be degraded below grade 4 if net scale is at least one third of gross scale.

Log Grades for All Other Softwood Logs

Grade 1

1. Logs must be 16 inches d.i.b. or larger, 10 feet in length or longer, and with deduction for defect, not over 30 percent of gross scale.
2. Logs must be at least 75 percent clear on each of three faces.
3. All knots outside clear cuttings must be sound and not more than 2-1/2 inches in size.

Grade 2

1. Logs must be 12 inches d.i.b. or larger, 10 feet in length or longer, and with a net scale after deduction for defect of at least 50 percent of the gross contents of the log.
2. Logs must be at least 50 percent clear on each of three faces or 75 percent clear on two faces.

Grade 3

1. Logs must be 6 inches d.i.b. or larger, 8 feet in length or longer, and with a net scale after deduction for defect of at least 50 percent of the gross contents of the log.

Note: Diameters are d.i.b. at small end of grading section and percent clear refers to percent clear in one continuous section.

METRIC EQUIVALENTS OF UNITS USED IN THIS REPORT

1 acre = 4,046.86 square meters or 0.405 hectare.
1,000 acres = 405 hectares.
1 cubic foot = 0.0283 cubic meter.
1 foot = 30.48 centimeters or 0.3048 meter.
1 inch = 25.4 millimeters, 2.54 centimeters, or 0.0254 meter.
1 pound = 0.454 kilogram.
1 ton = 0.907 metric ton.

TREE SPECIES GROUPS IN MICHIGAN'S NORTHERN LOWER PENINSULA

Species names are based on Little, 1981.

SOFTWOODS

Balsam fir ..... *Abies balsamea*
Tamarack ..... *Larix laricina*
White spruce ..... *Picea glauca*
Black spruce ..... *Picea mariana*
Jack pine ..... *Pinus banksiana*
Red pine ..... *Pinus resinosa*
Eastern white pine ..... *Pinus strobus*
Northern white-cedar ..... *Thuja occidentalis*
Eastern hemlock ..... *Tsuga canadensis*
Other softwoods:
  Engelmann spruce ..... *Picea engelmannii*
  Eastern redcedar ..... *Juniperus virginiana*
  Scotch pine ..... *Pinus sylvestris*

HARDWOODS

Hard maple[2]
  Sugar maple ..... *Acer saccharum*
Soft maple[3]
  Red maple ..... *Acer rubrum*
  Silver maple ..... *Acer saccharinum*
Birch
  Yellow birch[2] ..... *Betula alleghaniensis*
  River birch[3] ..... *Betula nigra*
  Paper birch[3] ..... *Betula papyrifera*
Bitternut hickory[2] ..... *Carya cordiformis*
Hackberry ..... *Celtis occidentalis*
Persimmon ..... *Diospyros virginiana*
American beech ..... *Fagus grandifolia*
Ash
  White ash[2] ..... *Fraxinus americana*
  Black ash[3] ..... *Fraxinus nigra*
  Green ash[2] ..... *Fraxinus pennsylvanica*
Butternut[3] ..... *Juglans cinerea*
Black walnut[2] ..... *Juglans nigra*
White poplar ..... *Populus alba*
Balsam poplar ..... *Populus balsamifera*
Cottonwood ..... *Populus deltoides*
Bigtooth aspen[3] ..... *Populus grandidentata*
Quaking aspen[3] ..... *Populus tremuloides*
Black cherry ..... *Prunus serotina*

[2] *This species or species group is considered a hard hardwood, with an average specific gravity greater than or equal to 0.50.*

[3] *This species or species group is considered a soft hardwood, with an average specific gravity of less than 0.50.*

Select white oaks[2]
White oak ..... *Quercus alba*
Swamp white oak ..... *Quercus bicolor*
Bur oak ..... *Quercus macrocarpa*
Select red oaks[2]
Northern red oak ..... *Quercus rubra*
Other red oak
Northern pin oak ..... *Quercus ellipsoidalis*
Pin oak ..... *Quercus palustris*
American basswood ..... *Tilia americana*
Elm
Winged elm[3] ..... *Ulmus alata*
American elm[3] ..... *Ulmus americana*
Slippery elm[3] ..... *Ulmus rubra*
Rock elm[2] ..... *Ulmus thomasii*
Other hardwoods
Boxelder ..... *Acer negundo*
Ohio buckeye ..... *Aesculus glabra*
Sweet birch ..... *Betula lenta*
Northern catalpa ..... *Catalpa speciosa*
Noncommercial species
Striped maple ..... *Acer pennsylvanicum*
Mountain maple ..... *Acer spicatum*
American hornbeam ..... *Carpinus caroliniana*
Hawthorn ..... *Crataegus* spp.
Apple ..... *Malus* spp.
Eastern hophornbeam ..... *Ostrya virginiana*
Canada plum ..... *Prunus nigra*
Pin cherry ..... *Prunus pensylvanica*
Wild plum ..... *Prunus* spp.
Chokecherry ..... *Prunus virginiana*
Peachleaf willow ..... *Salix amygdaloides*
Black willow ..... *Salix nigra*
Willow spp. ..... *Salix* spp.

DEFINITION OF TERMS

Average annual removals from growing stock.—The average net growing-stock volume in growing-stock trees removed annually for forest products (including roundwood products and logging residues) and for other uses (see Other removals). Average annual removals of growing stock are reported for a period of several years (1980 to 1992 in this report) and are based on information obtained from remeasurement plots (see Survey Procedures in Appendix).

Average annual removals from sawtimber.—The average net board foot sawtimber volume of live sawtimber trees removed annually for forest products (including roundwood products and other uses [see Other removals]). Average annual removals of sawtimber are reported for a period of several years (1980 to 1992 in this report) and are based on information obtained from remeasurement plots (see Survey Procedures in Appendix).

Average net annual growth of growing stock.—The annual change in volume of sound wood in live sawtimber and poletimber trees and the total volume of trees entering these classes through ingrowth, less volume losses resulting from natural causes.

Average net annual growth of sawtimber.—The annual change in the volume of live sawtimber trees and the total volume of trees reaching sawtimber size, less volume losses resulting from natural causes.

Basal area.—Tree area, in square feet, of the cross section at breast height of a single tree. When the basal areas of all trees in a stand are summed, the result is usually expressed as square feet of basal area per acre.

Butt log.—The first 12 to 16 feet from a 1-foot stump that could be, or is, cut. Minimum standards for butt logs vary by species.

Clear panel.—A section of hardwood tree surface one-fourth the circumference of the tree and at least 2 feet long, free of limbs, knots, bumps, and other indications of defect that preclude clear cuttings.

Commercial species.—Tree species presently or prospectively suitable for industrial wood products. (Note: Excludes species of typically small size, poor form, or inferior quality such as hophornbeam, osage-orange, and redbud.)

County and municipal land.—Land owned by counties and local public agencies or municipalities, or land leased to these governmental units for 50 years or more.

Cropland.— Land under cultivation within the past 24 months; including cropland harvested, crop failures, cultivated summer fallow, idle cropland used only for pasture, orchards, and land in soil improvement crops, but excluding land cultivated in developing improved pasture.

Cull.—Portions of a tree that are unusable for industrial wood products because of rot, missing or dead material, or other defect.

Diameter class.—A classification of trees based on diameter outside bark, measured at breast height (d.b.h.). Two-inch diameter classes are commonly used in Forest Inventory and Analysis, with the even inch the approximate midpoint for a class. For example, the 6-inch class includes trees 5.0 through 6.9 inches d.b.h.

Diameter at breast height (d.b.h.).—The outside bark diameter at 4.5 feet (1.37 m) above the forest floor on the uphill side of the tree. For determining breast height, the forest floor includes the duff layer that may be present, but does not include unincorporated woody debris that may rise above the ground line.

Face.—A section of the tree surface one-fourth the circumference of the tree extending the full length of the log.

Farm.—Any place from which $1,000 or more agricultural products were produced and sold during the year.

Farmer-owned land.—Land owned by farm operators whether part of the farmstead or not. (Note: Excludes land leased by farm operators from nonfarm owners, such as railroad companies and States.)

Forest industry land.—Land owned by companies or individuals operating wood-using plants.

Forest land.—Land at least 16.7 percent stocked by forest trees of any size, or formerly having had such tree cover, and not currently developed for nonforest use. (Note: Stocking is measured by comparing specified standards with basal area and/or number of trees, age or size, and spacing.) The minimum area for classification of forest land is 1 acre. Roadside, streamside, and shelterbelt strips of timber must have a crown width of at least 120 feet to qualify as forest land. Unimproved roads and trails, streams, or other bodies of water or clearings in forest areas shall be classed as forest if less than 120 feet wide. (See definitions for Land, Timberland, Reserved forest land, Other forest land, Stocking, and Water.)

Forest type.—A classification of forest land based on the species forming a plurality of live tree stocking. Major forest types in the State are:

Jack pine.—Forests in which jack pine comprises a plurality of the stocking. (Common associates include eastern white pine, red pine, aspen, birch, and maple.)

Red pine.—Forests in which red pine comprises a plurality of the stocking. (Common associates include eastern white pine, jack pine, aspen, birch, and maple.)

Eastern white pine.—Forests in which eastern white pine comprises a plurality of the stocking. (Common associates include red pine, jack pine, aspen, birch, and maple.)

Balsam fir.—Forests in which balsam fir and white spruce comprise a plurality of the stocking with balsam fir the most common. (Common associates include white spruce, aspen, maple, birch, northern white-cedar, and tamarack.)

White spruce.—Forests in which white spruce and balsam fir comprise a plurality of the stocking with white spruce the most common. (Common associates include balsam fir, aspen, maple, birch, northern white-cedar, and tamarack.)

Black spruce.—Forests in which swamp conifers comprise a plurality of the stocking with black spruce the most common. (Common associates include tamarack and northern white-cedar.)

Northern white-cedar.—Forests in which swamp conifer species comprise a plurality of the stocking with northern white-cedar the most common. (Common associates include tamarack and black spruce.)

Tamarack.—Forests in which swamp conifers comprise a plurality of the stocking with tamarack the most common. (Common associates include black spruce and northern white-cedar.)

Oak-hickory.—Forests in which northern red oak, white oak, bur oak, or hickories, singly or in combination, comprise a plurality of the stocking. (Common associates include jack pine, beech, yellow-poplar, elm, and maple.)

Elm-ash-soft maple.—Forests in which lowland elm, ash, red maple, silver maple, and cottonwood, singly or in combination, comprise a plurality of the stocking. (Common associates include birch, spruce, and balsam fir.)

Maple-birch.—Forests in which sugar maple, basswood, yellow birch, upland American elm, and red maple, singly or in combination, comprise a plurality of the stocking. (Common associates include birch, spruce, and balsam fir.)

Aspen.—Forests in which quaking aspen or bigtooth aspen, singly or in combination, comprise a plurality of the stocking. (Common associates include balsam poplar, balsam fir, and paper birch.)

Paper birch.—Forests in which paper birch comprises a plurality of the stocking. (Common associates include maple, aspen, and balsam fir.)

Balsam poplar.—Forests in which balsam poplar comprises a plurality of the stocking. (Common associates include aspen, elm, and ash.)

Growing-stock tree.—A live tree of commercial species that meets specified standards of size, quality, and merchantability. (Note: Excludes rough, rotten, and dead trees.)

Growing-stock volume.—Net volume in cubic feet of growing-stock trees 5.0 inches d.b.h. and over, from 1 foot above the ground to a minimum 4.0 inch top diameter (outside bark) of the central stem or to the point where the central stem breaks into limbs.

Hard hardwoods.—Hardwood species with an average specific gravity greater than 0.50 such as oaks, hard maple, and hickories.

Hardwoods.—Dicotyledonous trees, usually broad-leaved and deciduous. (See Soft hardwoods and Hard hardwoods.)

Improved pasture.—Land currently improved for grazing by cultivation, seeding, irrigation, or clearing of trees and brush.

Indian owned land.—Land held in trust by the United States for tribes or individual Native Americans.

Industrial wood.—All roundwood products except fuelwood.

Land.—*A. Bureau of the Census.* Dry land and land temporarily or partly covered by water such as marshes, swamps, and river flood plains (omitting tidal flats below mean high tide); streams, sloughs, estuaries, and canals less than one-eighth of a statute mile wide; and lakes, reservoirs, and ponds less than 40 acres in area.

B. Forest Inventory and Analysis. The same as the Bureau of the Census, except minimum width of streams, etc., is 120 feet and minimum size of lakes, etc., is less than 1 acre.

Live trees.—Growing-stock, rough, and rotten trees 1.0 inch d.b.h. and larger.

Log grade.—A log classification based on external characteristics as indicators of quality or value. (See Appendix for specific grading factors used.)

Marsh.—Nonforest land that characteristically supports low, generally herbaceous or shrubby vegetation and that is intermittently covered with water.

Merchantable.—Refers to a pulpwood or saw-log section that meets pulpwood or saw-log specifications, respectively.

Miscellaneous Federal land.—Federal land other than National Forest and land administered by the Bureau of Land Management or Bureau of Indian Affairs.

Miscellaneous private corporation.—Lands privately owned by any corporation other than forest industry or farmer.

Miscellaneous private land.—Privately owned land other than forest-industry and farmer-owned land.

Mortality.—The volume of sound wood in growing-stock and sawtimber trees that die annually.

National Forest land.—Federal land that has been legally designated as National Forest or purchase units, and other land administered by the USDA Forest Service.

Net volume.—Gross volume less deductions for rot, sweep, or other defect affecting use for timber products.

Noncommercial species.—Tree species of typically small size, poor form, or inferior quality that normally do not develop into trees suitable for industrial wood products.

Nonforest land.—Land that has never supported forests, and land formerly forested where use for timber management is precluded by development for other uses. (Note: Includes areas used for crops, improved pasture, residential areas, city parks, improved roads of any width and adjoining clearings, powerline clearings of any width, and 1- to 40-acre areas of water classified by the Bureau of the Census as land. If intermingled in forest areas, unimproved roads and nonforest strips must be more than 120 feet wide and more than 1 acre in area to qualify as nonforest land.)

a Nonforest land without trees.—Nonforest land with no live trees present.

b. Nonforest land with trees.—Nonforest land with one or more trees per acre at least 5 inches d.b.h.

Nonstocked land.—Forest land less than 16.7 percent stocked with all live trees.

Other forest land.—Forest land not capable of producing 20 cubic feet per acre per year of industrial wood crops under natural conditions and not associated with urban or rural development. These sites often contain tree species that are not currently utilized for industrial wood production or trees of poor form, small size, or inferior quality that are unfit for industrial products. Unproductivity may be the result of adverse site conditions such as sterile soil, dry climate, poor drainage, high elevation, and rockiness. This land is not withdrawn from timber utilization.

Other removals.—Growing-stock trees removed but not utilized for products, or trees left standing but "removed" from the timberland classification by land use change. Examples are removals from cultural operations such as timber stand improvement work, land clearing, and changes in land use.

Ownership size class.—The amount of timberland owned by one owner, regardless of the number of parcels.

Pasture.—Land presently used for grazing or under cultivation to develop grazing.

Poletimber stand.—(See Stand-size class.)

Poletimber tree.—A tree of commercial species at least 5.0 inches d.b.h. but smaller than sawtimber size.

Potential productivity class.—A classification of forest lands in terms of inherent capacity to grow crops of industrial wood. The class identifies the potential growth in merchantable cubic feet/acre/year at culmination of mean annual increment of fully stocked natural stands.

Reserved forest land.—Forest land withdrawn from timber utilization through statute, administrative regulation, designation, or exclusive use for Christmas tree production, as indicated by annual shearing.

Rotten tree.—A tree that does not meet regional merchantability standards because of excessive unsound cull. May include noncommercial tree species.

Rough tree.—A tree that does not meet regional merchantability standards because of excessive sound cull. May include noncommercial tree species.

Roundwood products.—Logs, bolts or other round sections (including chips from roundwood) cut from trees for industrial or consumer uses. (Note: Includes saw logs, veneer logs and bolts; cooperage logs and bolts; pulpwood; fuelwood; pilings; poles; posts; hewn ties; mine timbers; and various other round, split, or hewn products.)

Salvable dead tree.—A standing or down dead tree considered merchantable by regional standards.

Sapling.—A live tree 1.0 to 5.0 inches d.b.h.

Sapling-seedling stand.—(See Stand-size class.)

Saw log.—A log meeting minimum standards of diameter, length, and defect. A saw log must be at least 8 feet long, sound, straight, have a minimum diameter outside bark (d.o.b.) of 7.0 inches for softwoods and 9.0 inches for hardwoods, or have other combinations of size and defect specified by regional standards.

Saw-log portion.—That part of the bole of sawtimber trees between the stump and the saw-log top.

Saw-log top.—The point on the bole of sawtimber trees above which a saw log cannot be produced. The minimum saw-log top is 7.0 inches d.o.b. for softwoods and 9.0 inches d.o.b. for hardwoods.

Sawtimber stand.—(See Stand-size class.)

Sawtimber tree.—A tree of commercial species containing at least a 12-foot saw log or two noncontiguous saw logs 8 feet or longer, and meeting regional specifications for freedom from defect. Softwoods must be at least 9.0 inches d.b.h. Hardwoods must be at least 11.0 inches d.b.h.

Sawtimber volume.—Net volume of the saw-log portion of live sawtimber in board feet, International 1/4-inch rule (unless specified otherwise), from the stump to a minimum 7 inches top d.o.b. for softwoods and a minimum 9 inches top d.o.b. for hardwoods.

Seedling.—A live tree less than 1.0 inch d.b.h. that is expected to survive. Only softwood seedlings more than 6 inches tall and hardwood seedlings more than 1 foot tall are counted.

Short-log (rough tree).—Sawtimber-size trees of commercial species that contain at least one merchantable 8- to 11-foot saw log, but not a 12-foot saw log.

Site index.—An expression of forest site quality based on the height of a free-growing dominant, or codominant, tree of a representative species in the forest type at age 50.

Soft hardwoods.—Hardwood species with an average specific gravity less than 0.50 such as gum, yellow-poplar, cottonwood, red maple, basswood, and willow.

Softwoods.—Coniferous trees, usually evergreen, having needles or scale-like leaves.

Stand.—A group of trees on a minimum of 1 acre of forest land that is stocked by forest trees of any size.

Stand-age class.—Age of main stand. Main stand refers to trees of the dominant forest type and stand-size class.

Stand-size class.—A classification of stocked (see Stocking) forest land based on the size class of live trees on the area; that is, sawtimber, poletimber, or seedlings and saplings.

a. Sawtimber stands.—Stands with half or more of live stocking in sawtimber or poletimber trees, and with sawtimber stocking at least equal to poletimber stocking.

b. Poletimber stands.—Stands with half or more live stocking in poletimber and/or sawtimber trees, and with poletimber stocking exceeding that of sawtimber.

c. Sapling-seedling stands.—Stands with more than half of the live stocking in saplings and/or seedlings.

State land.—Land owned by States, or leased to them for 50 years or more.

Stocking.—The degree of occupancy of land by live trees, measured by basal area; and/or the number of trees in a stand by size or age and spacing, compared to the basal area; and/or number of trees required to fully utilize the growth potential of the land; that is, the stocking standard.

A stocking percent of 100 indicates full utilization of the site and is equivalent to 80 square feet of basal area per acre in trees 5.0 inches d.b.h. and larger. In a stand of trees less than 5 inches d.b.h., a stocking percent of 100 would indicate that the present number of trees is sufficient to produce 80 square feet of basal area per acre when the trees reach 5 inches d.b.h.

Stands are grouped into the following stocking classes:

Overstocked stands.—Stands in which stocking of live trees is 133 percent or more.

Fully stocked stands.—Stands in which stocking of live trees is from 100.0 to 132.9 percent.

Medium stocked stands.—Stands in which stocking of live trees is from 60.0 to 99.9 percent.

Poorly stocked stands.—Stands in which stocking of live trees is from 16.7 to 59.9 percent.

Nonstocked areas.—Timberland on which stocking of live trees is less than 16.7 percent.

Timberland.—Forest land that is producing, or capable of producing, in excess of 20 cubic feet per acre per year of industrial wood crops under natural conditions. In addition, the forest land must not be withdrawn from timber utilization, and not associated with urban or rural development. Currently inaccessible and inoperable areas are included.

Tree.—A woody plant usually having one or more perennial stems, a more or less definitely formed crown of foliage, and a height of at least 12 feet at maturity.

Tree grade.—A tree classification based on external characteristics as indicators of quality or value, used for hardwood species. (See Appendix for specific grading factors used.)

Tree-size class.—A classification of trees based on diameter at breast height, including sawtimber trees, poletimber trees, saplings, and seedlings.

Unproductive forest land.—Forest land incapable of producing 20 cubic feet per acre per year of industrial wood under natural conditions because of adverse site conditions. (Note: Adverse conditions include sterile soils, dry climate, poor drainage, high elevation, steepness, and rockiness.)

Upper stem portion.—That part of the bole of sawtimber trees above the saw-log top to a minimum top diameter of 4.0 inches outside bark, or to the point where the central stem breaks into limbs.

Water.—*(a) Bureau of the Census.*—Permanent inland water surfaces, such as lakes, reservoirs, and ponds at least 40 acres in area; and streams, sloughs, estuaries, and canals at least one-eighth of a statute mile wide.

(b) Noncensus.—Permanent inland water surfaces, such as lakes, reservoirs, and ponds from 1 to 39.9 acres in area; and streams, sloughs, estuaries, and canals from 120 feet to one-eighth of a statute mile wide.

Wooded pasture.—Improved pasture with more than 16.7 percent stocking in live trees, but with less than 25 percent stocking in growing-stock trees. Area is currently improved for grazing or there is evidence of grazing.

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TABLE TITLES

Area

Number of Trees

Volume

Growth, Removals, and Mortality

Table 1.--Area by county and major land-use class,
Northern Lower Peninsula, Michigan, 1993

(In thousand acres)

County	Total land and water area	Forest land				Nonforest land	Census water
		All forest land	Timberland	Other forest land	Reserved timber-land		
Alcona	1,146.0	333.0	321.9	2.1	9.0	98.7	714.3
Alpena	1,084.8	236.2	233.0	--	3.2	131.2	717.4
Antrim	385.2	189.7	189.7	--	--	115.5	80.0
Arenac	435.7	121.1	121.1	--	--	113.7	200.9
Bay	403.8	44.2	43.3	--	0.9	240.1	119.5
Benzie	550.2	146.6	136.9	--	9.7	59.0	344.6
Charlevoix	890.2	172.2	170.4	--	1.8	94.6	623.4
Cheboygan	566.6	350.3	339.6	0.9	9.8	107.7	108.6
Clare	368.2	245.5	245.5	--	--	117.3	5.4
Crawford	360.6	308.1	290.0	--	18.1	49.1	3.4
Emmet	564.7	208.1	197.6	2.3	8.2	91.4	265.2
Gladwin	330.5	186.9	186.9	--	--	137.4	6.2
Grand Traverse	384.7	175.8	170.9	2.2	2.7	121.8	87.1
Iosco	1,210.1	244.4	242.6	1.8	--	107.1	858.6
Isabella	369.8	101.6	101.6	--	--	266.0	2.2
Kalkaska	365.3	271.1	267.4	--	3.7	88.0	6.2
Lake	367.8	315.2	315.2	--	--	48.1	4.5
Leelanau	1,621.4	126.9	88.4	--	38.5	96.2	1,398.3
Manistee	819.8	253.3	249.1	--	4.2	94.8	471.7
Mason	794.9	172.7	157.0	2.8	12.9	144.3	477.9
Mecosta	365.5	163.4	163.4	--	--	192.3	9.8
Midland	337.9	175.6	175.6	--	--	158.0	4.3
Missaukee	367.3	237.9	229.3	1.7	6.9	124.9	4.5
Montmorency	360.0	293.8	293.6	--	0.2	56.7	9.5
Newaygo	551.3	331.5	330.4	--	1.1	207.6	12.2
Oceana	836.4	186.9	182.0	--	4.9	159.0	490.5
Ogemaw	367.8	229.1	228.5	--	0.6	132.1	6.6
Osceola	366.8	185.6	185.6	--	--	176.7	4.5
Oscoda	365.8	317.2	307.9	--	9.3	44.4	4.2
Otsego	336.6	239.6	239.6	--	--	89.7	7.3
Presque Isle	1,646.9	312.0	299.4	11.0	1.6	110.5	1,224.4
Roscommon	371.1	258.0	254.8	1.7	1.5	75.7	37.4
Wexford	368.6	281.7	259.3	--	22.4	80.3	6.6
All counties	19,662.3	7,415.2	7,217.5	26.5	171.2	3,929.9	8,317.2

Table 2.--Area of timberland by county and ownership class, Northern Lower Peninsula, Michigan, 1993

(In thousand acres)

County	Ownership class							
	All owners	National forest	Misc. federal	State	County and municipal	Forest industry	Misc. private-corporation	Misc. private-individual/farmer
Alcona	321.9	101.8	0.0	2.1	6.6	0.0	47.1	164.3
Alpena	233.0	0.0	0.0	36.8	2.4	0.0	37.8	156.0
Antrim	189.7	0.0	0.0	51.1	6.4	0.0	10.5	121.7
Arenac	121.1	0.0	0.0	34.3	1.8	0.0	3.5	81.5
Bay	43.3	0.0	0.0	0.0	0.0	0.0	0.0	43.3
Benzie	136.9	0.0	0.0	66.5	0.0	0.0	8.0	62.4
Charlevoix	170.4	0.0	0.0	62.3	0.0	0.0	15.6	92.5
Cheboygan	339.6	0.0	0.0	168.2	0.0	0.0	17.3	154.1
Clare	245.5	0.0	4.1	53.3	0.0	0.0	30.0	158.1
Crawford	290.0	35.9	2.1	151.9	0.0	0.0	4.3	95.8
Emmet	197.6	0.0	0.0	75.1	4.9	0.0	9.5	108.1
Gladwin	186.9	0.0	0.0	75.4	4.4	0.0	3.1	104.0
Grand Traverse	170.9	0.0	0.0	70.6	4.4	0.0	6.6	89.3
Iosco	242.6	107.8	0.0	15.2	0.0	0.0	20.9	98.7
Isabella	101.6	0.0	0.0	3.2	0.0	0.0	4.5	93.9
Kalkaska	267.4	0.0	0.0	144.1	0.0	0.0	17.7	105.6
Lake	315.2	111.9	1.7	63.5	0.0	0.0	13.1	125.0
Leelanau	88.4	0.0	0.0	5.9	0.0	0.0	5.3	77.2
Manistee	249.1	82.1	0.0	15.0	10.7	0.0	30.4	110.9
Mason	157.0	47.8	0.0	7.0	3.4	5.6	7.8	85.4
Mecosta	163.4	0.0	0.0	20.7	7.1	0.0	5.8	129.8
Midland	175.6	0.0	0.0	47.0	1.6	0.6	7.1	119.3
Missaukee	229.3	0.0	0.0	106.6	0.0	0.0	23.1	99.6
Montmorency	293.6	0.0	0.0	148.1	0.0	0.0	21.6	123.9
Newaygo	330.4	107.0	0.0	4.0	2.3	0.0	8.6	208.5
Oceana	182.0	52.7	0.0	1.8	2.3	0.0	14.0	111.2
Ogemaw	228.5	20.1	0.0	65.9	5.1	0.0	18.5	118.9
Osceola	185.6	0.0	0.0	20.9	1.7	0.0	13.6	149.4
Oscoda	307.9	141.2	0.0	42.4	0.0	0.0	47.2	77.1
Otsego	239.6	0.0	1.9	82.2	0.0	0.0	25.4	130.1
Presque Isle	299.4	0.0	2.2	72.7	1.2	0.0	44.4	178.9
Roscommon	254.8	0.0	0.0	168.3	1.7	0.0	32.0	52.8
Wexford	259.3	92.6	0.0	60.9	0.0	0.0	11.3	94.5
All counties	7,217.5	900.9	12.0	1,943.0	68.0	6.2	565.6	3,721.8

Table 3.--Area of timberland by county and forest type, Northern Lower Peninsula, Michigan, 1993

(In thousand acres)

County	All types	Forest type														
		Jack pine	Red pine	White pine	Balsam fir	White spruce	Black spruce	Northern white-cedar	Tamarack	Oak-hickory	Elm-ash-soft maple	Maple-birch	Aspen	Paper birch	Balsam poplar	Non-stocked
Alcona	321.9	8.0	20.8	4.8	6.2	5.4	2.6	34.9	2.1	88.7	8.4	39.2	88.4	2.1	9.9	0.4
Alpena	233.0	7.4	7.1	4.1	13.3	2.4	--	36.8	1.1	8.1	27.2	36.8	66.7	14.9	5.4	1.7
Antrim	189.7	6.8	7.2	--	--	--	--	15.2	--	--	6.1	126.4	28.0	--	--	--
Arenac	121.1	5.0	--	--	1.8	1.0	--	--	--	26.6	25.2	23.4	35.2	2.9	--	--
Bay	43.3	--	--	--	--	--	--	--	--	--	19.6	8.4	15.3	--	--	--
Benzie	136.9	3.3	13.7	--	--	2.3	--	--	3.3	--	12.2	93.0	9.1	--	--	--
Charlevoix	170.4	--	7.8	8.8	2.1	--	0.2	19.3	8.7	--	6.2	107.3	5.3	4.7	--	--
Cheboygan	339.6	17.5	16.8	2.3	2.7	1.2	2.3	28.5	--	14.9	16.2	122.1	107.5	3.6	4.0	--
Clare	245.5	24.5	15.4	--	--	--	--	3.8	1.5	46.3	33.4	57.1	63.5	--	--	--
Crawford	290.0	87.1	16.8	2.1	--	--	8.1	6.4	--	67.5	2.2	40.5	38.2	4.3	2.1	14.7
Emmet	197.6	7.0	7.6	--	1.3	1.7	--	12.2	--	1.8	10.2	118.8	31.1	5.9	--	--
Gladwin	186.9	1.9	6.1	--	--	--	--	--	--	26.2	29.6	33.7	80.0	--	9.4	--
Grand Traverse	170.9	13.3	36.4	2.2	--	--	--	7.0	2.2	30.8	4.4	42.3	27.9	4.4	--	--
Iosco	242.6	40.5	42.3	6.4	--	--	--	21.8	5.2	23.8	25.4	30.7	35.3	4.6	6.6	--
Isabella	101.6	4.0	2.5	0.5	--	--	--	2.4	--	15.3	14.0	25.1	35.7	2.1	--	--
Kalkaska	267.4	26.8	37.1	2.0	2.0	--	--	15.7	--	12.1	--	121.4	44.7	3.1	--	2.5
Lake	315.2	21.3	44.7	8.7	--	--	--	8.3	--	150.9	9.2	42.4	29.7	--	--	--
Leelanau	88.4	--	10.9	6.1	--	--	--	4.9	--	--	3.4	55.1	5.7	2.3	--	--
Manistee	249.1	10.6	32.9	3.9	--	--	--	4.8	--	53.5	23.5	88.6	29.8	1.5	--	--
Mason	157.0	8.8	24.7	0.6	--	--	--	--	--	54.0	22.8	23.6	22.5	--	--	--
Mecosta	163.4	4.3	5.5	1.2	--	1.3	--	3.8	--	13.5	23.9	71.5	36.8	1.6	--	--
Midland	175.6	--	--	0.6	--	--	--	--	--	23.8	38.7	49.3	53.3	5.8	--	4.1
Missaukee	229.3	12.8	17.0	--	--	3.0	--	18.6	4.0	27.8	28.6	57.1	58.9	1.5	--	--
Montmorency	293.6	23.0	18.6	1.9	7.5	1.6	--	16.7	2.8	47.7	8.7	88.9	68.3	2.0	2.0	3.9
Newaygo	330.4	13.6	29.4	10.4	--	--	--	--	1.3	127.6	43.2	85.8	19.1	--	--	--
Oceana	182.0	6.3	18.9	--	--	--	--	6.3	--	56.6	22.9	50.9	19.3	--	--	0.8
Ogemaw	228.5	31.0	16.6	2.9	1.7	--	--	15.4	--	27.7	12.9	52.0	58.3	10.0	--	--
Osceola	185.6	6.1	11.7	--	--	--	--	12.2	--	8.0	12.3	82.9	49.0	1.2	--	2.2
Oscoda	307.9	62.7	27.8	13.9	2.7	--	1.6	6.6	2.4	67.6	3.2	47.7	66.5	3.1	--	2.1
Otsego	239.6	12.0	19.8	5.9	4.0	1.9	1.8	12.4	--	13.5	2.0	130.6	25.9	3.9	2.0	3.9
Presque Isle	299.4	15.1	15.2	2.0	7.7	2.0	2.2	63.0	2.4	24.8	21.1	47.0	60.2	14.7	12.2	9.8
Roscommon	254.8	18.2	12.2	2.1	9.2	--	--	31.0	--	83.6	15.2	30.1	51.4	1.8	--	--
Wexford	259.3	17.1	47.6	2.5	--	1.2	3.6	10.0	1.2	15.4	13.8	96.5	46.0	4.4	--	--
All counties	7,217.5	516.0	591.1	95.9	62.2	25.0	22.4	418.0	38.2	1,158.1	545.7	2,126.2	1,412.6	106.4	53.6	46.1

Table 4.--Area of timberland by county and stand-size class, Northern Lower Peninsula, Michigan, 1993

(In thousand acres)

County	All stands	Stand-size class			
		Sawtimber	Poletimber	Sapling and Seedling	Non-stocked
Alcona	321.9	173.5	113.3	34.7	0.4
Alpena	233.0	77.5	91.7	62.1	1.7
Antrim	189.7	74.9	79.8	35.0	--
Arenac	121.1	39.9	29.9	51.3	--
Bay	43.3	12.6	11.1	19.6	--
Benzie	136.9	67.4	38.5	31.0	--
Charlevoix	170.4	106.7	57.5	6.2	--
Cheboygan	339.6	128.1	109.7	101.8	--
Clare	245.5	116.7	64.1	64.7	--
Crawford	290.0	102.6	113.7	59.0	14.7
Emmet	197.6	83.7	83.9	30.0	--
Gladwin	186.9	66.7	60.7	59.5	--
Grand Traverse	170.9	81.8	68.7	20.4	--
Iosco	242.6	110.4	85.6	46.6	--
Isabella	101.6	48.5	26.4	26.7	--
Kalkaska	267.4	99.7	106.2	59.0	2.5
Lake	315.2	151.1	95.5	68.6	--
Leelanau	88.4	56.3	22.3	9.8	--
Manistee	249.1	100.6	89.8	58.7	--
Mason	157.0	88.9	42.9	25.2	--
Mecosta	163.4	59.9	51.7	51.8	--
Midland	175.6	78.1	39.7	53.7	4.1
Missaukee	229.3	86.4	75.5	67.4	--
Montmorency	293.6	107.2	85.9	96.6	3.9
Newaygo	330.4	202.3	93.2	34.9	--
Oceana	182.0	91.3	40.9	49.0	0.8
Ogemaw	228.5	73.1	95.7	59.7	--
Osceola	185.6	65.0	57.6	60.8	2.2
Oscoda	307.9	105.3	79.7	120.8	2.1
Otsego	239.6	86.8	107.3	41.6	3.9
Presque Isle	299.4	96.4	119.5	73.7	9.8
Roscommon	254.8	120.1	72.3	62.4	--
Wexford	259.3	86.7	139.5	33.1	--
All counties	7,217.5	3,046.2	2,449.8	1,675.4	46.1

Table 5.--Area of timberland by county and potential productivity class, Northern Lower Peninsula, Michigan, 1993

(In thousand acres)

County	All classes	Potential productivity class (cubic feet of growth per acre per year)				
		165+	120-164	85-119	50-84	20-49
Alcona	321.9	4.3	26.3	92.6	137.2	61.5
Alpena	233.0	2.3	10.0	63.9	70.4	86.4
Antrim	189.7	2.1	4.2	56.6	80.1	46.7
Arenac	121.1	1.8	5.0	44.1	48.7	21.5
Bay	43.3	2.7	--	20.8	14.2	5.6
Benzie	136.9	3.3	15.1	23.8	51.8	42.9
Charlevoix	170.4	--	3.9	49.8	77.4	39.3
Cheboygan	339.6	--	9.1	78.5	144.4	107.6
Clare	245.5	2.1	16.4	81.2	86.9	58.9
Crawford	290.0	--	4.3	29.7	106.9	149.1
Emmet	197.6	2.3	5.0	49.4	97.8	43.1
Gladwin	186.9	1.8	17.2	58.7	91.5	17.7
Grand Traverse	170.9	--	2.7	30.1	69.3	68.8
Iosco	242.6	--	4.7	57.0	77.9	103.0
Isabella	101.6	--	17.0	44.5	29.9	10.2
Kalkaska	267.4	--	7.9	70.0	99.6	89.9
Lake	315.2	--	25.2	75.4	114.7	99.9
Leelanau	88.4	1.1	9.6	12.4	36.5	28.8
Manistee	249.1	--	6.9	59.8	119.5	62.9
Mason	157.0	--	14.3	35.9	72.2	34.6
Mecosta	163.4	1.9	11.9	56.4	72.9	20.3
Midland	175.6	--	4.1	49.5	93.4	28.6
Missaukee	229.3	--	22.5	68.3	77.3	61.2
Montmorency	293.6	--	5.2	55.6	154.2	78.6
Newaygo	330.4	0.9	18.2	82.0	162.8	66.5
Oceana	182.0	--	12.7	40.5	88.7	40.1
Ogemaw	228.5	1.8	8.4	59.4	76.0	82.9
Osceola	185.6	--	19.3	68.5	75.2	22.6
Oscoda	307.9	--	11.1	50.9	130.7	115.2
Otsego	239.6	4.4	4.1	60.0	125.1	46.0
Presque Isle	299.4	--	2.1	28.2	104.9	164.2
Roscommon	254.8	1.7	3.5	53.8	107.9	87.9
Wexford	259.3	0.5	11.8	82.6	99.3	65.1
All counties	7,217.5	35.0	339.7	1,789.9	2,995.3	2,057.6

Table 6.--Area of timberland by county and stocking class of growing-stock trees[1], Northern Lower Peninsula, Michigan, 1993

(In thousand acres)

County	Stocking class of growing-stock trees					
	All classes	Non-stocked[2]	Poorly stocked	Moderately stocked	Fully stocked	Over-stocked
Alcona	321.9	0.4	45.2	107.3	125.7	43.3
Alpena	233.0	4.0	23.5	89.6	90.4	25.5
Antrim	189.7	--	38.7	54.1	68.7	28.2
Arenac	121.1	--	13.9	52.3	44.2	10.7
Bay	43.3	--	8.4	18.0	16.9	--
Benzie	136.9	--	32.3	48.4	36.6	19.6
Charlevoix	170.4	2.1	8.3	65.6	52.7	41.7
Cheboygan	339.6	6.0	62.9	146.1	89.4	35.2
Clare	245.5	--	42.0	119.8	63.9	19.8
Crawford	290.0	14.7	68.1	135.0	54.0	18.2
Emmet	197.6	2.0	13.9	78.0	82.6	21.1
Gladwin	186.9	--	55.9	82.1	43.8	5.1
Grand Traverse	170.9	1.4	34.4	78.2	41.5	15.4
Iosco	242.6	2.5	49.4	68.7	83.3	38.7
Isabella	101.6	--	23.6	39.9	27.6	10.5
Kalkaska	267.4	9.3	61.3	102.1	60.1	34.6
Lake	315.2	--	39.8	103.5	112.4	59.5
Leelanau	88.4	--	12.8	30.9	29.4	15.3
Manistee	249.1	3.4	28.9	82.7	86.4	47.7
Mason	157.0	--	25.6	56.8	46.0	28.6
Mecosta	163.4	0.5	31.5	62.5	53.5	15.4
Midland	175.6	4.1	40.2	68.4	54.8	8.1
Missaukee	229.3	--	33.7	80.2	92.8	22.6
Montmorency	293.6	3.9	50.5	106.6	98.3	34.3
Newaygo	330.4	--	36.5	97.7	137.6	58.6
Oceana	182.0	2.3	35.8	52.5	60.6	30.8
Ogemaw	228.5	--	61.3	72.2	63.7	31.3
Osceola	185.6	7.1	42.9	63.4	56.7	15.5
Oscoda	307.9	2.1	38.5	114.1	125.0	28.2
Otsego	239.6	3.9	34.0	92.8	76.9	32.0
Presque Isle	299.4	9.8	38.2	131.4	90.1	29.9
Roscommon	254.8	--	23.8	109.8	96.8	24.4
Wexford	259.3	5.1	27.1	84.0	94.1	49.0
All counties	7,217.5	84.6	1,182.9	2,694.7	2,356.5	898.8

[1] This table is based on the stocking percent of growing-stock trees rather than that of all live trees. To use the definitions of stocking for this table, replace the term "all live" by "growing-stock."

[2] Timberland insufficiently stocked with growing-stock trees.

Table 7.--Area of timberland by forest type and ownership class, Northern Lower Peninsula, Michigan, 1993

(In thousand acres)

Forest type	Ownership class							
	All owners	National forest	Misc. federal	State	County and municipal	Forest industry	Misc. private-corporation	Misc. private-individual/farmer
Jack pine	516.0	121.8	6.2	202.2	6.2	--	29.6	150.0
Red pine	591.1	184.3	--	165.9	9.2	--	44.9	186.8
White pine	95.9	12.4	--	30.7	--	--	10.5	42.3
Balsam fir	62.2	6.8	--	21.7	3.7	--	2.1	27.9
White spruce	25.0	--	--	4.2	--	--	3.9	16.9
Black spruce	22.4	1.9	--	10.0	--	--	--	10.5
Northern white-cedar	418.0	23.2	--	130.5	11.8	--	42.9	209.6
Tamarack	38.2	1.8	--	12.2	--	--	2.0	22.2
Oak-hickory	1,158.1	246.3	--	297.8	10.0	5.6	94.5	503.9
Elm-ash-soft maple	545.7	47.7	--	117.2	2.6	0.6	46.0	331.6
Maple-birch	2,126.2	128.9	--	481.7	16.6	--	141.4	1,357.6
Aspen	1,412.6	113.4	5.8	410.3	7.9	--	131.0	744.2
Paper birch	106.4	3.9	--	23.9	--	--	13.8	64.8
Balsam poplar	53.6	6.6	--	8.0	--	--	1.3	37.7
Nonstocked	46.1	1.9	--	26.7	--	--	1.7	15.8
All types	7,217.5	900.9	12.0	1,943.0	68.0	6.2	565.6	3,721.8

Table 8.--Area of timberland by ownership class and stocking class of growing-stock trees[1], Northern Lower Peninsula, Michigan, 1993

(In thousand acres)

Ownership class	All classes	Stocking class of growing-stock trees				
		Non-stocked[2]	Poorly stocked	Moderately stocked	Fully stocked	Over-stocked
National forest	900.9	4.8	40.2	184.4	437.4	234.1
Misc. federal	12.0	--	2.1	8.0	1.9	--
State	1,943.0	39.4	328.6	766.0	567.5	241.5
County and municipal	68.0	--	6.9	25.4	27.8	7.9
Forest industry	6.2	--	2.8	0.6	2.8	--
Misc. private-corporation	565.6	3.2	89.8	243.6	182.8	46.2
Misc. private-individual/farmer	3,721.8	37.2	712.5	1,466.7	1,136.3	369.1
All owners	7,217.5	84.6	1,182.9	2,694.7	2,356.5	898.8

[1] This table is based on the stocking percent of growing-stock trees rather than that of all live trees. To use the definitions of stocking for this table, replace the term "all live" by "growing-stock."

[2] Timberland insufficiently stocked with growing-stock trees.

Table 9.--Area of timberland by forest type and stand-size class, Northern Lower Peninsula, Michigan, 1993

(In thousand acres)

Forest type	All stands	Stand-size class			
		Sawtimber	Poletimber	Sapling and seedling	Non-stocked
Jack pine	516.0	118.9	223.8	173.3	--
Red pine	591.1	252.4	281.6	57.1	--
White pine	95.9	74.5	16.2	5.2	--
Balsam fir	62.2	16.5	28.7	17.0	--
White spruce	25.0	2.7	14.4	7.9	--
Black spruce	22.4	2.5	11.0	8.9	--
Northern white-cedar	418.0	169.4	218.6	30.0	--
Tamarack	38.2	11.2	13.8	13.2	--
Oak-hickory	1,158.1	636.5	339.6	182.0	--
Elm-ash-soft maple	545.7	217.6	171.6	156.5	--
Maple-birch	2,126.2	1,003.9	663.0	459.3	--
Aspen	1,412.6	483.1	398.9	530.6	--
Paper birch	106.4	37.2	57.6	11.6	--
Balsam poplar	53.6	19.8	11.0	22.8	--
Nonstocked	46.1	--	--	--	46.1
All types	7,217.5	3,046.2	2,449.8	1,675.4	46.1

Table 10.--Number of all live trees on timberland by species group and diameter class, Northern Lower Peninsula, Michigan, 1993

(In thousand trees)

Species group	All classes	Diameter class (inches at breast height) 1.0-2.9	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	21.0-28.9-	29.0+
Softwoods													
Jack pine	191,607	78,414	46,039	33,736	20,504	9,212	2,927	558	176	35	6	--	--
Red pine	256,281	27,453	51,462	79,336	62,643	21,876	7,210	2,978	1,614	894	477	337	1
White pine	115,485	58,424	25,655	14,311	6,394	3,975	2,515	1,433	965	670	437	631	75
White spruce	23,124	10,216	5,386	3,119	2,587	831	535	239	126	58	6	18	3
Black spruce	37,775	19,445	10,212	4,708	2,573	558	226	24	15	14	--	--	--
Balsam fir	199,629	127,511	44,214	16,743	6,904	3,193	759	251	40	14	--	--	--
Hemlock	28,064	8,544	5,965	5,533	3,119	2,104	1,159	575	550	223	121	160	11
Tamarack	23,581	9,506	6,985	3,736	1,712	968	417	165	75	15	--	2	--
Eastern redcedar	382	93	48	179	31	23	--	6	--	--	--	2	--
Northern white-cedar	322,848	82,982	97,893	77,941	38,810	16,091	5,996	2,058	718	208	111	40	--
Other softwoods	46,669	10,752	15,546	11,591	6,102	2,303	318	49	8	--	--	--	--
Total	1,245,445	433,340	309,405	250,933	151,379	61,134	22,062	8,336	4,287	2,131	1,158	1,190	90
Hardwoods													
Select white oak	107,349	40,410	23,209	16,102	10,093	7,601	4,169	2,885	1,377	758	337	372	36
Other white oak	458	261	45	29	33	90	--	--	--	--	--	--	--
Select red oak	174,133	70,272	21,978	18,655	17,127	16,626	12,338	7,796	3,894	2,388	1,540	1,419	100
Other red oak	46,442	17,073	7,371	7,200	4,643	3,945	2,544	1,500	947	615	339	243	22
Other hickory	113	--	--	--	--	64	49	--	--	--	--	--	--
Other hickory	785	183	180	350	--	46	10	11	--	--	5	--	--
Basswood	47,722	9,738	3,442	6,818	8,689	8,073	5,780	2,936	1,317	534	217	172	6
Beech	61,470	31,131	11,644	6,783	4,039	2,927	1,593	927	969	586	358	469	44
Yellow birch	18,377	5,924	3,741	4,251	1,938	1,008	927	258	140	140	24	26	--
Hard maple	392,268	171,651	82,457	62,565	34,694	20,306	10,622	5,405	2,337	1,153	522	490	66
Soft maple	576,205	308,773	113,252	66,546	37,669	24,284	13,064	6,211	3,302	1,551	697	781	75
Elm	42,978	23,251	12,529	2,886	2,397	1,219	420	178	49	23	13	13	--
Black ash	126,224	73,023	28,666	16,447	5,298	1,751	646	230	119	14	18	12	--
White and green ash	133,920	78,695	23,705	11,190	8,193	4,981	3,029	1,905	1,257	589	212	149	15
Sycamore	17	--	--	--	--	--	--	--	--	10	--	7	--
Cottonwood	1,276	279	39	117	247	170	87	103	91	35	32	67	9
Willow	2,757	1,572	420	209	196	77	52	72	63	41	20	31	4
Balsam poplar	31,489	15,572	5,618	2,867	1,996	2,305	1,127	821	514	332	155	176	6
Bigtooth aspen	313,369	163,280	62,189	29,675	19,387	15,947	12,053	6,731	2,496	1,015	378	212	6
Quaking aspen	411,743	217,089	91,185	46,476	21,641	15,699	9,923	5,257	2,553	1,229	347	344	--
Paper birch	87,064	24,733	18,753	18,910	12,601	7,510	3,011	986	331	149	55	25	--
River birch	26	--	--	26	--	--	--	--	--	--	--	--	--
Tupelo	395	69	123	84	47	45	--	23	--	--	--	4	--
Black cherry	108,793	74,609	13,046	8,074	6,119	3,348	1,844	839	530	229	60	93	2
Black walnut	160	60	60	8	--	3	9	--	8	8	--	--	4
Butternut	29	--	--	--	--	11	12	--	--	6	--	--	--
Sassafras	13,059	8,380	3,349	960	174	29	84	53	25	5	--	--	--
Other hardwoods	2,665	1,223	384	638	258	152	--	--	10	--	--	--	--
Noncommercial spp.	137,212	106,484	21,848	6,387	1,863	426	143	47	6	--	4	4	--
Total	2,838,498	1,443,735	549,233	334,253	199,342	138,643	83,536	45,174	22,335	11,410	5,333	5,109	395
All species	4,083,943	1,877,075	858,638	585,186	350,721	199,777	105,598	53,510	26,622	13,541	6,491	6,299	485

Table 11.--Number of growing-stock trees on timberland by species group and diameter class, Northern Lower Peninsula, Michigan, 1993

(In thousand trees)

Species group	All classes	Diameter class (inches at breast height) 1.0-2.9	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	21.0-28.9-	29.0+
Softwoods													
Jack pine	181,674	76,933	43,351	30,728	19,015	8,388	2,636	480	118	22	3	--	--
Red pine	250,896	26,868	49,704	78,056	61,534	21,381	7,123	2,933	1,614	879	472	331	1
White pine	112,434	58,109	24,656	13,799	5,894	3,728	2,330	1,293	916	621	422	600	66
White spruce	22,804	10,111	5,386	2,931	2,573	831	525	239	126	58	6	18	--
Black spruce	36,891	19,023	9,996	4,559	2,476	558	226	24	15	14	--	--	--
Balsam fir	197,847	126,364	44,019	16,474	6,830	3,141	731	234	40	14	--	--	--
Hemlock	26,691	8,544	5,591	5,251	2,812	1,932	1,076	519	485	199	116	155	11
Tamarack	22,015	8,814	6,679	3,461	1,619	867	348	151	59	15	--	2	--
Eastern redcedar	382	93	48	179	31	23	--	6	--	--	--	2	--
Northern white-cedar	298,088	79,454	92,266	70,856	34,949	13,610	4,493	1,669	536	165	60	30	--
Other softwoods	41,952	10,431	13,680	10,707	4,993	1,860	234	39	8	--	--	--	--
Total	1,191,674	424,744	295,376	237,001	142,726	56,319	19,722	7,587	3,917	1,987	1,079	1,138	78
Hardwoods													
Select white oak	102,403	39,894	21,646	15,484	9,458	7,105	3,849	2,602	1,226	612	235	285	7
Other white oak	413	261	45	29	33	45	--	--	--	--	--	--	--
Select red oak	167,559	70,236	21,135	17,320	16,385	15,610	11,265	7,164	3,489	2,240	1,398	1,247	70
Other red oak	42,125	16,824	6,258	6,127	4,003	3,580	2,183	1,263	822	564	291	192	18
Select hickory	113	--	--	--	--	64	49	--	--	--	--	--	--
Other hickory	785	183	180	350	--	46	10	11	--	--	5	--	--
Basswood	45,793	9,495	3,133	6,550	8,419	7,784	5,571	2,762	1,248	493	205	130	3
Beech	57,903	30,260	11,095	6,474	3,709	2,535	1,372	712	748	414	270	294	20
Yellow birch	15,895	5,534	3,432	3,412	1,515	863	694	195	119	94	20	17	--
Hard maple	378,325	165,878	80,627	60,263	33,372	19,319	9,984	4,965	2,114	969	442	359	33
soft maple	557,214	304,963	108,574	62,094	36,041	22,734	11,784	5,617	2,869	1,360	546	572	60
Elm	41,110	22,766	11,727	2,761	2,173	1,166	318	128	35	14	13	9	--
Black ash	116,861	69,346	26,172	14,294	4,592	1,541	549	213	119	9	18	8	--
White and green ash	130,555	77,903	22,982	10,403	7,637	4,854	2,882	1,798	1,188	571	183	142	12
Sycamore	17	--	--	--	--	--	--	--	--	10	--	7	--
Cottonwood	1,043	219	--	87	167	159	87	103	91	32	27	64	7
Willow	2,388	1,470	420	110	142	50	33	48	57	16	20	22	--
Balsam poplar	29,815	14,975	5,270	2,707	1,890	2,156	1,063	740	419	291	133	165	6
Bigtooth aspen	305,307	162,533	60,270	27,808	18,305	15,249	11,436	6,182	2,250	815	313	144	2
Quaking aspen	393,887	213,131	87,777	42,213	19,611	14,314	8,753	4,507	2,113	962	269	237	--
Paper birch	81,902	23,712	17,799	17,765	11,847	6,884	2,598	829	276	134	45	13	--
River birch	26	--	--	26	--	--	--	--	--	--	--	--	--
Tupelo	357	69	123	84	13	45	--	23	--	--	--	--	--
Black cherry	96,639	72,143	10,113	5,620	4,001	2,191	1,302	631	369	155	35	77	2
Black walnut	156	60	60	8	--	3	9	--	8	8	--	--	--
Butternut	29	--	--	--	--	11	12	--	--	6	--	--	--
Sassafras	10,955	8,212	2,252	315	43	10	45	53	25	--	--	--	--
Other hardwoods	2,168	1,223	312	308	219	106	--	--	--	--	--	--	--
Total	2,581,743	1,311,290	501,402	302,612	183,575	128,424	75,848	40,546	19,585	9,769	4,468	3,984	240
All species	3,773,417	1,736,034	796,778	539,613	326,301	184,743	95,570	48,133	23,502	11,756	5,547	5,122	318

Table 12.--Net volume of growing stock on timberland by species group and diameter class, Northern Lower Peninsula, Michigan, 1993

(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											
Jack pine	300,553	69,980	97,020	78,581	39,428	10,608	3,901	852	183	--	--
Red pine	1,116,254	218,154	358,321	214,765	114,404	69,189	52,673	38,134	25,807	24,647	160
White pine	329,399	30,097	30,380	36,466	37,733	31,505	32,655	30,294	26,448	59,869	13,952
White spruce	58,606	7,619	15,845	9,531	9,839	6,447	4,658	2,712	326	1,629	--
Black spruce	40,514	12,929	15,410	6,540	3,866	614	508	647	--	--	--
Balsam fir	132,186	40,986	40,179	31,756	11,711	5,603	1,290	661	--	--	--
Hemlock	134,913	13,136	15,571	19,130	17,904	12,934	17,689	10,304	7,985	17,633	2,627
Tamarack	44,426	10,635	10,437	9,842	6,233	4,264	2,107	729	--	179	--
Eastern redcedar	1,151	467	196	214	--	126	--	--	--	148	--
Northern white-cedar	592,010	165,463	179,671	122,650	63,479	34,596	15,366	6,025	2,808	1,952	--
Other softwoods	74,527	24,959	26,192	18,594	3,655	902	225	--	--	--	--
Total	2,824,539	594,425	789,222	548,069	308,252	176,788	131,072	90,358	63,557	106,057	16,739
Hardwoods											
Select white oak	355,361	36,135	49,129	65,519	56,431	55,167	36,021	23,823	11,591	20,591	954
Other white oak	644	71	178	395	--	--	--	--	--	--	--
Select red oak	1,007,873	40,730	90,526	151,148	171,826	161,498	109,577	94,265	75,003	100,333	12,967
Other red oak	189,967	12,952	19,252	31,532	29,208	25,394	22,667	19,945	13,523	12,767	2,727
Select hickory	1,671	--	--	818	853	--	--	--	--	--	--
Other hickory	1,885	638	--	490	185	309	--	--	263	--	--
Basswood	418,108	20,085	54,234	88,667	98,527	69,730	43,186	22,032	11,364	9,678	605
Beech	201,747	18,834	24,120	30,290	24,704	18,253	25,964	18,643	15,443	22,911	2,585
Yellow birch	53,745	9,631	9,487	9,124	11,269	4,428	3,858	3,722	1,009	1,217	--
Hard maple	1,107,205	170,011	219,096	225,770	180,196	130,136	75,135	45,138	26,083	30,237	5,403
Soft maple	1,235,177	167,521	225,290	252,275	203,830	140,301	96,965	60,127	31,208	44,879	12,781
Elm	40,696	6,257	11,656	11,529	5,198	2,933	1,174	546	681	722	--
Black ash	101,536	37,326	26,917	16,558	9,299	5,590	3,870	356	945	675	--
White and green ash	301,786	25,700	41,987	50,219	48,381	44,329	40,324	26,186	10,669	11,675	2,316
Sycamore	1,221	--	--	--	--	--	--	605	--	616	--
Cottonwood	18,615	146	1,133	1,741	1,332	2,480	3,079	1,403	1,368	5,038	895
Willow	8,413	226	723	459	518	1,065	1,756	691	1,120	1,855	--
Balsam poplar	127,390	7,578	11,574	24,057	17,691	18,111	14,189	12,488	8,013	12,682	1,007
Bigtooth aspen	908,070	80,329	122,423	177,283	209,266	164,802	83,573	39,258	19,091	11,761	284
Quaking aspen	798,817	109,877	119,236	156,347	150,343	112,419	72,455	43,577	15,169	19,394	--
Paper birch	297,553	53,760	76,887	78,153	46,692	21,841	10,230	6,449	2,665	876	--
River birch	74	74	--	--	--	--	--	--	--	--	--
Tupelo	1,130	218	91	390	--	431	--	--	--	--	--
Black cherry	136,969	15,778	26,892	26,647	23,387	16,471	12,945	6,994	1,833	5,790	232
Black walnut	849	31	--	41	159	--	249	369	--	--	--
Butternut	489	--	--	121	166	--	--	202	--	--	--
Sassafras	3,215	599	189	103	661	1,016	647	--	--	--	--
Other hardwoods	2,914	664	1,158	1,092	--	--	--	--	--	--	--
Total	7,323,120	815,171	1,132,178	1,400,768	1,290,122	996,704	657,864	426,819	247,041	313,697	42,756
All species	10,147,659	1,409,596	1,921,400	1,948,837	1,598,374	1,173,492	788,936	517,177	310,598	419,754	59,495

Table 13.--Net volume of growing stock in the saw-log portion of sawtimber trees on timberland by species group and diameter class, Northern Lower Peninsula, Michigan 1993

(In thousand cubic feet)

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									
Jack pine	112,399	64,092	34,413	9,458	3,502	769	165	--	--
Red pine	489,594	188,228	105,563	64,419	49,063	35,427	23,942	22,805	147
White pine	229,503	28,322	31,634	27,071	28,293	26,339	23,056	52,453	12,335
White spruce	31,661	8,237	8,917	5,914	4,286	2,503	302	1,502	--
Black spruce	11,334	5,995	3,663	583	482	611	--	--	--
Balsam fir	42,435	25,568	10,148	4,971	1,154	594	--	--	--
Hemlock	93,277	15,914	15,779	11,533	15,765	9,197	7,096	15,667	2,326
Tamarack	20,606	8,367	5,594	3,890	1,926	665	--	164	--
Eastern redcedar	421	171	--	114	--	--	--	136	--
Northern white-cedar	207,719	98,801	54,911	30,635	13,713	5,391	2,519	1,749	--
Other softwoods	19,248	15,072	3,172	803	201	--	--	--	--
Total	1,258,197	458,767	273,794	159,391	118,385	81,496	57,080	94,476	14,808
Hardwoods									
Select white oak	145,530	--	36,205	39,155	26,680	17,989	8,847	15,908	746
Select red oak	524,761	--	110,695	115,414	81,521	71,530	57,601	77,751	10,249
Other red oak	92,215	--	18,796	18,286	17,086	15,342	10,494	10,037	2,174
Select hickory	494	--	494	--	--	--	--	--	--
Other hickory	519	--	115	210	--	--	194	--	--
Basswood	184,113	--	66,073	51,224	32,833	17,030	8,850	7,617	486
Beech	98,633	--	16,693	13,628	20,252	14,820	12,435	18,663	2,142
Yellow birch	18,641	--	7,553	3,328	3,003	2,960	808	989	--
Hard maple	346,758	--	115,338	93,066	56,058	34,357	20,078	23,548	4,313
Soft maple	412,856	--	128,452	98,925	71,605	45,297	23,817	34,620	10,140
Elm	7,448	--	3,146	2,004	842	400	507	549	--
Black ash	15,156	--	6,377	4,213	2,998	280	750	538	--
White and green ash	134,379	--	32,350	32,428	30,422	20,026	8,236	9,078	1,839
Sycamore	964	--	--	--	--	476	--	488	--
Cottonwood	11,069	--	766	1,626	2,155	1,011	1,006	3,801	704
Willow	4,935	--	297	690	1,226	496	824	1,402	--
Balsam poplar	62,526	--	11,974	13,304	10,786	9,623	6,184	9,864	791
Bigtooth aspen	386,876	--	144,360	123,119	64,319	30,597	14,996	9,259	226
Quaking aspen	302,199	--	102,412	83,402	55,532	33,800	11,864	15,189	--
Paper birch	60,350	--	29,917	15,461	7,503	4,799	2,003	667	--
Tupelo	310	--	--	310	--	--	--	--	--
Black cherry	47,995	--	15,028	11,868	9,642	5,331	1,420	4,522	184
Black walnut	589	--	106	--	192	291	--	--	--
Butternut	266	--	106	--	--	160	--	--	--
Sassafras	1,701	--	452	750	499	--	--	--	--
Total	2,861,283	--	847,705	722,411	495,154	326,615	190,914	244,490	33,994
All species	4,119,480	458,767	1,121,499	881,802	613,539	408,111	247,994	338,966	48,802

Table 14--Net volume of sawtimber on timberland by species group and diameter class, Northern Lower Peninsula, Michigan, 1993

(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									
Jack pine	652,919	377,311	194,632	54,452	20,820	4,668	1,036	--	--
Red pine	2,824,402	1,078,750	587,476	365,652	286,843	213,083	147,269	144,351	978
White pine	1,394,973	167,249	177,879	154,809	166,880	160,322	143,782	340,186	83,866
White spruce	187,341	48,405	51,289	34,712	25,817	15,390	1,903	9,825	--
Black spruce	64,714	34,012	20,681	3,359	2,884	3,778	--	--	--
Balsam fir	247,935	151,090	57,652	28,715	6,836	3,642	--	--	--
Hemlock	553,112	88,930	86,529	65,310	92,753	56,165	44,549	102,920	15,956
Tamarack	120,545	48,861	32,035	22,887	11,591	4,109	--	1,062	--
Eastern redcedar	2,666	1,093	--	686	--	--	--	887	--
Northern white-cedar	1,246,823	606,316	319,382	179,429	81,937	32,866	15,728	11,165	--
Other softwoods	110,733	87,165	17,778	4,610	1,180	--	--	--	--
Total	7,406,163	2,689,182	1,545,333	914,621	697,541	494,023	354,267	610,396	100,800
Hardwoods									
Select white oak	907,431	--	228,733	239,253	163,528	111,854	55,905	103,124	5,034
Select red oak	3,288,147	--	697,232	704,024	500,000	445,692	364,962	506,214	70,023
Other red oak	579,186	--	120,727	112,255	105,015	95,370	66,181	64,929	14,709
Select hickory	3,145	--	3,145	--	--	--	--	--	--
Other hickory	3,229	--	719	1,286	--	--	1,224	--	--
Basswood	1,146,677	--	414,326	314,296	202,661	106,577	56,215	49,314	3,288
Beech	632,110	--	107,724	85,696	127,591	94,281	80,040	122,327	14,451
Yellow birch	118,263	--	48,485	20,728	18,760	18,670	5,159	6,461	--
Hard maple	2,191,113	--	735,860	577,616	349,376	216,690	128,443	153,891	29,237
Soft maple	2,620,173	--	824,242	615,496	446,741	285,641	152,260	225,913	69,880
Elm	47,149	--	20,180	12,427	5,235	2,511	3,225	3,571	--
Black ash	94,748	--	40,251	25,928	18,537	1,743	4,758	3,531	--
White and green ash	829,926	--	199,361	196,155	185,937	124,726	52,169	58,912	12,666
Sycamore	6,243	--	--	--	--	3,047	--	3,196	--
Cottonwood	70,003	--	4,877	9,899	13,194	6,278	6,329	24,643	4,783
Willow	30,990	--	1,889	4,214	7,496	3,077	5,202	9,112	--
Balsam poplar	392,690	--	75,092	81,588	66,739	60,286	39,459	64,143	5,383
Bigtooth aspen	2,395,032	--	895,756	752,263	397,460	192,107	95,674	60,252	1,520
Quaking aspen	1,880,131	--	639,550	510,810	343,142	212,059	75,521	99,049	--
Paper birch	379,220	--	189,360	95,627	46,746	30,332	12,840	4,315	--
Tupelo	1,886	--	--	1,886	--	--	--	--	--
Black cherry	303,039	--	96,362	73,773	59,936	33,497	9,022	29,230	1,219
Black walnut	3,703	--	675	--	1,193	1,835	--	--	--
Butternut	1,706	--	706	--	--	1,000	--	--	--
Sassafras	10,423	--	2,805	4,566	3,052	--	--	--	--
Total	17,936,363	--	5,348,057	4,439,786	3,062,339	2,047,273	1,214,588	1,592,127	232,193
All species	25,342,526	2,689,182	6,893,390	5,354,407	3,759,880	2,541,296	1,568,855	2,202,523	332,993

[1]International 1/4-inch rule.

Table 15.--Net volume of growing stock and sawtimber on timberland by county and major species group, Northern Lower Peninsula, Michigan, 1993

County	Growing-stock					Sawtimber				
		Species group					Species group			
	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
	Thousand cubic feet					*Thousand board feet* [1]				
Alcona	489,983	59,632	59,672	216,855	153,824	1,277,584	175,619	143,742	527,916	430,307
Alpena	308,737	32,395	86,884	155,077	34,381	749,064	131,415	180,764	347,224	89,661
Antrim	335,828	18,831	29,961	158,855	128,181	755,000	46,614	101,187	355,776	251,423
Arenac	145,689	12,838	5,420	96,214	31,217	365,927	44,301	11,928	215,052	94,646
Bay	56,318	--	--	46,683	9,635	130,943	--	--	98,551	32,392
Benzie	226,845	42,803	14,632	76,065	93,345	570,902	73,967	41,350	207,102	248,483
Charlevoix	375,396	33,571	75,529	122,610	143,686	1,032,994	138,401	195,602	336,287	362,704
Cheboygan	438,074	66,354	67,153	190,445	114,122	1,032,210	216,281	168,675	447,880	199,374
Clare	328,363	54,546	14,033	165,869	93,915	818,238	149,140	31,626	327,092	310,380
Crawford	305,796	103,661	16,792	74,003	111,340	719,822	329,082	33,112	115,870	241,758
Emmet	371,533	19,984	37,590	144,519	169,440	904,641	77,759	92,585	370,216	364,081
Gladwin	212,062	18,463	3,729	157,635	32,235	498,457	60,462	7,794	341,742	88,459
Grand Traverse	273,855	93,864	27,077	85,924	66,990	608,278	131,380	68,045	212,887	195,966
Iosco	314,680	91,258	46,587	129,187	47,648	807,836	256,874	117,647	321,952	111,363
Isabella	142,954	6,209	7,433	84,282	45,030	404,980	8,850	18,123	212,105	165,902
Kalkaska	375,844	117,683	28,471	114,165	115,525	800,400	241,100	77,840	246,036	235,424
Lake	442,830	123,828	18,314	104,441	196,247	1,252,515	369,629	37,234	233,427	612,225
Leelanau	176,598	24,605	12,231	34,261	105,501	504,292	57,235	34,640	89,816	322,601
Manistee	369,809	73,384	15,624	131,178	149,623	967,541	144,587	43,979	341,116	437,859
Mason	235,540	51,614	3,580	93,139	87,207	604,135	84,716	11,473	227,985	279,961
Mecosta	213,473	23,458	17,580	121,864	50,571	541,008	84,068	45,780	267,523	143,637
Midland	231,367	13,175	5,553	158,814	53,825	605,634	58,691	15,356	376,609	154,978
Missaukee	297,564	51,617	41,147	137,513	67,287	706,107	150,421	99,124	268,108	188,454
Montmorency	342,233	63,149	38,167	137,348	103,569	827,244	233,152	71,001	260,461	262,630
Newaygo	543,442	103,935	17,839	185,833	235,835	1,605,242	282,791	59,645	512,132	750,674
Oceana	244,813	44,143	14,798	97,797	88,075	644,059	110,186	45,568	213,814	274,491
Ogemaw	287,737	41,682	25,434	146,543	74,078	631,115	90,276	46,970	332,816	161,053
Osceola	232,124	19,015	34,845	105,284	72,980	646,363	45,643	122,052	253,561	225,107
Oscoda	312,463	103,203	16,583	99,300	93,377	863,005	343,613	33,112	208,316	277,964
Otsego	379,754	53,606	33,235	136,147	156,766	807,199	140,808	78,493	293,463	294,435
Presque Isle	367,629	50,626	109,375	151,937	55,691	835,822	192,096	243,682	291,707	108,337
Roscommon	353,737	58,334	56,717	124,193	114,493	922,802	222,194	98,116	263,740	338,752
Wexford	414,589	142,443	28,645	110,204	133,297	901,167	283,529	55,038	251,405	311,195
All counties	10,147,659	1,813,909	1,010,630	4,094,184	3,228,936	25,342,526	4,974,880	2,431,283	9,369,687	8,566,676

[1] International 1/4-inch rule.

Table 16.--Net volume of timber on timberland by class of timber and major species group, Northern Lower Peninsula, Michigan, 1993

(In thousand cubic feet)

Class of timber	All species	Species group			
		Pine	Other softwoods	Soft hardwoods	Hard hardwoods
Live trees					
Growing-stock trees					
Sawtimber					
Saw log portion	4,119,480	849,311	408,886	1,497,063	1,364,220
Upper stem portion	1,296,415	114,639	68,056	586,737	526,983
Total	5,415,895	963,950	476,942	2,083,800	1,891,203
Poletimber	4,731,764	849,959	533,688	2,010,384	1,337,733
All growing-stock trees	10,147,659	1,813,909	1,010,630	4,094,184	3,228,936
Cull trees					
Short-log trees	168,341	11,434	14,732	62,744	79,431
Rough trees					
Sawtimber	252,656	27,842	27,624	93,187	104,003
Poletimber	250,148	28,242	26,423	107,157	88,326
Total	502,804	56,084	54,047	200,344	192,329
Rotten trees					
Sawtimber	84,269	1,223	10,497	47,752	24,797
Poletimber	29,258	796	5,289	17,787	5,386
Total	113,527	2,019	15,786	65,539	30,183
All cull trees	784,672	69,537	84,565	328,627	301,943
All live trees	10,932,331	1,883,446	1,095,195	4,422,811	3,530,879
Salvable dead trees					
Sawtimber	30,684	3,815	2,784	11,564	12,521
Poletimber	23,258	2,598	3,107	13,368	4,185
Total	53,942	6,413	5,891	24,932	16,706
All classes	10,986,273	1,889,859	1,101,086	4,447,743	3,547,585

Table 17.--Net volume of live trees and growing stock on timberland by ownership class and species group, Northern Lower Peninsula, Michigan, 1993

(In thousand cubic feet)

Ownership class	Live trees					Growing-stock trees				
		Species group					Species group			
	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
National forest	1,302,144	448,811	68,060	361,772	423,501	1,227,093	442,132	62,776	330,787	391,398
Misc. federal	16,199	5,996	712	7,020	2,471	15,720	5,931	550	6,918	2,321
State	2,586,669	561,600	312,573	1,004,571	707,925	2,398,603	540,359	288,355	923,342	646,547
County and municipal	117,741	31,833	16,509	36,362	33,037	107,693	31,538	14,603	33,205	28,347
Forest industry	12,155	- -	- -	4,245	7,910	10,887	- -	- -	3,104	7,783
Misc. private-corporation	887,460	134,260	98,804	385,937	268,459	822,861	128,110	89,867	360,316	244,568
Misc. private-individual/farmer	6,009,963	700,946	598,537	2,622,904	2,087,576	5,564,802	665,839	554,479	2,436,512	1,907,972
All owners	10,932,331	1,883,446	1,095,195	4,422,811	3,530,879	10,147,659	1,813,909	1,010,630	4,094,184	3,228,936

Table 18.--Average annual net growth of growing stock and sawtimber on timberland by county and major species group, Northern Lower Peninsula, Michigan, 1980-1992

County	Growing-stock					Sawtimber				
		Species group					Species group			
	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
	Thousand cubic feet					*Thousand board feet*[1]				
Alcona	13,062	2,887	1,091	5,073	4,011	53,516	9,024	3,976	21,857	18,659
Alpena	8,801	1,037	2,639	4,020	1,105	27,245	3,953	6,306	13,108	3,878
Antrim	10,482	963	817	4,389	4,313	31,756	2,868	3,424	14,892	10,572
Arenac	4,690	352	243	3,122	973	18,885	2,233	739	11,338	4,575
Bay	2,021	--	--	1,569	452	9,215	--	--	7,524	1,691
Benzie	7,819	2,332	407	2,332	2,748	25,167	5,966	1,007	8,461	9,733
Charlevoix	8,756	817	2,078	2,041	3,820	33,427	4,375	6,070	10,471	12,511
Cheboygan	13,616	2,892	1,729	5,099	3,896	41,581	9,499	5,504	16,828	9,750
Clare	10,164	2,080	77	5,830	2,177	35,475	7,859	764	16,157	10,695
Crawford	8,708	2,936	365	2,252	3,155	32,386	13,963	1,495	5,628	11,300
Emmet	10,708	1,321	650	3,591	5,146	38,536	6,569	2,057	13,986	15,924
Gladwin	7,368	943	82	5,240	1,103	24,280	2,602	380	16,899	4,399
Grand Traverse	8,906	4,699	626	1,512	2,069	22,947	7,266	2,450	5,540	7,691
Iosco	9,072	3,185	1,044	3,484	1,359	37,732	14,426	3,502	14,269	5,535
Isabella	4,969	273	193	2,895	1,608	20,077	648	832	11,643	6,954
Kalkaska	13,019	5,590	714	3,172	3,543	35,073	11,767	3,274	10,415	9,617
Lake	13,552	4,932	587	3,032	5,001	52,408	17,764	1,734	11,055	21,855
Leelanau	5,741	1,507	321	1,113	2,800	19,870	4,342	1,186	3,196	11,146
Manistee	11,231	3,418	360	3,549	3,904	38,077	9,834	1,308	12,035	14,900
Mason	8,204	3,038	120	3,110	1,936	30,690	8,721	489	11,573	9,907
Mecosta	8,367	1,286	707	4,497	1,877	24,153	4,669	2,382	12,024	5,078
Midland	7,502	442	136	5,223	1,701	27,927	2,032	845	19,527	5,523
Missaukee	11,839	2,705	1,374	5,453	2,307	30,598	7,099	4,256	12,399	6,844
Montmorency	10,507	2,197	554	4,596	3,160	34,455	8,371	1,763	12,155	12,166
Newaygo	15,672	4,464	245	5,371	5,592	61,539	15,205	2,197	18,918	25,219
Oceana	7,880	1,622	481	3,183	2,594	26,789	6,230	1,846	7,744	10,969
Ogemaw	10,020	2,560	666	4,467	2,327	28,511	3,305	1,698	15,253	8,255
Osceola	7,730	1,263	674	3,746	2,047	25,015	3,787	3,490	9,463	8,275
Oscoda	10,442	4,280	659	2,846	2,657	36,290	14,044	1,293	8,807	12,146
Otsego	11,402	2,348	971	3,270	4,813	33,276	6,438	2,008	10,815	14,015
Presque Isle	9,677	1,519	2,723	3,707	1,728	31,383	6,883	7,990	11,919	4,591
Roscommon	8,093	1,227	1,313	2,879	2,674	35,712	6,364	3,630	11,292	14,426
Wexford	15,127	6,456	1,089	3,660	3,922	42,046	16,391	3,472	9,948	12,235
All counties	315,147	77,571	25,735	119,323	92,518	1,066,037	244,497	83,367	397,139	341,034

[1]International 1/4-inch rule.

Table 19.--Average annual removals of growing stock and sawtimber on timberland by county and major species group, Northern Lower Peninsula, Michigan, 1980-1992

County	Growing-stock					Sawtimber				
		Species group					Species group			
	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
		Thousand cubic feet					*Thousand board feet*[1]			
Alcona	4,138	447	47	1,871	1,773	10,043	1,796	78	4,036	4,133
Alpena	4,654	65	521	3,563	505	9,889	368	1,723	7,118	680
Antrim	2,044	--	--	584	1,460	5,505	--	--	1,304	4,201
Arenac	1,020	21	62	762	175	2,111	--	--	1,700	411
Bay	894	--	--	807	87	2,175	--	--	2,117	58
Benzie	3,092	19	30	1,792	1,251	9,520	--	--	4,814	4,706
Charlevoix	3,372	1,495	709	985	183	9,155	4,944	920	2,506	785
Cheboygan	2,970	212	230	2,186	342	4,892	854	512	3,045	481
Clare	3,117	308	50	2,661	98	9,145	1,271	--	7,450	424
Crawford	3,501	545	--	1,342	1,614	4,913	1,697	--	1,903	1,313
Emmet	3,813	1,319	113	1,318	1,063	11,005	4,404	520	4,056	2,025
Gladwin	2,932	30	--	2,845	57	7,816	48	--	7,509	259
Grand Traverse	1,034	327	--	359	348	2,153	--	--	466	1,687
Iosco	3,559	674	375	2,169	341	9,600	1,379	1,463	6,052	706
Isabella	409	--	62	245	102	855	--	339	85	431
Kalkaska	2,616	1,624	106	631	255	8,979	6,390	237	1,366	986
Lake	5,817	1,620	13	1,879	2,305	9,824	2,086	--	3,522	4,216
Leelanau	1,272	224	142	342	564	4,681	1,227	322	1,008	2,124
Manistee	2,977	1,036	--	595	1,346	7,501	2,807	--	1,308	3,386
Mason	2,329	356	243	1,433	297	4,920	1,239	998	1,656	1,027
Mecosta	923	--	25	767	131	2,249	--	135	1,872	242
Midland	1,475	--	--	1,440	35	1,921	--	--	1,759	162
Missaukee	877	204	--	492	181	2,185	82	--	1,369	734
Montmorency	3,056	1,291	54	1,269	442	6,961	2,494	202	2,790	1,475
Newaygo	6,771	1,060	--	3,251	2,460	18,037	2,727	--	6,326	8,984
Oceana	2,513	308	24	1,140	1,041	8,084	768	132	3,263	3,921
Ogemaw	5,077	901	106	2,487	1,583	11,016	1,466	--	5,733	3,817
Osceola	4,026	240	--	3,605	181	9,077	--	--	8,634	443
Oscoda	4,811	2,850	128	835	998	9,008	4,353	160	1,692	2,803
Otsego	4,646	834	16	1,825	1,971	11,732	2,145	85	2,837	6,665
Presque Isle	4,366	134	2,106	2,068	58	9,743	742	3,717	5,284	--
Roscommon	3,147	1,120	272	1,271	484	8,274	4,196	275	2,690	1,113
Wexford	4,843	1,828	6	2,261	748	8,525	2,664	--	3,992	1,869
All counties	102,091	21,092	5,440	51,080	24,479	241,494	52,147	11,818	111,262	66,267

[1]International 1/4-inch rule.

Table 20.--Average annual net growth, average annual mortality, and average annual removals of growing stock and sawtimber on timberland by species group, Northern Lower Peninsula, Michigan, 1980-1992

Species group	Growing-stock			Sawtimber		
	Net growth [1]	Mortality	Removals	Net growth [1]	Mortality	Removals
	Thousand cubic feet			*Thousand board feet* [2]		
Softwoods						
Jack pine	4,437	7,904	7,077	22,216	14,630	15,208
Red pine	55,375	439	10,676	151,188	1,157	26,016
White pine	13,872	796	2,623	61,912	3,377	10,289
White spruce	3,230	919	125	8,824	3,697	276
Black spruce	19	1,141	143	-173	1,910	494
Balsam fir	2,622	3,616	1,239	8,046	5,950	2,373
Hemlock	3,527	206	248	17,635	837	1,192
Tamarack	746	576	--	3,112	1,651	--
Eastern redcedar	65	1	--	299	8	--
Northern white-cedar	14,848	1,374	3,685	44,887	2,290	7,483
Other softwoods	4,565	301	716	9,918	20	634
Total	103,306	17,273	26,532	327,864	35,527	63,965
Hardwoods						
Select white oak	8,930	255	2,893	34,012	470	5,302
Other white oak	25	--	--	--	--	--
Select red oak	27,175	4,449	10,786	129,933	7,658	29,908
Other red oak	4,164	982	1,312	18,929	1,845	3,022
Select hickory	47	--	--	167	--	--
Other hickory	68	11	--	76	--	--
Basswood	7,584	2,375	2,266	37,500	6,317	8,396
Beech	6,118	268	1,186	20,903	638	4,328
Yellow birch	982	465	70	3,583	1,164	200
Hard maple	33,508	2,226	6,309	91,747	4,012	18,292
Soft maple	42,008	3,397	9,323	121,017	6,941	16,789
Elm	1,626	1,254	303	1,621	2,316	371
Black ash	2,825	1,081	1,478	3,768	857	2,717
White and green ash	11,159	1,161	1,885	41,041	1,993	5,134
Sycamore	21	--	--	111	--	--
Cottonwood	457	155	13	1,980	779	47
Willow	152	99	105	688	350	188
Balsam poplar	2,726	3,055	1,246	9,214	10,038	5,365
Bigtooth aspen	29,975	10,235	20,420	115,913	22,711	46,264
Quaking aspen	23,008	16,642	9,718	76,497	34,850	22,674
Paper birch	5,143	3,725	4,133	16,006	3,989	4,889
River birch	-6	6	--	-29	30	--
Tupelo	40	--	14	64	--	--
Black cherry	3,775	460	2,061	12,873	327	3,562
Black walnut	15	1	--	158	3	--
Butternut	-17	35	--	-113	163	--
Sassafras	190	11	38	514	18	81
Other hardwoods	143	10	--	--	--	--
Total	211,841	52,358	75,559	738,173	107,469	177,529
All species	315,147	69,631	102,091	1,066,037	142,996	241,494

[1] An estimate of average gross growth may be computed by adding average mortality to average net growth.

[2] International 1/4-inch rule.

Table 21.--Average annual net growth and average annual removals of growing stock on timberland by ownership class and major species group, Northern Lower Peninsula, Michigan, 1980-1992

(In thousand cubic feet)

Ownership class	Growth					Removals				
		Species group					Species group			
	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
National forest	39,487	18,951	909	9,262	10,365	15,625	6,739	433	4,893	3,560
Misc. federal	307	100	14	125	68	--	--	--	--	--
State	73,397	20,153	6,521	27,402	19,321	31,123	8,826	810	14,832	6,655
County and municipal	3,373	1,625	293	847	608	440	64	63	58	255
Forest industry	265	--	--	96	169	237	--	--	237	--
Misc. private-corporation	23,353	5,088	2,307	9,340	6,618	7,842	906	134	4,704	2,098
Misc. private-individual/farmer	174,965	31,654	15,691	72,251	55,369	46,824	4,557	4,000	26,356	11,911
All owners	315,147	77,571	25,735	119,323	92,518	102,091	21,092	5,440	51,080	24,479

Table 22.--Average annual net growth and average annual removals of sawtimber on timberland by ownership class and major species group, Northern Lower Peninsula, Michigan, 1980-1992

(In thousand board feet) [1]

Ownership class	Growth					Removals				
		Species group					Species group			
	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
National forest	133,636	59,811	3,963	29,942	39,920	28,782	11,424	1,495	8,533	7,330
Misc. federal	1,608	649	26	788	145	--	--	--	--	--
State	240,712	70,742	18,932	86,548	64,490	62,613	23,035	1,670	25,976	11,932
County and municipal	9,255	3,017	781	1,887	3,570	990	341	226	124	299
Forest industry	1,159	--	--	362	797	196	--	--	196	--
Misc. private-corporation	85,486	14,295	7,469	34,685	29,037	22,118	2,236	81	13,655	6,146
Misc. private-individual/farmer	594,181	95,983	52,196	242,927	203,075	126,795	15,111	8,346	62,778	40,560
All owners	1,066,037	244,497	83,367	397,139	341,034	241,494	52,147	11,818	111,262	66,267

[1] International 1/4-inch rule.

Table 23.--Current annual net growth, current annual mortality, and 1990 removals of growing stock and sawtimber on timberland by species group, Northern Lower Peninsula, Michigan, 1992

Species group	Growing stock			Sawtimber		
	1992 Net Growth [1]	1992 Mortality	1990 Removals [2]	1992 Net Growth[1]	1992 Mortality	1990 Removals[2]
	----- *Thousand cubic feet* -----			----- *Thousand board feet* [3] -----		
Softwoods						
Jack pine	3,870	8,431	7,796	19,475	17,648	24,594
Red pine	57,771	95	11,915	218,015	685	61,739
White pine	16,270	507	1,366	73,661	1,931	7,325
White spruce	4,601	476	292	20,659	2,123	1,012
Black spruce	80	1,201	*	268	2,087	*
Balsam fir	4,771	2,477	346	14,237	5,310	1,259
Hemlock	3,918	215	133	17,998	1,021	424
Tamarack	751	657	--	3,453	1,486	--
Eastern redcedar	65	1	--	299	8	--
Northern white-cedar	13,915	725	1,188	44,402	2,570	3,878
Other softwoods	4,902	34	--	13,476	72	--
Total	110,914	14,819	23,036	425,943	34,941	100,231
Hardwoods						
Select white oak	9,466	19	3,517	36,071	497	9,211
Other white oak	25	--	--	--	--	--
Select red oak	27,484	5,536	17,351	136,800	10,669	68,621
Other red oak	4,612	1,360	--	20,298	3,011	--
Select hickory	42	4	10	617	8	65
Other hickory	28	22	--	428	10	--
Basswood	7,232	2,930	3,271	35,653	8,512	13,313
Beech	6,501	504	1,270	27,561	1,477	5,325
Yellow birch	807	626	103	2,845	1,345	349
Hard maple	34,910	2,812	7,383	112,008	4,743	33,505
Soft maple	45,888	4,687	12,427	145,548	8,990	35,085
Elm	3,124	780	36	5,061	1,423	214
Black ash	3,447	1,148	2,016	4,894	704	7,581
White and green ash	12,619	1,462	**	48,417	1,629	**
Sycamore	15	4	--	82	21	--
Cottonwood	550	70	90	3,118	295	454
Willow	278	31	--	949	117	--
Balsam poplar	3,554	2,676	292	17,277	7,776	431
Bigtooth aspen	32,690	12,808	53,638	122,387	33,473	128,895
Quaking aspen	29,083	16,642	***	95,539	34,850	***
Paper birch	5,975	2,785	3,909	20,743	3,909	8,190
Tupelo	41	7	--	59	7	--
Black cherry	4,326	442	--	16,068	767	--
Black walnut	19	2	1	143	10	15
Butternut	15	1	--	58	5	--
Sassafras	145	53	--	259	150	--
Other hardwoods	204	27	973	985	6	2,585
Total	233,055	57,438	106,287	853,868	124,404	313,839
All species	343,969	72,257	129,323	1,279,811	159,345	414,070

[1] An estimate of current gross growth may be computed by adding current mortality to current net growth.

[2] Based on mill survey data (Hackett and Pilon 1993). For the Northern Lower Peninsula, 1990 is the most current mill survey.

[3] International 1/4-inch rule.

* Removals for the black spruce species group are included in the removals for white spruce.

** Removals for the white and green ash species group are included in the removals for black ash.

*** Removals for the quaking aspen species group are included in the removals for bigtooth aspen.

Table 24.--Net volume of sawtimber trees on timberland by species group and butt log grade or tree grade, Northern Lower Peninsula, Michigan, 1993

(In thousand board feet)[1]

Species	All grades	Butt log grade 1	2	3	Tie and timber
Softwoods					
Jack pine	652,919	3,099	--	649,820	--
Red pine	2,824,402	124,683	167,039	2,532,681	--
White pine	1,394,973	150,954	309,833	735,839	198,347
White spruce	187,341	10,450	23,921	152,970	--
Black spruce	64,714	--	2,675	62,039	--
Balsam fir	247,935	--	10,518	237,417	--
Hemlock	553,112	14,180	48,723	490,210	--
Tamarack	120,545	2,980	5,091	112,474	--
Eastern redcedar	2,666	--	--	--	--
Northern white-cedar	1,246,823	--	49,682	1,197,141	--
Other softwoods	110,733	--	--	110,733	--
Total	7,406,163	324,234	624,197	6,252,601	205,131

Species	All grades	Tree grade 1	2	3	Tie and timber
Hardwoods					
Select white oak	907,431	75,397	257,833	431,947	142,254
Select red oak	3,288,147	547,539	1,161,255	1,205,385	373,968
Other red oak	579,186	30,560	88,610	274,393	185,623
Select hickory	3,145	--	--	--	--
Other hickory	3,229	--	--	--	--
Basswood	1,146,677	187,942	508,652	441,513	8,570
Beech	632,110	96,915	170,568	290,173	74,454
Yellow birch	118,263	14,741	32,558	61,906	9,059
Hard maple	2,191,113	232,231	653,856	1,115,103	189,923
Soft maple	2,620,173	237,813	700,978	1,413,667	267,716
Elm	47,149	16,481	25,981	4,687	--
Black ash	94,748	2,296	37,540	50,390	4,522
White and green ash	829,926	213,805	304,598	296,876	14,647
Sycamore	6,243	--	--	--	--
Cottonwood	70,003	45,504	13,405	8,758	2,336
Willow	30,990	3,759	14,108	7,566	5,557
Balsam poplar	392,690	61,657	106,040	177,470	47,523
Bigtooth aspen	2,395,032	116,507	731,258	1,350,867	196,400
Quaking aspen	1,880,131	99,557	545,517	1,004,131	230,926
Paper birch	379,220	5,776	78,821	263,314	31,309
Tupelo	1,886	--	--	--	--
Black cherry	303,039	56,609	75,586	153,242	17,602
Black walnut	3,703	--	3,703	--	--
Butternut	1,706	--	--	1,706	--
Sassafras	10,423	--	5,590	4,833	--
Total	17,936,363	2,038,291	5,458,423	8,443,066	1,996,583
All species	25,342,526	2,261,287	5,763,749	15,236,951	2,080,540

[1]International 1/4-inch rule.

Table 25.--Comparison of adjusted 1980 and 1993 area and growing-stock volume by forest type, Northern Lower Peninsula, Michigan

Forest type	Area 1980	Area 1993	Change in area amount	Percent change in area 1980-93	Growing-stock volume 1980	Growing-stock volume / acre 1980	Growing-stock volume 1993	Growing-stock volume / acre 1993	Change in amount of volume	Percent change growing-stock 1980-93
	(thousand acres)	*(thousand acres)*	*(thousand acres)*	*(%)*	*(thousand cubic feet)*	*(cubic feet per acre)*	*(thousand cubic feet)*	*(cubic feet per acre)*	*(thousand cubic feet)*	*(%)*
Jack pine	594.3	516.0	-78.3	-13.2	394,413	664	377,932	732	-16,481	-4.2
Red pine	387.3	591.1	203.8	52.6	450,872	1,164	1,119,817	1,894	668,945	148.4
White pine	70.1	95.9	25.8	36.8	90,020	1,284	155,621	1,623	65,601	72.9
Balsam fir	57.1	62.2	5.1	8.9	56,026	981	66,652	1,072	10,626	19.0
White spruce	12.5	25.0	12.5	100.0	8,006	640	18,043	722	10,037	125.4
Black spruce	29.2	22.4	-6.8	-23.3	14,373	492	13,512	603	-861	-6.0
Northern white-cedar	368.0	418.0	50.0	13.6	538,032	1,462	679,729	1,626	141,697	26.3
Tamarack	32.3	38.2	5.9	18.3	12,495	387	31,253	818	18,758	150.1
Oak-hickory	1,051.0	1,158.1	107.1	10.2	1,023,495	974	1,564,974	1,351	541,179	52.9
Elm-ash-soft maple	462.9	545.7	82.8	17.9	471,632	1,019	676,126	1,239	204,494	43.4
Maple-birch	1741.4	2,126.2	384.8	22.1	2,209,225	1,269	3,469,595	1,632	1,260,370	57.1
Aspen	1680.1	1,412.6	-267.5	-15.9	1,522,599	906	1,748,968	1,238	226,369	14.9
Paper birch	125.3	106.4	-18.9	-15.1	137,635	1,098	167,841	1,577	30,206	21.9
Balsam poplar	59.9	53.6	-6.3	-10.5	50,284	839	52,949	988	2,665	5.3
Nonstocked	30.3	46.1	15.8	52.1	173	6	4,647	101	4,474	2,586.1
Total/ average	6,701.7	7,217.5	515.8	7.7	6,979,280	1,041	10,147,659	1,406	3,168,379	45.4

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The fifth inventory of Michigan's Northern Lower Peninsula forests reports 11,345.1 thousand acres of land, of which 7,415.2 thousand acres are forested. This bulletin presents statistical highlights and contains detailed tables of forest area, as well as timber volume, growth, removals, mortality, and ownership.

KEY WORDS: Forest area, timber volume, growth, removals, mortality.

Our job at the North Central Forest Experiment Station is discovering and creating new knowledge and technology in the field of natural resources and conveying this information to the people who can use it. As a new generation of forests emerges in our region, managers are confronted with two unique challenges: (1) Dealing with the great diversity in composition, quality, and ownership of the forests, and (2) Reconciling the conflicting demands of the people who use them. Helping the forest manager meet these challenges while protecting the environment is what research at North Central is all about.