United States Department of Agriculture

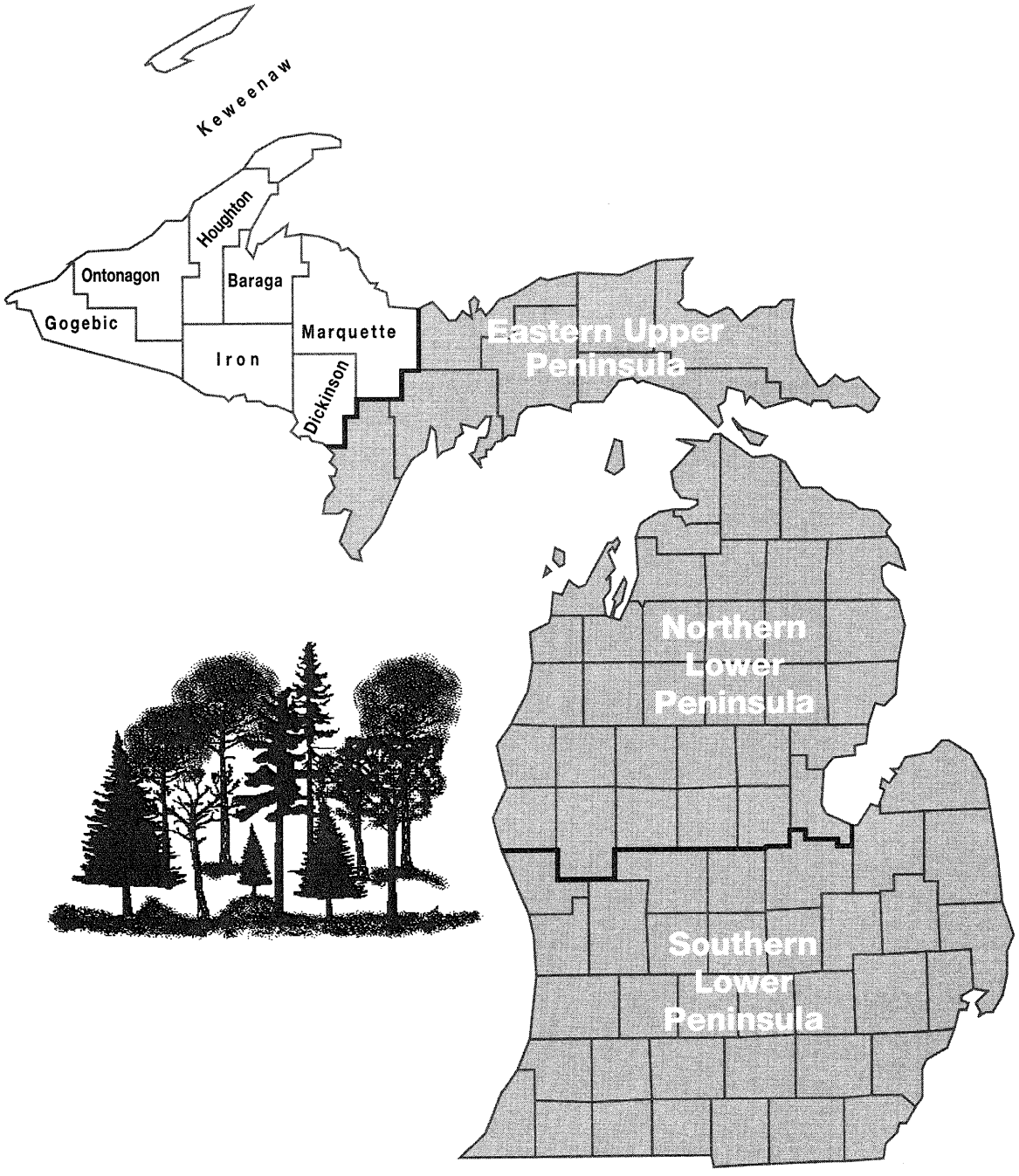
Forest Service

North Central Forest Experiment Station

Resource Bulletin **NC-153**

Forest Statistics for Michigan's Western Upper Peninsula Unit, 1993

Earl C. Leatherberry



North Central Forest Experiment Station
Forest Service—U.S. Department of Agriculture
1992 Folwell Avenue
St. Paul, Minnesota 55108
Manuscript approved for publication January 24, 1994
1994

This report includes the most commonly used Forest Inventory and Analysis (FIA) statistics from the U.S. Department of Agriculture, Forest Service. 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.

Requests for information may be directed to:

Project Leader
Forest Inventory and Analysis
North Central Forest Experiment Station
1992 Folwell Avenue
St. Paul, Minnesota 55108
Phone: (612) 649-5139

or

State Forester
Michigan Department of Natural Resources
Forestry Division
P.O. Box 30028
Lansing, Michigan 48909
Phone: (517) 373-1275

Area served: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, Wisconsin.

Printed on recycled and recyclable paper.

FOREWORD

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 Western Upper Peninsula Unit was begun in April 1991 and completed in September 1992. 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 tripled, providing reliable data at a county level. Such sampling was made possible through the cooperation, assistance, and additional funding provided by the Michigan Department of Natural Resources (MiDNR) and the Michigan State Legislature. 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.

Contents

Forest Statistics for Michigan's Western Upper Peninsula Unit, 1993

Earl C. Leatherberry

HIGHLIGHTS

NOTE: *Data from new forest inventories are often compared with data from earlier inventories to determine trends in forest resources. However, for the comparisons 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 made 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. Please refer to the appendix section labeled "Comparing the Fifth Inventory of the Western Upper Peninsula with the Fourth Inventory" for more details.* ***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

The Western Upper Peninsula of Michigan (fig. 1) is comprised of eight counties. Natural resource exploitation has long driven the economy of the region. During the 1840's, one of the richest mining eras in American history was centered on the Keweenaw Peninsula, giving the region its current nickname of Copper Country. During the 1880's and 1890's, most of the virgin stands of timber were cut and used to build the cities and towns of the Midwest. Later, iron ore mining dominated economic activity in the region. Today, nearly all the mines are closed, only remnant stands of the old growth timber remain, and younger trees now abound. Forest resources once again support much of the economic activity of the region.

In the Western Upper Peninsula, the deciduous and coniferous forests merge, in a region of unsurpassed beauty and charm. Several forested areas attract visitors seeking recreation experiences where solitude is valued; for example, the Sylvania, Sturgeon River Gorge, and McCormick National Wilderness Areas, administered by the Ottawa National Forest; and the Porcupine Mountain Wilderness State Park, and Isle Royale National Park. The region has some of the oldest exposed volcanic rock on Earth. The Huron, Keweenaw, and Porcupine Mountains possess landscapes that are uncommon in the Upper Midwest. During the winter, the hills and forests of the region are used for a variety of outdoor recreational activities. The diverse forest once again supports wildlife species, such as the eastern timber wolf and moose, which were nearly extinct in the area. The following are some major highlights from the 1993 inventory of Michigan's Western Upper Peninsula, with comparisons to 1980, the year of the previous inventory.

Area

- In 1993 forest land accounted for 4.8 million acres (88 percent of the Unit's land area). The vast majority of forest land (95 percent) was classified timberland. Most of the remaining forest land was classified as reserved timberland.

- Between 1980 and 1993, total area of forest land in the Unit increased by 24,700 acres. This modest increase reverses a two-decade-long pattern of decline in forest land.

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

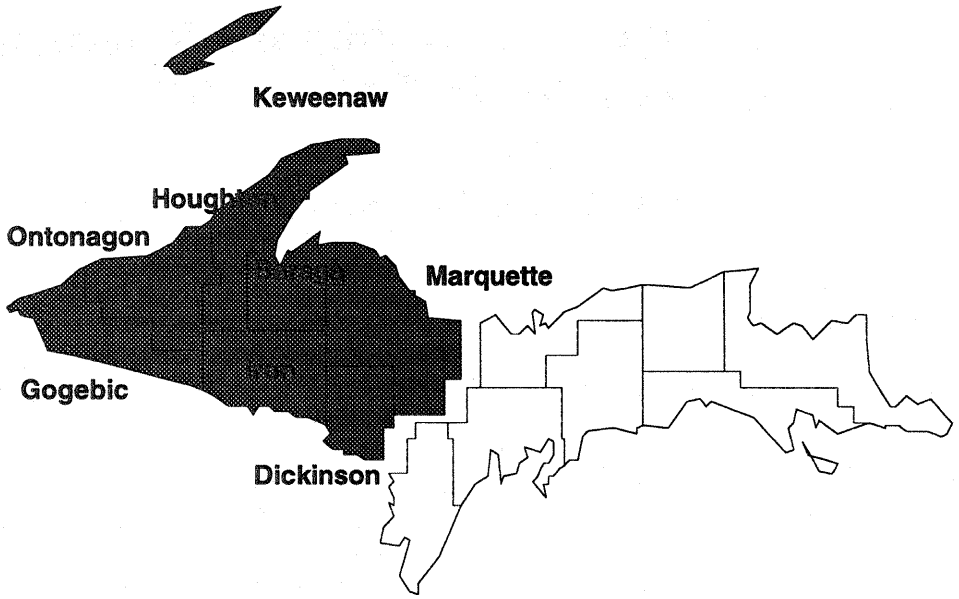


Figure 1.—*Western Upper Peninsula Unit, 1993.*

- Between inventories, timberland area increased by 83,800 acres. The increase in timberland resulted largely because land classed as unproductive forest land in 1980 was found to be marginally productive in 1993. Also, some land classed as productive-reserved in 1980 has been reclassified as timberland. Unproductive forest land and reserved timberland declined by 24,900 and 34,200 acres, respectively, between inventories.

- Marquette County contains 1 million acres of timberland—more timberland than in any other county in the Unit. Timberland area in Marquette County amounts to 22 percent of the Unit's total (fig. 2).

- Every county in the Unit is at least 80-percent forested. In Gogebic and Keweenaw Counties, 9 of every 10 acres of land are forested.

- Forest industries (24 percent) and private individuals (24 percent) together own nearly half of the timberland in the Unit. Thirty-four percent of the Unit's timberland area is publicly owned, the largest proportion (19 percent) being in the Ottawa National Forest. The remaining 18 percent is owned by miscellaneous corporations not engaged in the forest industry (fig. 3). Less than 1-percent (6 thousand acres) of timberland is Indian owned.

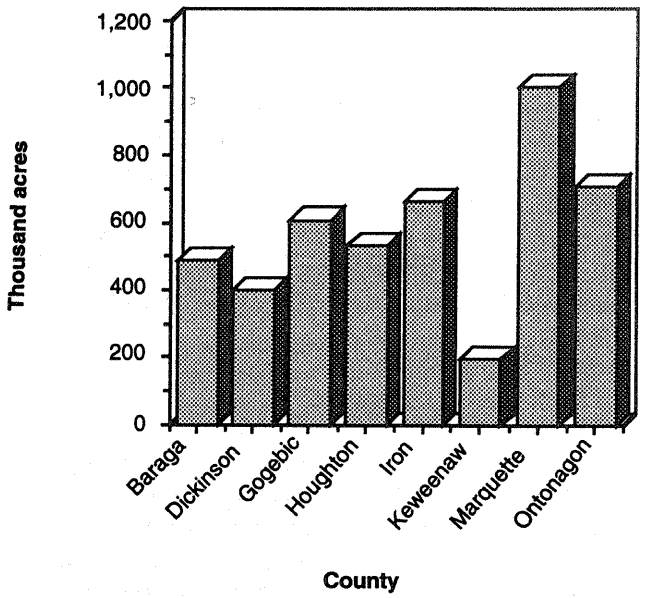


Figure 2.—*Area of timberland by county, Western Upper Peninsula, 1993.*

- The maple-birch forest type continues to dominate timberland area, occupying 54 percent of the timberland area, compared to 52 percent in 1980 (fig. 4).

- In 1993 almost half (49 percent) the Unit's timberland was in the sawtimber stand-size class. The area in sawtimber-size stands increased between inventories. In 1980 close to half (44 percent) of the timberland

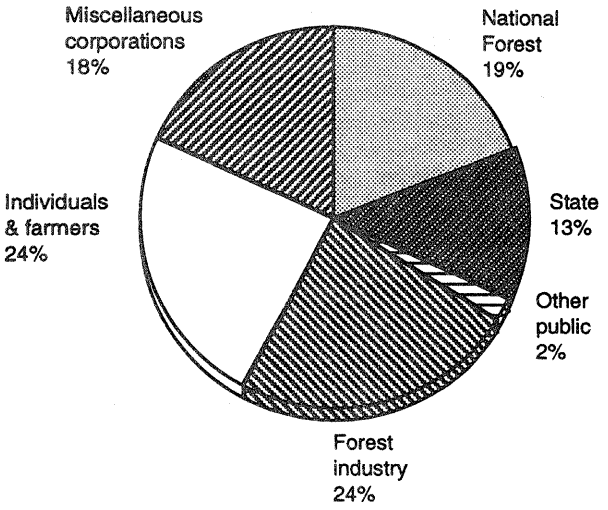


Figure 3.—*Area of timberland by ownership class, Western Upper Peninsula, 1993.*

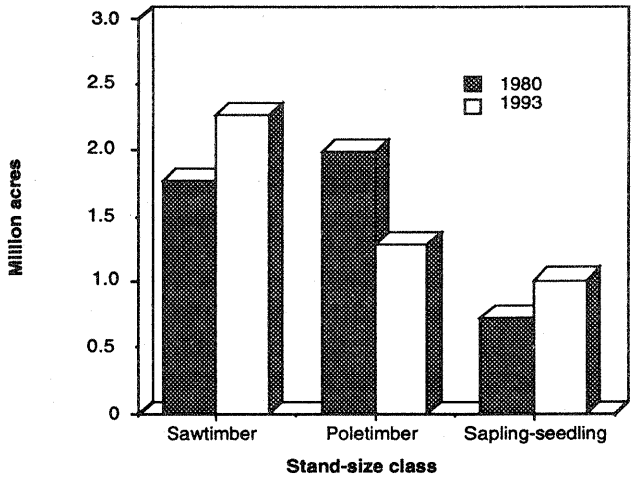


Figure 5.—*Area of timberland by stand size class, Western Upper Peninsula, 1980 and 1993.*

was in poletimber stands compared to 28 percent in 1993. The increase in sawtimber-size stands and the corresponding decline in poletimber-size stands show the continuing maturation of forest stands in the Western Upper Peninsula. The area in sapling-seedling stands increased by 40 percent (290,000 acres) between inventories (fig. 5).

Volume

- Growing-stock volume on timberland increased 19 percent between inventories, from 6.2 billion cubic feet in 1980 to 7.3 billion cubic feet in 1993. Average growing-stock volume per acre in 1993 was 1,590 cubic feet, compared to 1,365 cubic feet in 1980.

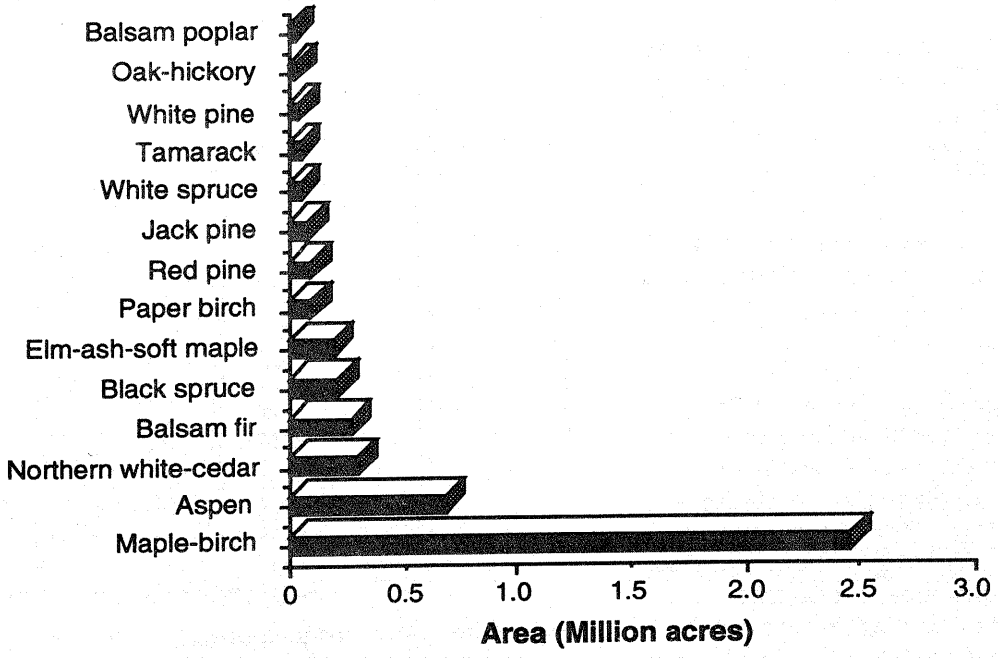


Figure 4.—*Area of timberland by forest type, Western Upper Peninsula, 1993.*

- In 1993 sawtimber volume totaled 20.2 billion board feet, up one-third since 1980 when sawtimber volume was 15.2 billion board feet.

- Softwood growing-stock volume totaled 2.3 billion cubic feet in 1993. Fifty-nine percent (1.4 billion cubic feet) of this volume is in three species groups—hemlock, northern white-cedar, and balsam fir (fig. 6). Between inventories, the growing-stock volume of balsam fir declined by 2.8 percent, and the growing-stock volume of northern white-cedar and hemlock increased by 28 and 19 percent, respectively.

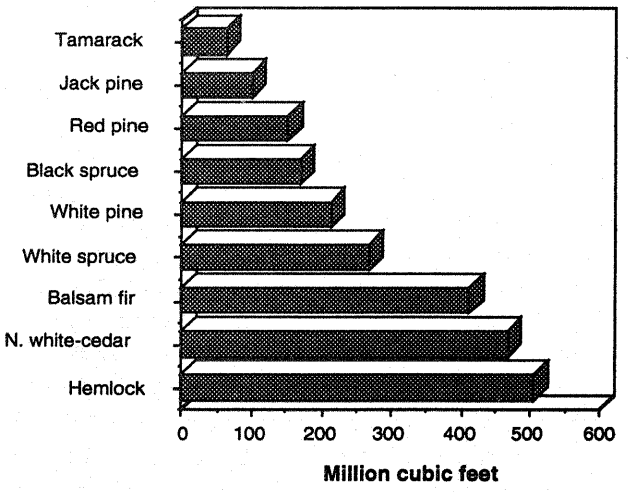


Figure 6.—*Growing-stock volume for softwoods by major species groups, Western Upper Peninsula, 1993.*

- Hardwood growing-stock volume totaled 5 billion cubic feet in 1993, an increase of 18 percent over 1980. Fifty-seven percent (2.8 billion cubic feet) of hardwood growing-stock volume is in maples (fig. 7).

- Hard maple, hemlock, and white pine accounted for 69 percent of the growing-stock volume in trees over 21 inches in diameter, and this volume accounts for 4 percent of total growing-stock volume. These larger and generally older trees have aesthetic appeal not associated with smaller trees. Also, the larger trees and older stands provide wildlife food and cover not available in younger stands.

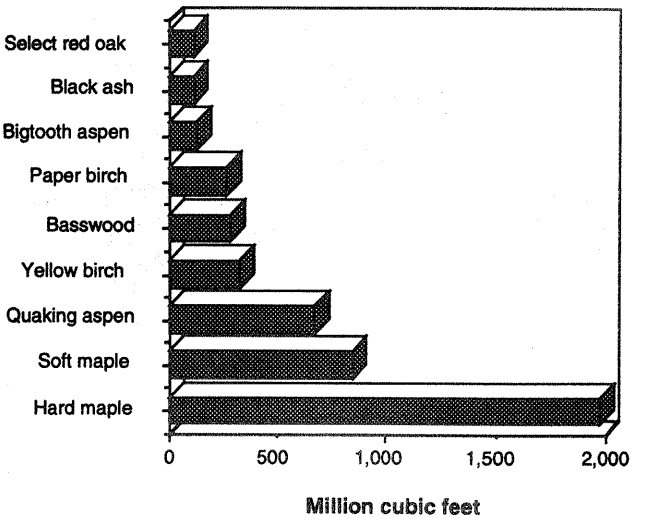


Figure 7.—*Growing-stock volume for hardwoods by major species groups, Western Upper Peninsula, 1993.*

- Growing-stock volume of all four major species groups increased from 1980 to 1993 (fig. 8). The greatest proportional increase was for pines, which increased by 29 percent, followed by an increase of 28 percent for hard hardwoods, 18 percent for other softwoods, and 9 percent for soft hardwoods.

- Between 1980 and 1993, growing-stock volume increased for all species groups except jack pine, balsam fir, select white oak, yellow birch, and elm. The volume of

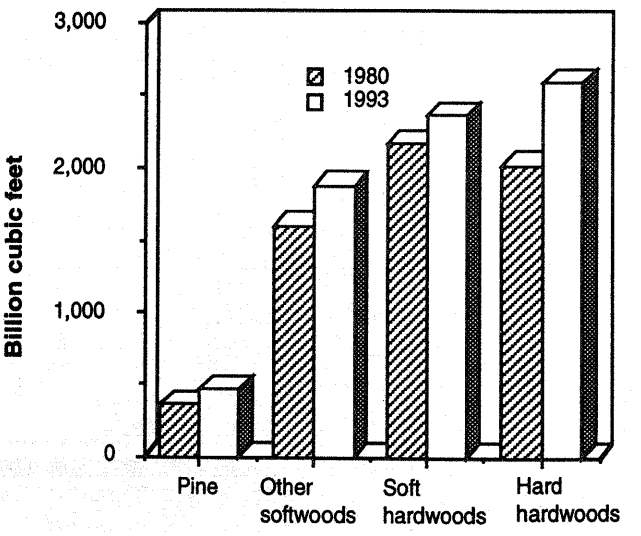


Figure 8.—*Net volume of growing-stock by four major species groups, Western Upper Peninsula, 1993.*

elm declined by 109.4 million cubic feet (74 percent) as a result of the spread of Dutch elm disease during the years between inventories. The decline in the other species was more modest.

- Twenty-five percent of the growing-stock volume in the Unit is on forest industry timberland. Nonindustrial private owners hold 43 percent of the growing-stock volume. Thirty-two percent of the volume is on public timberland. The Ottawa National Forest administers 18 percent of the Unit's total volume and 29 percent of the Unit's pine volume.

- In addition to the 7.3 billion cubic feet of growing stock in the Unit, there are 940.8 million cubic feet in cull trees (rough and rotten) and in salvable dead trees.

- Hard maple accounted for 41 percent of all hardwood volume with a tree grade of one, best of the four tree grades used.

TIMBER GROWTH, REMOVALS, AND MORTALITY

Growth

- Average net annual growth of growing stock on timberland in the Western Upper Peninsula of Michigan was 167.8 million cubic feet during the period 1980 through 1992.

- Softwoods accounted for 52 million cubic feet (31 percent) of the total average net annual growth of growing stock between 1980 and 1992. Hardwoods accounted for 115.7 million cubic feet (69 percent).

- Growing-stock average net annual growth between 1980 and 1992 was 2.3 percent of inventory.

- Sawtimber averaged 634.9 million board feet of net annual growth during the period 1980 through 1992. On average, every acre of timberland in the Unit grew about 138 board feet of sawtimber annually.

Removals

- Annual removals of growing stock from timberland averaged 82.5 million cubic feet from 1980 through 1992. Annual sawtimber removals averaged 268.6 million board feet between those years.

- More than half (58 percent) of the softwood sawtimber average annual removals was from three species—white pine (24 percent), hemlock (21 percent), and northern white-cedar (13 percent). Sixty percent of the sawtimber average annual removals from hardwoods was from hard maple (39 percent) and quaking aspen (21 percent).

- Timberland owned by forest industries accounted for one-third of the Unit's average annual removals of growing stock. Although many species were removed hard maple at 9.8 million cubic feet totaled 35 percent of all removals from timberland owned by forest industries. For the Ottawa National Forest, quaking aspen annual removals, at 4.4 million cubic feet, amounted to 35 percent of all removals from the Forest.

- Forest industry timberland accounted for 41 percent of all sawtimber annual removals between 1980 and 1992, followed by nonindustrial timberland owners with 39 percent of sawtimber average annual removals (fig. 9).

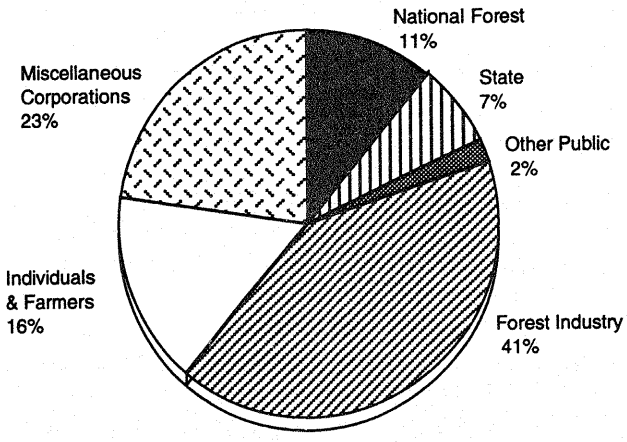


Figure 9.—*Average annual removals of sawtimber on timberland by ownership class, Western Upper Peninsula, 1980-1992.*

- Annual growing-stock removals on timberland in the Western Upper Peninsula Unit averaged almost half (49 percent) of annual growing-stock growth from 1980 through 1992—82.5 million cubic feet of removals compared to 167.8 million cubic feet of growth.

- Annual growing-stock removals on timberland averaged 18 cubic feet per acre, representing slightly more than 1 percent of the total volume per acre.

Mortality

- Mortality of growing stock averaged 64 million cubic feet per year from 1980 through 1992. Sawtimber average annual mortality was 157.9 million board feet during the period.

- Balsam fir, aspen, and elm accounted for about half of the average growing-stock mortality volume between inventories. Wind damage in older stands and the spruce budworm and other insects caused mortality in balsam fir. Aspen is susceptible to many diseases, and much of the aspen mortality may be because many of the stands are beyond pathological rotation age. Most of the mortality in elm resulted from Dutch elm disease.

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 Western Upper Peninsula Unit in Michigan in 1993—7,297.7 million cubic feet—has a sampling error of ± 1.05 percent (± 76.6 million cubic feet). Based on this sampling error, growing-stock volume from a 100-percent inventory would be expected to fall between 7,221.1 and 7,374.3 million cubic feet (7,297.7 ± 76.6), there being a one in three chance that this is not the case. The following tabulation shows the sampling errors for Michigan's Western Upper Peninsula Forest Inventory:

Item	Unit totals	Sampling error
Growing stock	Million cubic feet	Percent
Volume (1993)	7,297.7	1.05
Average annual growth (1980-1992)	167.8	1.59
Average annual removals (1980-1992)	82.5	7.69
Sawtimber	Million board feet	
Volume (1993)	20,239.1	1.50
Average annual growth (1980-1992)	634.9	1.79
Average annual removals (1980-1992)	268.6	9.09
Timberland	Thousand acres	
area (1993)	4,589.4	0.54

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 = 2,464,500 acres;
2. Total area of all timberland in the Unit from table 3 = 4,589,400 acres;
3. Unit total error for timberland area from the above tabulation = 0.54 percent.

Using the above formula:

$$E = \frac{(0.54)\ \sqrt{(4{,}589{,}400)}}{\sqrt{(2{,}464{,}500)}} = \pm\ 0.74 \text{ percent.}$$

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 4.589 million acres of timberland would require a sampling error of 1.40 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 eight counties in the Western Upper 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 well below 5 percent.

COMPARING THE FIFTH INVENTORY OF THE WESTERN UPPER 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 Western Upper 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. 10). Detailed descriptions of the sampling and estimation procedures are presented by Hansen (1990). The growth model used in the survey design for Michigan's Western Upper Peninsula was the Lake States Stand and Tree Evaluation and Modeling System (STEMS) (Belcher *et al.* 1982).

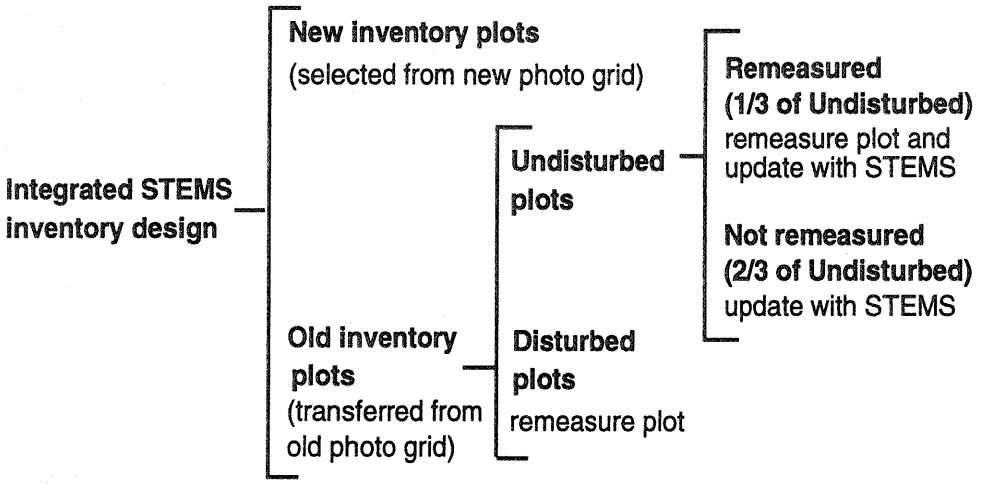


Figure 10.—*Overview of the sample design for the Western Upper Peninsula 1993 survey.*

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, and 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	23,835
Reserved forest land	1,204
Other forest land	36
Questionable	522
Nonforest with trees	561
Nonforest without trees	2,747
Water	977
All classes	29,882

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 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 comparison of 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	1,074	1,434	657	3,165
Reserved forest land	7	10	243	260
Other forest land	12	0	3	15
Nonforest with trees	34	14	13	61
Nonforest without trees	59	213	92	364
Water	16	81	32	129
Total	1,202	1,752	1,040	3,994

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 Western Upper 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 Western Upper 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 Western Upper 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	0.8287	0.8317
13.0-14.9	0.8577	0.8611
15.0-16.9	0.8784	0.8827
17.0-18.9	0.8945	0.8999
19.0-20.9	0.9079	0.9132
21.0-22.9	0.9168	0.9239
23.0-24.9	0.9240	0.9325
25.0-26.9	0.9299	0.9396
27.0-28.9	0.9321	0.9454
29.0+	0.9357	0.9544

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 Western Upper 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 Western Upper 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 Western Upper 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" (Peterson 1965). 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

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 [a] (feet)	Best 12	Best 12	Best 12
D.b.h., minimum (inches)	16[b]	13	11
Diameter, minimum inside bark at top of grading section (inches)	13[b] 16 20	11[c] 12	8
Clear cuttings (on the three best faces):[d]			
Length, minimum (feet)	7 5 3	3 3	2
Number on face (maximum)	2	2 3	e
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[f]	50

a 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.

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

c 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.

d 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.

e Unlimited.

f 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]

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.

Log Grades for Jack Pine and Red Pine

Grade 1: Logs with three or four clear faces on the 16-foot grading section. [a]
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] 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 Saw log Grade Specifications

Grading Factor	Log Grade 1	Log Grade 2	Log Grade 3	Log Grade 4
1. Minimum Scaling Diameter (inches)	14 [a]	6	6	6
2. Minimum Log Length (feet)	10 [b]	8	8	8
3. Maximum Weevil Injury (number)	None	None	2 Injuries [c]	No Limit
4. Minimum Face Requirements	Two full length or four 50% [d] length 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 [e].
   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 [e].
   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. Twelve- and thirteen-inch logs with four full length good faces are acceptable.
b. Eight-foot logs with four full length good faces are acceptable.
c. Eight-foot Number 3 logs limited to one weevil injury.
d. Minimum 50% length good face must be at least 6 feet.
e. Factors 7 and 8 are not cumulative (total degrade based on more serious of the two). No log is 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. Trees 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 cutting 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 WESTERN UPPER 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[1]
  Sugar maple ..... *Acer saccharum*
Soft maple[2]
  Red maple ..... *Acer rubrum*
  Silver maple ..... *Acer saccharinum*
Birch
  Yellow birch[1] ..... *Betula alleghaniensis*
  River birch[2] ..... *Betula nigra*
  Paper birch[2] ..... *Betula papyrifera*
Bitternut hickory[1] ..... *Carya cordiformis*
Hackberry ..... *Celtis occidentalis*
Persimmon ..... *Diospyros virginiana*
American beech ..... *Fagus grandifolia*
Ash
  White ash[1] ..... *Fraxinus americana*
  Black ash[2] ..... *Fraxinus nigra*
  Green ash[1] ..... *Fraxinus pennsylvanica*
Butternut[2] ..... *Juglans cinerea*
Black walnut[1] ..... *Juglans nigra*
White poplar ..... *Populus alba*
Balsam poplar ..... *Populus balsamifera*
Cottonwood ..... *Populus deltoides*
Bigtooth aspen[2] ..... *Populus grandidentata*
Quaking aspen[2] ..... *Populus tremuloides*
Black cherry ..... *Prunus serotina*
Select white oaks[1]
  White oak ..... *Quercus alba*
  Swamp white oak ..... *Quercus bicolor*
  Bur oak ..... *Quercus macrocarpa*
Select red oaks[1]
  Northern red oak ..... *Quercus rubra*

---

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

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

Other red oak
Northern pin oak ..... *Quercus ellipsoidalis*
Pin oak ..... *Quercus palustris*
American basswood ..... *Tilia americana*
Elm
Winged elm[2] ..... *Ulmus alata*
American elm[2] ..... *Ulmus americana*
Slippery elm[2] ..... *Ulmus rubra*
Rock elm[1] ..... *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 1993 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 1993 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 worth of 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 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 residential 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 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 be 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.

LITERATURE CITED

Belcher, D.W.; Holdaway, M.R.; Brand, G.J. 1982. **A description of STEMS the stand and tree evaluation and modeling system.** Gen. Tech. Rep. NC-79. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 18 p.

Campbell, Robert A. 1964. **Forest Service log grades for southern pine.** Res. Pap. SE-11. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station. 17 p.

Hackett, Ronald L.; Pilon, John. 1993. **Michigan's timber industry—an assessment of timber product output and use, 1990.** Resour. Bull. NC-144. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 56 p.

Hahn, Jerold T. 1984. **Tree volume and biomass equations for the Lake States.** Res. Pap. NC-250. St. Paul, MN: U. S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 10 p.

Hanks, Leland F. 1976. **Hardwood tree grades for factory lumber.** Res. Pap. NE-333. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 81 p.

Hansen, Mark H. 1990. **A comprehensive sampling system for forest inventory based on an individual tree growth model.** St. Paul, MN: University of Minnesota, College of Natural Resources. 256 p. Ph.D. dissertation.

Little, Elbert L. 1981. **Checklist of native and naturalized trees of the United States.** Agric. Handb. 541. Washington, DC: U.S. Department of Agriculture, Forest Service. 385 p.

Loetsch, F.; Haller, K.E. 1964. **Forest inventory, volume 1, statistics of forest inventory and information from aerial photographs.** Vienna: BLV Verlagsgesellschaft Munch Basle. 436 p.

Peterson, Ted. 1965. **Log grades.** Spec. Circ. 60. Madison, WI: University of Wisconsin Extension Service, College of Agriculture. 4 p.

Rast, Everette D.; Sonderman, David L.; Gammon, Glenn L. 1973. **A guide to hardwood log grading.** Gen. Tech. Rep. NE-1. Upper Darby, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 31 p.

Smith, W. Brad. 1983. **Adjusting the STEMS regional growth models to improve local predictions**. Res. Note NC-297. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 5 p.

VanDeusen, P.C.; Dell, T.R.; Thomas, C.E. 1986. **Volume growth estimation from permanent horizontal points**. Forest Science. 32: 415-422.

Wiant, Harry V., Jr.; Castenaeda, Froylan. 1977. **Mesavage and Girard's volume tables formulated**. BLM4. Denver, CO: U.S. Department of the Interior, Bureau of Land Management, Denver Service Center: 1-4.

TABLE TITLES

Area

Number of Trees

Volume

Growth, Removals and Mortality

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

(In thousand acres)

County	Total land and water	Forest land				Nonforest land	Census water
		All forest land	Timber-land	Other forest land	Reserved timber-land		
Baraga	684.2	508.3	486.7	2.3	19.3	70.3	105.6
Dickinson	497.4	398.2	398.2	--	--	92.3	6.9
Gogebic	945.0	635.3	608.4	--	26.9	70.0	239.7
Houghton	961.0	540.4	528.9	1.6	9.9	107.1	313.5
Iron	775.1	662.3	658.0	4.3	--	84.2	28.6
Keweenaw	3,878.7	312.1	198.5	1.3	112.3	34.3	3,532.3
Marquette	2,193.2	1,027.4	1,005.1	8.0	14.3	138.2	1,027.6
Ontonagon	2,394.5	752.5	705.6	--	46.9	87.0	1,555.0
All counties	12,329.1	4,836.5	4,589.4	17.5	229.6	683.4	6,809.2

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

(In thousand acres)

County	Ownership class								
	All owners	National forest	Misc. federal	State	County and municipal	Indian	Forest industry	Misc. private-corporation	Misc. private-individual/farmer
Baraga	486.7	33.7	10.1	57.9	1.3	6.4	252.4	23.9	101.0
Dickinson	398.2	--	1.6	195.9	4.0	--	38.6	34.8	123.3
Gogebic	608.4	267.1	--	2.7	57.7	--	123.7	66.2	91.0
Houghton	528.9	141.5	--	40.3	5.8	--	89.6	101.6	150.1
Iron	658.0	169.0	--	73.8	3.1	--	95.9	153.4	162.8
Keweenaw	198.5	--	1.3	1.2	--	--	160.3	16.0	19.7
Marquette	1,005.1	5.0	1.4	224.5	14.2	--	171.4	293.2	295.4
Ontonagon	705.6	247.1	2.7	20.4	3.9	--	153.8	144.3	133.4
All counties	4,589.4	863.4	17.1	616.7	90.0	6.4	1,085.7	833.4	1,076.7

Table 3.--Area of timberland by county and forest type, Western Upper 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
Baraga	486.7	7.2	3.6	1.3	31.8	1.0	24.9	32.8	5.9	0.6	17.3	320.4	33.8	5.0	1.1	--
Dickinson	398.2	3.0	6.3	7.6	40.5	4.0	25.6	53.9	3.2	4.2	15.7	114.8	99.4	7.6	12.4	--
Gogebic	608.4	--	17.9	--	35.5	9.7	10.8	29.3	9.8	2.7	49.4	376.8	60.9	3.9	--	1.7
Houghton	528.9	13.3	15.7	1.6	20.1	5.4	4.6	16.6	6.4	2.4	22.3	361.7	51.0	7.8	--	--
Iron	658.0	1.2	18.7	11.0	58.8	8.7	49.4	25.0	16.2	2.9	4.8	307.3	123.1	23.4	7.5	--
Keweenaw	198.5	--	--	3.5	11.9	4.9	5.2	41.1	--	4.2	5.6	95.1	13.5	13.5	--	--
Marquette	1,005.1	62.6	19.9	12.0	52.1	9.4	79.1	84.1	6.9	10.7	46.8	454.6	127.1	31.5	3.3	5.0
Ontonagon	705.6	--	13.2	9.2	17.2	8.1	8.6	8.5	--	1.3	27.1	433.8	168.9	5.2	1.8	2.7
All counties	4,589.4	87.3	95.3	46.2	267.9	51.2	208.2	291.3	48.4	29.0	189.0	2,464.5	677.7	97.9	26.1	9.4

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

(In thousand acres)

County	All stands	Stand-size class			
		Sawtimber	Poletimber	Sapling and Seedling	Non-stocked
Baraga	486.7	310.5	80.6	95.6	--
Dickinson	398.2	151.2	155.4	91.6	--
Gogebic	608.4	299.1	221.8	85.8	1.7
Houghton	528.9	291.1	156.3	81.5	--
Iron	658.0	289.6	182.2	186.2	--
Keweenaw	198.5	124.6	43.2	30.7	--
Marquette	1,005.1	458.6	264.6	276.9	5.0
Ontonagon	705.6	345.5	191.0	166.4	2.7
All counties	4,589.4	2,270.2	1,295.1	1,014.7	9.4

Table 5.--Area of timberland by county and potential productivity class, Western Upper Peninsula, Michigan, 1992

(In thousand acres)

County	All classes	Potential productivity class (cubic feet of growth per acre per year)					
		225+	165-224	120-164	85-119	50-84	20-49
Baraga	486.7	--	1.2	8.8	65.9	215.6	195.2
Dickinson	398.2	--	2.2	17.8	95.0	180.2	103.0
Gogebic	608.4	--	1.2	43.8	103.6	262.4	197.4
Houghton	528.9	1.1	--	22.2	103.9	295.3	106.4
Iron	658.0	--	1.1	38.3	130.8	330.7	157.1
Keweenaw	198.5	--	--	1.2	12.9	53.4	131.0
Marquette	1,005.1	--	1.3	29.9	122.7	397.9	453.3
Ontonagon	705.6	--	1.8	23.7	159.1	367.9	153.1
All counties	4,589.4	1.1	8.8	185.7	793.9	2,103.4	1,496.5

Table 6.--Area of timberland by county and stocking class of growing-stock trees[1], Western Upper 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
Baraga	486.7	--	41.2	178.0	141.8	125.7
Dickinson	398.2	--	61.2	150.3	114.1	72.6
Gogebic	608.4	1.7	50.9	238.0	205.0	112.8
Houghton	528.9	12.1	53.3	194.3	182.6	86.6
Iron	658.0	1.8	72.1	191.8	226.2	166.1
Keweenaw	198.5	--	13.7	81.0	63.1	40.7
Marquette	1,005.1	6.4	92.6	337.1	260.3	308.7
Ontonagon	705.6	5.2	45.3	199.5	179.9	275.7
All counties	4,589.4	27.2	430.3	1,570.0	1,373.0	1,188.9

[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, Western Upper Peninsula, Michigan, 1993

(In thousand acres)

Forest type	Ownership class								
	All owners	National forest	Misc. federal	State	County and municipal	Indian	Forest industry	Misc. private-corporation	Misc. private-individual/farmer
Jack pine	87.3	14.5	1.4	26.3	8.4	--	3.2	21.5	12.0
Red pine	95.3	49.9	--	11.1	--	--	15.3	5.7	13.3
White pine	46.2	11.7	--	8.0	--	--	2.5	13.9	10.1
Balsam fir	267.9	49.2	2.4	47.2	2.8	--	66.2	48.7	51.4
White spruce	51.2	15.9	--	9.1	--	--	7.0	10.5	8.7
Black spruce	208.2	25.0	--	43.7	3.4	--	48.5	22.0	65.6
Northern white-cedar	291.3	34.3	--	71.5	3.7	--	99.3	24.5	58.0
Tamarack	48.4	12.5	--	14.5	5.2	--	5.5	5.5	5.2
Oak-hickory	29.0	3.5	--	3.4	--	--	4.2	10.1	7.8
Elm-ash-soft maple	189.0	36.0	--	18.7	6.5	--	36.3	33.4	58.1
Maple-birch	2,464.5	462.1	8.0	206.3	50.1	5.1	695.4	478.0	559.5
Aspen	677.7	137.0	5.3	126.5	9.1	1.3	77.6	132.8	188.1
Paper birch	97.9	10.5	--	15.1	--	--	19.7	24.2	28.4
Balsam poplar	26.1	1.3	--	13.3	--	--	5.0	1.2	5.3
Nonstocked	9.4	--	--	2.0	0.8	--	--	1.4	5.2
All types	4,589.4	863.4	17.1	616.7	90.0	6.4	1,085.7	833.4	1,076.7

Table 8.--Area of timberland by ownership class and stocking class of growing-stock trees[1], Western Upper 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	863.4	--	21.9	138.0	298.8	404.7
Misc. federal	17.1	--	2.4	9.6	3.9	1.2
State	616.7	2.0	81.9	202.6	157.2	173.0
County and municipal	90.0	2.2	13.1	35.4	27.9	11.4
Indian	6.4	--	--	2.6	1.3	2.5
Forest industry	1,085.7	--	82.7	455.2	322.0	225.8
Misc. private-corporation	833.4	4.9	92.4	316.1	234.5	185.5
Misc. private-individual/farmer	1,076.7	18.1	135.9	410.5	327.4	184.8
All owners	4,589.4	27.2	430.3	1,570.0	1,373.0	1,188.9

[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, Western Upper Peninsula, Michigan, 1993

(In thousand acres)

Forest type	All stands	Stand-size class			
		Sawtimber	Poletimber	Sapling and seedling	Non-stocked
Jack pine	87.3	44.0	13.2	30.1	--
Red pine	95.3	48.4	24.6	22.3	--
White pine	46.2	38.2	2.6	5.4	--
Balsam fir	267.9	110.5	72.6	84.8	--
White spruce	51.2	22.7	14.4	14.1	--
Black spruce	208.2	23.1	71.6	113.5	--
Northern white-cedar	291.3	178.6	78.4	34.3	--
Tamarack	48.4	9.2	15.5	23.7	--
Oak-hickory	29.0	18.6	6.1	4.3	--
Elm-ash-soft maple	189.0	77.4	62.5	49.1	--
Maple-birch	2,464.5	1,442.7	716.0	305.8	--
Aspen	677.7	214.2	145.3	318.2	--
Paper birch	97.9	30.3	61.0	6.6	--
Balsam poplar	26.1	12.3	11.3	2.5	--
Nonstocked	9.4	--	--	--	9.4
All types	4,589.4	2,270.2	1,295.1	1,014.7	9.4

Table 10.-- Number of all live trees on timberland by species group and diameter class, Western Upper 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	23,901	5,730	4,686	4,336	4,260	2,633	1,388	580	220	61	6	1	--
Red pine	27,136	3,768	5,745	6,954	4,630	3,061	1,524	661	337	244	101	111	--
White pine	16,302	4,247	2,925	2,211	1,170	1,410	1,095	865	682	539	407	679	72
White spruce	57,063	19,744	12,931	8,228	6,151	3,962	2,824	1,589	877	491	168	96	2
Black spruce	133,666	52,143	44,515	24,290	8,588	2,648	627	129	78	43	5	--	--
Balsam fir	465,192	253,251	125,540	51,876	21,792	9,202	2,536	794	146	39	5	11	--
Hemlock	46,908	11,690	7,613	5,076	3,760	4,638	4,294	3,535	2,708	1,619	908	1,007	60
Tamarack	30,074	11,445	8,022	5,431	3,081	1,304	483	150	100	44	12	2	--
Northern white-cedar	170,295	47,353	41,292	32,149	21,680	13,401	6,876	4,040	1,732	1,052	406	308	6
Other softwoods	1,798	912	354	385	85	59	--	--	3	--	--	--	--
Total	971,343	410,583	253,623	140,936	75,497	42,318	21,647	12,343	6,883	4,132	2,018	2,215	140
Hardwoods													
Select white oak	53	--	--	--	--	--	22	28	--	3	--	--	--
Select red oak	18,429	7,353	1,882	2,000	2,054	1,799	1,303	805	550	317	210	145	11
Other red oak	285	216	36	33	--	--	--	--	--	--	--	--	--
Basswood	44,771	12,556	6,064	6,403	6,660	5,427	4,056	1,836	994	452	161	159	3
Beech	174	90	--	--	23	44	3	7	--	7	--	--	--
Yellow birch	108,329	40,098	26,206	15,389	9,197	6,823	3,703	2,616	1,858	1,023	569	767	80
Hard maple	780,281	368,021	165,619	111,998	59,245	33,902	18,363	9,491	6,118	3,687	1,878	1,883	76
Soft maple	346,588	132,692	88,289	55,520	33,064	18,664	9,414	4,425	2,426	1,202	470	403	19
Elm	15,639	8,710	3,562	1,070	801	494	439	220	149	110	34	48	2
Black ash	95,928	52,340	23,878	10,192	4,781	2,474	1,229	627	287	73	28	19	--
White and green ash	21,916	11,885	4,011	2,534	1,192	1,103	554	293	182	98	43	21	--
Willow	242	183	45	--	--	--	--	4	3	5	--	2	--
Balsam poplar	19,479	10,040	3,580	1,945	1,478	986	652	291	262	98	60	83	4
Bigtooth aspen	30,733	18,040	3,341	1,133	2,301	2,047	1,639	1,105	657	260	119	91	--
Quaking aspen	388,074	258,038	59,447	20,365	16,210	13,586	10,138	5,239	3,025	1,261	456	305	4
Paper birch	70,691	18,766	14,832	14,658	10,034	6,889	3,308	1,343	539	208	42	67	5
River birch	209	45	130	30	--	--	--	--	--	4	--	--	--
Black cherry	44,744	27,628	5,974	4,085	3,324	2,161	903	420	181	45	9	14	--
Other hardwoods	656	192	54	260	77	58	6	4	5	--	--	--	--
Noncommercial spp.	125,129	91,902	23,096	7,058	2,158	688	158	54	9	4	2	--	--
Total	2,112,350	1,058,795	430,046	254,673	152,599	97,145	55,890	28,808	17,245	8,857	4,081	4,007	204
All species	3,084,685	1,469,378	683,669	395,609	228,096	139,463	77,537	41,151	24,128	12,989	6,099	6,222	344

Table 11.--Number of growing-stock trees on timberland by species group and diameter class, Western Upper 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	23,089	5,730	4,497	4,080	4,134	2,524	1,319	547	193	61	4	--	--
Red pine	26,818	3,768	5,634	6,898	4,592	2,970	1,517	649	337	244	98	111	--
White pine	15,145	4,106	2,646	1,997	1,097	1,255	1,012	811	620	504	399	635	63
White spruce	56,346	19,744	12,676	8,137	5,969	3,891	2,735	1,568	877	485	168	94	2
Black spruce	132,301	52,227	43,918	23,979	8,714	2,608	607	124	76	43	5	--	--
Balsam fir	461,911	252,638	124,274	51,192	21,426	8,995	2,448	752	134	39	2	11	--
Hemlock	41,929	11,648	7,325	4,239	3,047	3,499	3,526	2,999	2,388	1,493	810	908	47
Tamarack	29,004	11,400	7,839	5,055	2,783	1,203	450	134	85	41	12	2	--
Northern white-cedar	151,192	46,025	38,205	28,183	18,097	10,430	5,018	2,820	1,263	687	274	188	2
Other softwoods	1,637	912	258	320	85	59	--	--	3	--	--	--	--
Total	939,372	408,198	247,272	134,080	69,944	37,434	18,632	10,404	5,976	3,597	1,772	1,949	114
Hardwoods													
Select white oak	28	--	--	--	--	--	--	28	--	--	--	--	--
Select red oak	17,484	7,317	1,840	1,814	1,861	1,658	1,147	757	489	286	190	118	7
Other red oak	285	216	36	33	--	--	--	--	--	--	--	--	--
Basswood	41,999	12,481	5,498	5,742	6,177	5,125	3,691	1,709	887	406	149	133	1
Beech	164	90	--	--	23	44	3	--	--	4	--	--	--
Yellow birch	92,370	37,799	23,223	12,182	6,972	4,991	2,636	1,736	1,358	656	380	415	22
Hard maple	730,779	356,671	153,903	102,761	53,254	29,236	15,167	8,051	5,321	3,160	1,678	1,530	47
Soft maple	320,826	130,262	81,345	49,997	28,925	15,949	7,458	3,491	1,878	891	352	270	8
Elm	14,854	8,515	3,217	889	801	473	429	203	134	110	34	48	1
Black ash	91,354	51,555	22,088	9,293	4,258	2,206	1,048	572	244	50	25	15	--
White and green ash	21,339	11,885	3,684	2,510	1,160	1,028	473	278	166	95	41	19	--
Willow	195	183	--	--	--	--	--	4	3	5	--	--	--
Balsam poplar	18,995	9,941	3,400	1,945	1,383	965	609	282	240	92	60	74	4
Bigtooth aspen	29,475	17,910	3,180	982	2,071	1,934	1,476	994	566	214	98	50	--
Quaking aspen	375,790	257,716	56,892	18,615	14,333	12,039	8,384	4,217	2,254	889	285	163	3
Paper birch	64,809	18,516	13,510	12,883	9,116	6,116	2,834	1,178	433	158	29	36	--
River birch	205	45	130	30	--	--	--	--	--	--	--	--	--
Black cherry	38,808	26,956	3,688	2,965	2,465	1,650	634	260	146	30	6	8	--
Other hardwoods	357	192	54	63	23	25	--	--	--	--	--	--	--
Hardwoods	1,860,177	948,250	375,730	222,704	132,841	83,439	45,989	23,760	14,119	7,046	3,327	2,879	93
All species	2,799,549	1,356,448	623,002	356,784	202,785	120,873	64,621	34,164	20,095	10,643	5,099	4,828	207

Table 12.--Net volume of growing stock on timberland by species group and diameter class, Western Upper 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	101,568	9,743	22,804	24,966	21,323	13,071	6,465	2,946	250	--	--
Red pine	151,334	17,852	26,567	30,083	24,255	15,461	11,747	10,700	5,642	9,027	--
White pine	211,184	4,921	6,027	12,155	16,499	20,188	22,268	24,683	25,567	65,921	12,955
White spruce	266,862	20,795	37,753	43,160	49,178	41,462	32,172	23,559	10,338	8,169	276
Black spruce	169,222	68,784	52,711	28,421	10,733	3,334	2,682	2,175	382	--	--
Balsam fir	410,095	128,122	123,569	92,763	40,285	18,117	4,395	1,812	113	919	--
Hemlock	505,099	10,489	16,782	35,893	57,792	75,274	85,900	73,439	51,538	87,984	10,008
Tamarack	62,883	14,700	17,640	13,659	7,798	3,510	2,919	1,797	671	189	--
Northern white-cedar	466,595	65,104	91,363	93,669	71,203	58,283	36,131	25,469	12,889	12,227	257
Other softwoods	1,892	737	385	661	--	--	109	--	--	--	--
Total	2,346,734	341,247	395,601	375,430	299,066	248,700	204,788	166,580	107,390	184,436	23,496
Hardwoods											
Select white oak	635	--	--	--	--	635	--	--	--	--	--
Select red oak	112,668	4,348	10,335	16,181	17,813	16,635	15,223	11,787	10,266	8,970	1,110
Other red oak	42	42	--	--	--	--	--	--	--	--	--
Basswood	284,323	16,230	39,245	56,816	63,608	43,152	29,408	17,367	8,292	9,998	207
Beech	895	--	124	542	57	--	--	172	--	--	--
Yellow birch	328,291	32,169	41,965	51,829	42,197	39,357	42,296	26,542	19,288	29,833	2,815
Hard maple	1,974,606	283,555	340,397	330,827	265,163	204,823	184,488	142,947	94,413	120,981	7,012
Soft maple	839,902	132,941	179,988	175,100	126,708	84,465	61,835	38,062	18,677	20,762	1,364
Elm	37,925	2,037	4,556	4,973	7,020	4,739	4,154	4,694	1,671	3,937	144
Black ash	116,285	24,010	25,136	23,327	17,684	13,442	8,051	2,086	1,493	1,056	--
White and green ash	51,109	6,119	6,833	10,633	7,535	6,792	5,419	4,065	2,489	1,224	--
Willow	429	--	--	--	--	100	108	221	--	--	--
Balsam poplar	63,255	5,409	8,141	10,346	10,127	6,800	8,232	4,115	3,420	5,973	692
Bigtooth aspen	133,084	3,119	13,668	22,423	26,695	25,978	20,545	10,502	6,024	4,130	--
Quaking aspen	668,493	50,203	86,615	131,977	145,803	105,936	78,793	40,064	15,775	12,769	558
Paper birch	270,297	38,264	59,708	68,303	48,632	29,100	14,710	7,148	1,591	2,841	--
River birch	83	83	--	--	--	--	--	--	--	--	--
Black cherry	68,171	8,642	16,145	19,166	10,758	6,488	4,944	1,206	299	523	--
Other hardwoods	489	169	97	223	--	--	--	--	--	--	--
Total	4,950,982	607,340	832,953	922,666	789,800	588,442	478,206	310,978	183,698	222,997	13,902
All species	7,297,716	948,587	1,228,554	1,298,096	1,088,866	837,142	682,994	477,558	291,088	407,433	37,398

Table 13--Net volume of growing stock in the saw-log portion of sawtimber trees on timberland by species group and diameter class, Western Upper 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	59,227	20,327	18,608	11,622	5,799	2,646	225	--	--
Red pine	97,614	26,433	22,373	14,400	10,919	9,925	5,219	8,345	--
White pine	172,793	9,388	13,874	17,355	19,297	21,464	22,282	57,696	11,437
White spruce	188,303	36,985	44,583	38,074	29,630	21,710	9,524	7,541	256
Black spruce	44,120	25,829	10,165	3,168	2,545	2,053	360	--	--
Balsam fir	132,403	74,967	34,927	16,039	3,920	1,621	102	827	--
Hemlock	424,755	30,140	51,019	67,234	76,844	65,631	46,098	78,763	9,026
Tamarack	26,998	11,642	7,020	3,212	2,681	1,653	616	174	--
Northern white-cedar	267,020	75,766	61,729	51,631	32,260	22,817	11,574	11,012	231
Other softwoods	643	545	--	--	98	--	--	--	--
Total	1,413,876	312,022	264,298	222,735	183,993	149,520	96,000	164,358	20,950
Hardwoods									
Select white oak	450	--	--	450	--	--	--	--	--
Select red oak	59,385	--	11,506	11,889	11,324	8,945	7,863	6,977	881
Basswood	124,816	--	42,628	31,794	22,448	13,439	6,471	7,869	167
Beech	176	--	39	--	--	137	--	--	--
Yellow birch	154,129	--	28,432	29,528	32,977	21,097	15,495	24,270	2,330
Hard maple	739,011	--	170,718	147,447	138,330	109,326	72,991	94,611	5,588
Soft maple	245,919	--	80,049	59,801	45,771	28,830	14,291	16,098	1,079
Elm	18,237	--	4,260	3,243	2,978	3,430	1,244	2,970	112
Black ash	32,197	--	12,190	10,087	6,247	1,641	1,187	845	--
White and green ash	20,080	--	4,977	4,994	4,109	3,120	1,923	957	--
Willow	301	--	--	67	76	158	--	--	--
Balsam poplar	29,044	--	6,830	4,993	6,252	3,154	2,643	4,630	542
Bigtooth aspen	69,776	--	18,329	19,430	15,798	8,207	4,732	3,280	--
Quaking aspen	292,325	--	99,496	78,655	60,284	31,065	12,343	10,037	445
Paper birch	71,540	--	31,352	20,671	10,814	5,346	1,200	2,157	--
Black cherry	16,760	--	6,855	4,649	3,695	923	230	408	--
Total	1,874,146	--	517,661	427,698	361,103	238,818	142,613	175,109	11,144
All species	3,288,022	312,022	781,959	650,433	545,096	388,338	238,613	339,467	32,094

Table 14.--Net volume of sawtimber on timberland by species group and diameter class, Western Upper 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	342,139	118,200	104,867	67,015	34,422	16,229	1,406	--	--
Red pine	566,678	151,382	124,552	81,694	64,062	59,678	32,237	53,073	--
White pine	1,069,677	55,580	78,029	99,388	113,903	130,548	139,114	375,557	77,558
White spruce	1,121,688	218,403	256,601	223,358	178,507	134,116	60,064	48,915	1,724
Black spruce	253,488	147,416	57,398	18,446	15,219	12,685	2,284	--	--
Balsam fir	771,012	441,130	198,156	92,559	23,272	9,909	640	5,346	--
Hemlock	2,545,270	167,586	280,491	381,293	452,751	400,019	288,902	512,364	61,864
Tamarack	158,814	68,242	40,375	18,843	16,167	10,167	3,887	1,133	--
Northern white-cedar	1,603,308	465,278	359,649	302,303	192,830	139,315	72,064	70,313	1,556
Other softwoods	3,679	3,099	--	--	580	--	--	--	--
Total	8,435,713	1,836,316	1,500,118	1,284,899	1,091,713	912,666	600,598	1,066,701	142,702
Hardwoods									
Select white oak	2,739	--	--	2,739	--	--	--	--	--
Select red oak	371,096	--	72,335	72,572	69,396	55,687	49,718	45,413	5,975
Basswood	779,084	--	267,987	195,113	138,656	84,016	41,103	51,058	1,151
Beech	1,124	--	251	--	--	873	--	--	--
Yellow birch	978,674	--	182,747	184,164	205,832	133,009	98,864	158,282	15,776
Hard maple	4,681,201	--	1,092,429	916,484	862,426	689,256	466,075	616,691	37,840
Soft maple	1,558,051	--	514,779	372,581	285,504	181,765	91,209	104,921	7,292
Elm	115,494	--	27,338	20,120	18,472	21,503	7,917	19,394	750
Black ash	201,125	--	76,933	62,218	38,677	10,269	7,560	5,468	--
White and green ash	123,980	--	30,917	30,241	25,121	19,359	12,192	6,150	--
Willow	1,856	--	--	406	468	982	--	--	--
Balsam poplar	182,634	--	42,811	30,616	38,678	19,769	16,848	30,227	3,685
Bigtooth aspen	433,431	--	113,915	118,787	97,532	51,562	30,206	21,429	--
Quaking aspen	1,816,548	--	620,546	481,666	372,568	194,831	78,553	65,338	3,046
Paper birch	450,174	--	199,179	128,064	67,363	33,775	7,687	14,106	--
Black cherry	106,161	--	44,345	28,943	22,999	5,790	1,461	2,623	--
Total	11,803,372	--	3,286,512	2,644,714	2,243,692	1,502,446	909,393	1,141,100	75,515
All species	20,239,085	1,836,316	4,786,630	3,929,613	3,335,405	2,415,112	1,509,991	2,207,801	218,217

[1]International 1/4-inch rule.

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

County	Growing stock					Sawtimber				
		Major species group					Major 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]				
Baraga	866,800	25,937	233,963	250,288	356,612	2,707,985	117,222	908,115	637,683	1,044,965
Dickinson	584,576	32,995	171,308	252,266	128,007	1,349,454	142,933	405,849	594,774	205,898
Gogebic	967,501	36,313	270,840	292,381	367,967	2,569,091	136,997	997,878	634,316	799,900
Houghton	917,972	56,367	186,553	300,507	374,545	2,641,621	229,217	741,970	696,867	973,567
Iron	919,766	56,781	213,076	323,197	326,712	2,467,681	252,406	667,155	747,761	800,359
Keweenaw	331,531	20,899	106,517	96,870	107,245	960,266	99,911	342,852	221,508	295,995
Marquette	1,600,614	187,608	466,252	520,817	425,937	4,497,819	811,556	1,488,069	1,076,680	1,121,514
Ontonagon	1,108,956	47,752	233,573	4445,838	381,793	3,045,168	188,252	905,331	1,034,969	916,616
All counties	7,297,716	464,652	1,882,082	2,482,164	2,468,818	20,239,085	1,978,494	6,457,219	5,644,558	6,158,814

[1]International 1/4-inch rule.

Table 16.--Net volume of timber on timberland by class of timber and major species group, Western Upper 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	3,287,933	329,634	1,084,153	868,718	1,005,428
Upper stem portion	909,874	46,538	149,459	343,146	370,731
Total	4,197,807	376,172	1,233,612	1,211,864	1,376,159
Poletimber	3,098,925	88,480	647,568	1,153,933	1,208,944
All growing-stock trees	7,296,732	464,652	1,881,180	2,365,797	2,585,103
Cull trees					
Short-log trees	185,188	5,498	40,739	62,242	76,709
Rough trees					
Sawtimber	207,307	8,293	37,488	67,289	94,237
Poletimber	263,632	2,271	25,989	88,324	147,048
Total	470,939	10,564	63,477	155,613	241,285
Rotten trees					
Sawtimber	154,082	1,414	43,203	58,018	51,447
Poletimber	39,386	17	5,656	19,074	14,639
Total	193,468	1,431	48,859	77,092	66,086
All cull trees	849,595	17,493	153,075	294,947	384,080
All live trees	8,146,327	482,145	2,034,255	2,660,744	2,969,183
Salvable dead trees					
Sawtimber	51,638	2,553	20,285	23,774	5,026
Poletimber	39,529	1,619	9,536	22,873	5,501
Total	91,167	4,172	29,821	46,647	10,527
All classes	8,237,494	486,317	2,064,076	2,707,391	2,979,710

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

(In thousand cubic feet)

Ownership class	Live trees					Growing-stock trees				
		Major species group					Major species group			
	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
National forest	1,483,332	140,441	353,379	479,650	509,862	1,293,051	136,472	324,480	406,676	425,423
Misc. federal	37,666	475	8,077	18,811	10,303	33,891	318	7,857	16,823	8,893
State	998,913	84,960	307,768	378,998	227,187	915,431	81,140	283,448	346,773	204,070
County and municipal	145,162	13,443	25,311	51,676	54,732	128,449	12,898	22,947	45,659	46,945
Indian	17,606	--	3,700	7,706	6,200	16,758	--	3,655	7,349	5,754
Forest industry	2,001,691	49,141	557,164	538,040	857,346	1,785,666	47,757	512,908	475,133	749,868
Misc. private-corporation	1,544,396	99,300	352,028	541,433	551,635	1,389,904	95,989	326,597	675,437	479,492
Misc. private-individual/farmer	1,918,545	94,385	427,730	771,276	625,154	1,734,566	87,130	400,190	695,925	548,373
All owners	8,147,311	482,145	2,035,157	2,787,590	2,842,419	7,297,716	464,652	1,882,082	2,482,164	2,468,818

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

County	Growing stock					Sawtimber				
		Major species group					Major 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]				
Baraga	16,790	883	3,856	4,312	7,739	67,458	4,143	18,618	18,262	26,435
Dickinson	15,053	1,364	3,721	6,184	3,784	55,550	6,802	15,726	23,050	9,972
Gogebic	22,358	1,629	4,619	6,677	9,433	81,017	6,538	26,070	24,757	23,652
Houghton	20,995	1,601	3,974	6,473	8,947	81,847	8,953	20,719	23,906	28,269
Iron	22,107	2,082	4,301	7,035	8,689	87,142	8,708	20,503	31,159	26,772
Keweenaw	5,672	640	1,371	1,548	2,113	23,293	3,438	6,300	5,665	7,890
Marquette	38,634	5,655	9,634	13,666	9,679	140,867	26,574	38,993	43,951	31,349
Ontonagon	26,148	1,679	5,013	10,121	9,335	97,705	7,132	26,610	39,350	24,613
All counties	167,757	15,533	36,489	56,016	59,719	634,879	72,288	173,539	210,100	178,952

[1]International 1/4-inch rule.

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

County	Growing stock					Sawtimber				
	All species	Major species group				All species	Major species group			
		Pine	Other softwoods	Soft hardwoods	Hard hardwoods		Pine	Other softwoods	Soft hardwoods	Hard hardwoods
	Thousand cubic feet					*Thousand board feet*[1]				
Baraga	10,709	433	2,036	3,228	5,012	44,421	1,403	10,770	9,947	22,301
Dickinson	4,090	72	821	3,166	31	4,372	200	1,423	2,749	--
Gogebic	6,272	748	343	2,888	2,293	20,778	3,098	1,291	8,990	7,419
Houghton	7,931	470	1,295	2,732	3,434	27,557	1,126	5,240	6,221	14,970
Iron	14,670	1,374	3,236	7,478	2,582	46,748	7,461	10,043	19,843	9,401
Keweenaw	1,255	250	--	404	601	4,798	1,386	--	884	2,528
Marquette	25,289	3,827	6,006	9,495	5,961	83,163	17,141	20,959	22,204	22,859
Ontonagon	12,321	87	610	7,008	4,616	36,767	432	2,098	16,342	17,895
All counties	82,537	7,261	14,347	36,399	24,530	268,604	32,247	51,824	87,160	97,373

[1]International 1/4-inch rule.

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

Species group	Growing stock			Sawtimber		
	Net growth [1]	Mortality	Removals	New growth [1]	Mortality	Removals
	Thousand cubic feet			*Thousand board feet* [2]		
Softwoods						
Jack pine	2,646	1,051	2,592	12,801	3,116	8,542
Red pine	6,437	116	798	23,399	458	3,979
White pine	6,408	621	3,871	36,088	2,781	19,726
White spruce	8,979	2,377	2,113	44,159	9,728	8,854
Black spruce	2,247	3,084	1,572	4,831	5,289	3,031
Balsam fir	5,349	13,509	4,543	22,560	25,799	11,267
Hemlock	8,399	2,368	3,175	52,086	11,230	17,310
Tamarack	1,694	361	22	6,745	1,080	61
Northern white-cedar	9,744	1,320	2,922	42,908	6,015	11,301
Other softwoods	119	--	--	250	--	--
Total	52,022	24,807	21,608	245,827	65,496	84,071
Hardwoods						
Select white oak	-26	35	--	-99	152	--
Select red oak	2,822	511	1,606	14,213	1,237	6,177
Other red oak	17	2	--	--	--	--
Basswood	7,060	771	2,064	30,976	2,122	8,313
Beech	22	--	--	33	--	--
Yellow birch	2,789	4,758	3,992	11,011	15,590	17,727
Hard maple	52,330	4,627	18,557	148,735	12,552	71,878
Soft maple	22,314	2,784	7,313	57,738	5,619	19,464
Elm	-4,830	6,563	927	-9,048	15,276	2,721
Black ash	2,189	1,077	81	4,481	2,249	389
White and green ash	1,774	98	375	5,086	144	1,591
Willow	32	--	--	139	--	--
Balsam poplar	1,081	1,313	904	3,776	3,868	2,333
Bigtooth aspen	4,221	1,149	2,374	21,527	2,730	7,493
Quaking aspen	18,756	11,317	16,690	80,100	25,001	38,045
Paper birch	3,980	3,629	5,706	14,514	5,482	7,595
River birch	2	--	--	--	--	--
Black cherry	1,213	595	340	5,897	393	807
Other hardwoods	-1	1	--	-27	--	--
Noncommercial spp.	-10	--	--	--	--	--
Total	115,735	39,230	60,929	389,052	92,415	184,533
All species	167,757	64,037	82,537	634,879	157,911	268,604

[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, Western Upper Peninsula, Michigan, 1980-1992

(In thousand cubic feet)

Ownership class	Growth					Removals				
		Major species group					Major species group			
	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
National forest	26,819	4,477	5,457	7,743	9,142	12,524	1,588	2,060	6,626	2,250
Misc. federal	868	62	210	395	201	--	--	--	--	--
State	22,943	2,791	5,903	8,717	5,532	9,521	384	2,785	5,912	440
County and municipal	3,322	476	399	1,105	1,342	1,523	262	15	919	327
Indian	282	--	51	179	52	--	--	--	--	--
Forest industry	38,807	1,783	9,119	9,820	18,085	27,785	1,393	5,283	8,055	13,054
Misc. private-corporation	31,220	2,755	5,911	11,653	10,901	19,221	2,337	2,731	7,499	6,654
Misc. private-individual/farmer	43,496	3,189	9,439	16,404	14,464	11,963	1,297	1,473	7,388	1,805
All owners	167,757	15,533	36,489	56,016	59,719	82,537	7,261	14,347	36,399	23,530

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

(In thousand board feet) [1]

Ownership class	Growth					Removals				
		Major species group					Major species group			
	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
National forest	117,576	21,694	32,419	34,089	29,374	30,333	5,238	5,437	12,878	6,780
Misc. federal	3,573	150	1,079	1,450	894	--	--	--	--	--
State	81,350	12,041	25,944	29,078	14,287	19,275	1,453	8,078	8,487	1,257
County and municipal	11,868	2,426	2,165	4,123	3,154	4,196	830	77	2,680	609
Indian	1,276	--	260	721	295	--	--	--	--	--
Forest industry	140,414	7,120	41,884	36,074	55,336	108,748	6,855	22,413	23,291	56,189
Misc. private-corporation	122,550	14,250	30,279	44,563	33,458	62,187	11,340	10,703	13,881	26,263
Misc. private-individual/farmer	156,272	14,607	39,509	60,002	42,154	43,865	6,531	5,116	25,943	6,275
All owners	634,879	72,288	173,539	210,100	178,952	268,604	32,247	51,824	87,160	97,373

[1] International 1/4-inch rule.

Table 23.--Current annual net growth and mortality, and 1990 removals of growing stock and sawtimber on timberland by species group, Western Upper 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	2,024	1,506	5,477	10,038	5,,681	13.393
Red pine	7,273	10	3,495	30,302	109	15,761
White pine	7,522	155	2,377	41,790	1,613	12,806
White spruce	11,558	2,139	3,477	59,715	9,521	11,045
Black spruce	2,605	3,502	*	5,635	5,751	*
Balsam fir	7,989	11,876	2,627	27,654	21,999	7,142
Hemlock	9,153	2,454	1,983	53,790	10,680	6,130
Tamarack	2,021	457	319	8,607	1,075	1,067
N. white-cedar	9,589	606	967	40,302	5,211	2,320
Other softwoods	183	3	0	581	5	0
Total	59,917	22,708	20,722	278,414	61,645	69,664
Hardwoods						
Select white oak	18	0	30	89	3	82
Select red oak	2,932	613	2,474	15,724	1509	7,774
Hickory	0	0	0	0	0	0
Basswood	7,301	1,005	3,591	33,904	2,774	12,581
Beech	22	2	545	24	3	1,562
Yellow birch	2,980	4,730	3,341	8,526	15,122	12,951
Hard maple	53,984	6,654	21,985	168,249	16,064	96,712
Soft maple	23,457	3,926	8,820	68,522	6,480	25,988
Elm	-563	1,767	705	-711	5,064	1,201
Black ash	2,295	1,360	1,334	5,741	2,599	3,022
White / green ash	2,210	92	**	6,867	133	**
Cottonwood	0	0	0	0	0	0
Willow	13	0	0	66	8	0
Balsam poplar	1,213	1,327	1,252	5,185	3,536	2,054
Bigtooth aspen	3,971	1,560	***	23,335	5,152	***
Quaking aspen	20,998	12,202	32,222	90,070	30,584	65,624
Paper birch	3,619	3,656	5,574	17,098	6,454	10,864
Black cherry	1,308	629	0	8,321	290	0
Butternut	0	0	0	0	0	0
Other hardwoods	37	7	879	0	0	1,583
Total	125,795	39,530	82,752	451,010	95,775	241,998
All species	185,712	62,238	103,474	729,424	157,420	311,662

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 Western Upper 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 bigtooth aspen species group are included in the removals for quaking aspen.

Table 24.--Net volume of sawtimber trees on timberland by species group and butt log grade (softwoods) or tree grade (hardwoods), Western Upper Peninsula, Michigan, 1993

(In thousand board feet)[1]

Species	All grades	Butt log grade 1	2	3	Tie and timber
Softwoods					
Jack pine	342,139	--	6,789	335,350	--
Red pine	566,678	122,278	32,942	411,458	--
White pine	1,069,677	161,807	297,345	528,610	81,915
White spruce	1,121,688	--	25,201	1,096,487	--
Black spruce	253,448	--	--	253,448	--
Balsam fir	771,012	--	--	771,012	--
Hemlock	2,545,270	38,487	231,338	2,275,445	--
Tamarack	158,814	--	12,712	146,102	--
Northern white-cedar	1,603,308	--	32,098	1,571,210	--
Other softwoods	3,679	--	--	3,679	--
Total	8,435,713	322,572	638,425	7,392,801	81,915

Species	All grades	Tree Grade 1	2	3	Tie and timber
Hardwoods					
Select white oak	2,739	--	--	2,739	--
Select red oak	371,096	78,666	113,355	150,213	28,862
Basswood	779,084	141,130	223,036	393,336	21,582
Beech	1,124	191	284	605	44
Yellow birch	978,674	139,903	290,182	483,198	65,391
Hard maple	4,681,201	638,811	1,436,506	2,262,453	343,431
Soft maple	1,558,051	188,017	455,751	795,760	118,523
Elm	115,494	115,494	--	--	--
Black ash	201,125	17,343	68,702	111,164	3,916
White and green ash	123,980	15,984	44,854	61,318	1,824
Willow	1,856	500	589	687	80
Balsam poplar	182,634	49,185	57,945	67,606	7,898
Bigtooth aspen	433,431	77,573	139,381	202,987	13,490
Quaking aspen	1,816,548	59,376	316,617	1,261,905	178,650
Paper birch	450,174	16,694	129,579	280,137	23,764
Black cherry	106,161	3,242	42,169	51,793	8,957
Total	11,803,372	1,542,109	3,318,950	6,125,901	816,412
All species	20,239,085	1,864,681	3,957,377	13,518,702	898,325

[1]International 1/4-inch rule.

Table 25.--Comparison of adjusted 1980 and 1993 area and growing-stock volume by forest type, Western Upper 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 growing-stock volume amount	Percent change in growing-stock 1980-93
	(thousand acres)	*(thousand acres)*	*(thousand acres)*	*(%)*	*(million cubic feet)*	*(cubic feet per acre)*	*(million cubic feet)*	*(cubic feet per acre)*	*(million cubic feet)*	*(%)*
Jack pine	91.9	87.3	-4.6	-5.0	100.6	1,094.6	98.5	1,128.1	-2.1	-2.9
Red pine	57.6	95.3	37.7	65.5	76.2	1,322.7	154.0	1,615.5	77.8	102.1
White pine	49.3	46.2	-3.1	-6.3	104.2	2,111.5	93.6	2,025.7	-10.6	-10.1
Balsam fir	332.2	267.9	-64.3	-19.4	376.4	1,133.2	338.8	1,264.8	-37.6	-9.9
White spruce	63.0	51.2	-11.8	-18.7	67.8	1,075.4	73.4	1,432.9	5.6	-8.3
Black spruce	186.1	208.2	22.1	11.9	123.7	664.8	163.4	784.8	39.7	32.1
Northern white-cedar	244.5	291.3	46.8	19.1	326.2	1,334.3	445.2	1,528.2	119.0	36.5
Tamarack	39.0	48.4	9.4	24.1	22.3	571.1	33.9	700.9	11.6	52.3
Oak-hickory	23.7	29.0	5.3	22.4	31.4	1,325.6	48.6	1,675.7	17.2	54.7
Elm-ash-soft maple	183.1	189.0	5.9	3.2	226.2	1,235.5	236.5	1,251.2	10.3	4.6
Maple-birch	2,355.2	2,464.5	109.3	4.6	3,744.2	1,589.8	4,616.1	1,873.1	871.9	23.3
Aspen	695.2	677.7	-17.5	-2.5	735.1	1,057.4	777.0	1,146.5	41.9	5.7
Paper birch	139.6	97.9	-41.7	-29.9	191.4	1,371.0	179.5	1,833.8	-11.8	-6.2
Balsam poplar	23.3	26.1	2.8	12.0	26.0	1,114.0	38.2	1,465.6	12.2	47.4
Nonstocked	21.9	9.4	-12.5	-57.1	0.2	10.5	1.0	110.0	0.8	351.5
Total/average	4,505.6	4,589.4	83.8	1.9	6,151.9	1,365.4	7,296.7	1,590.1	1,145.8	18.6

☆U.S. GOVERNMENT PRINTING OFFICE: 1994 - 556-957/80155

Leatherberry, Earl C.
1994. **Forest statistics for Michigan's Western Upper Peninsula Unit, 1993.** Resour. Bull. NC-153. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 45 p.

The fifth inventory of Michigan's Western Upper Peninsula Unit reports 12,329.1 million acres of land, of which 4,836.5 million 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.