



United States
Department of
Agriculture

Forest
Service

North Central
Research Station

Resource Bulletin
NC-262



Minnesota's Forest Resources 2004

Patrick D. Miles, Gary J. Brand, and Manfred E. Mielke





Contents

Results	2
Area	2
Volume	5
Biomass	6
Growth, Removals, and Mortality	6
Forest Health	7
Appendix.....	11
Inventory Methods.....	11
Sampling Phases	12
Phase 1.....	12
Phase 2.....	12
Phase 3.....	13
Literature Cited	14
Table Titles.....	14
Tables	15

**North Central
Research Station**
USDA Forest Service

1992 Folwell Avenue
Saint Paul, Minnesota,
55108

2006

www.ncrs.fs.fed.us



Minnesota's Forest Resources In 2004

The North Central Research Station's Forest Inventory and Analysis (NCFIA) program began fieldwork for the seventh forest inventory of Minnesota's forest resources in 2004. The sixth inventory (1999-2003) initiated the new NCFIA annual inventory system in which one-fifth of the field plots (considered one panel) in the State were measured each year. A complete inventory consists of measuring and compiling the data for all plots (or five panels). Once all panels have been measured, each will be remeasured approximately every 5 years. For example, in Minnesota, the field plots measured in 1999 were remeasured in 2004.

The first panel of the seventh inventory of Minnesota's forest resources was completed in 2004. This panel was combined with the second, third, fourth, and fifth panels from the sixth inventory to generate the 2004 report. The 2004 report is based on a double intensification of the standard base Federal sample. This double intensification was made possible by additional resources provided by the State of Minnesota.

Reports of previous completed inventories of Minnesota are dated 1936, 1953, 1962, 1977, 1990, and 2003. Results presented are estimates

based on sampling techniques; estimates were compiled assuming the 2000, 2001, 2002, 2003, and 2004 data represent one large sample.

Data from new 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 efficiency and reliability of the inventory, several changes in procedures and definitions have been made since the fifth Minnesota inventory in 1990 (Miles *et al.* 1995) (see appendix). Although these changes will have little impact on statewide estimates of forest area, timber volume, and tree biomass, they may have significant impacts on plot classification variables such as forest type and stand-size class. Some of these changes make it inappropriate to directly compare 2004 data tables with those published for 1990.

All of the tables in this report and many others can be generated at our Web site:
www.fia.fs.fed.us

About the Authors:

Patrick D. Miles and Gary J. Brand

are Research Foresters with the North Central Research Station, St. Paul, MN.

Manfred E. Mielke

is a Plant Pathologist with the Northeastern Area State and Private Forestry, Forest Health Protection, Forest Health Monitoring Program, St. Paul, MN.

RESULTS

Area

The total land area of Minnesota is 50.9 million acres of which 32 percent or 16.2 million acres are forest land (table 1). There are three components to forest land: (1) Timberland¹—forest land not restricted from harvesting by statute, administrative regulation, or designation and capable of growing trees at a rate of 20 cubic feet per acre per year; (2) Reserved forest land—land restricted from harvesting by statute, administrative regulation, or designation (i.e., national parks, wilderness areas, etc.); and (3) Other forest land—low-productivity forest land not capable of growing trees at a rate of 20 cubic feet per acre per year.

The estimated area of forest land declined from 16.7 million acres in 1990 to 16.2 million acres in 2004. During the same period the area of timberland increased slightly from 14.7 million acres in 1990 to 14.8 million acres in 2004 (fig. 1)². The decrease in forest land and the increase in timberland are due in large part to changes in the estimated reserved and other

forest land components. The estimate of reserved forest land decreased from 1,117 thousand acres in 1990 to 888 thousand acres in 2004, and the area estimate of other forest land decreased from 840 thousand acres to 512 thousand acres. Nearly half of this acreage decrease in reserved and other forest land was due to conversion to nonforest land and the other half was due to conversion to timberland. It is unclear how much of this decrease in reserved and other forest land was due to actual on-the-ground change or due

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

² The accuracy bracket atop each bar in figure 1 provides a measure of reliability of these figures. In 2003 there was a two out of three chance that if a 100-percent inventory had been taken, using the same methods, the result would have been within the limits indicated by the bracket—14,794.8 thousand acres plus or minus 101.2 thousand acres.



Figure 1.—Area of timberland in Minnesota by inventory year.

to changing field crew interpretation of FIA classification rules, although the classification rules remained unchanged over the period (the approximately 50 thousand acre decrease in reserved State and county forest land from 1990 to 2004 was most likely due to misclassification in 1990). The net effect was a decrease in the area estimate for forest land and an increase in the area estimate for timberland.

The estimate of forest land in public ownership remained relatively constant from 1990 to 2004 (fig. 2). The public timberland estimate, however, increased from 7.6 million acres in

1990 to 8.0 million acres in 2004 with a corresponding decline in the area of other and reserved forest land (table 2).

Private ownership of timberland declined from 7.1 million acres to 6.8 million acres over the period. Hardwood forest types are concentrated on private lands (53 percent) while softwood forest types are concentrated on public lands (74 percent).

The aspen/birch forest type, with 6.3 million acres of timberland (table 3), is the dominant forest type in the State (fig. 3) and is an important

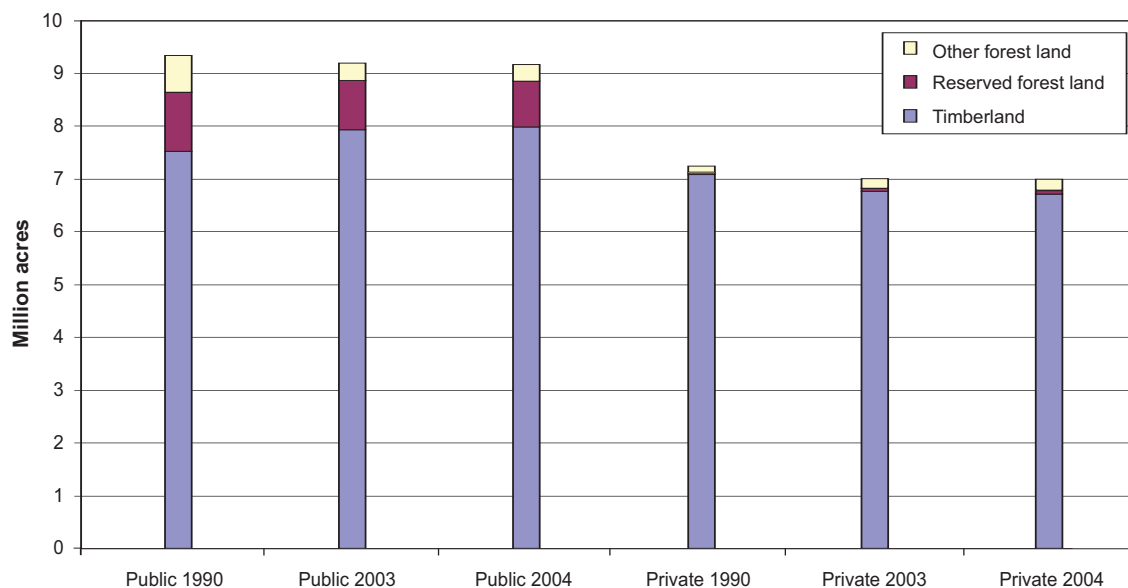


Figure 2.—Area of forest land in Minnesota by forest land component, owner category and inventory year.

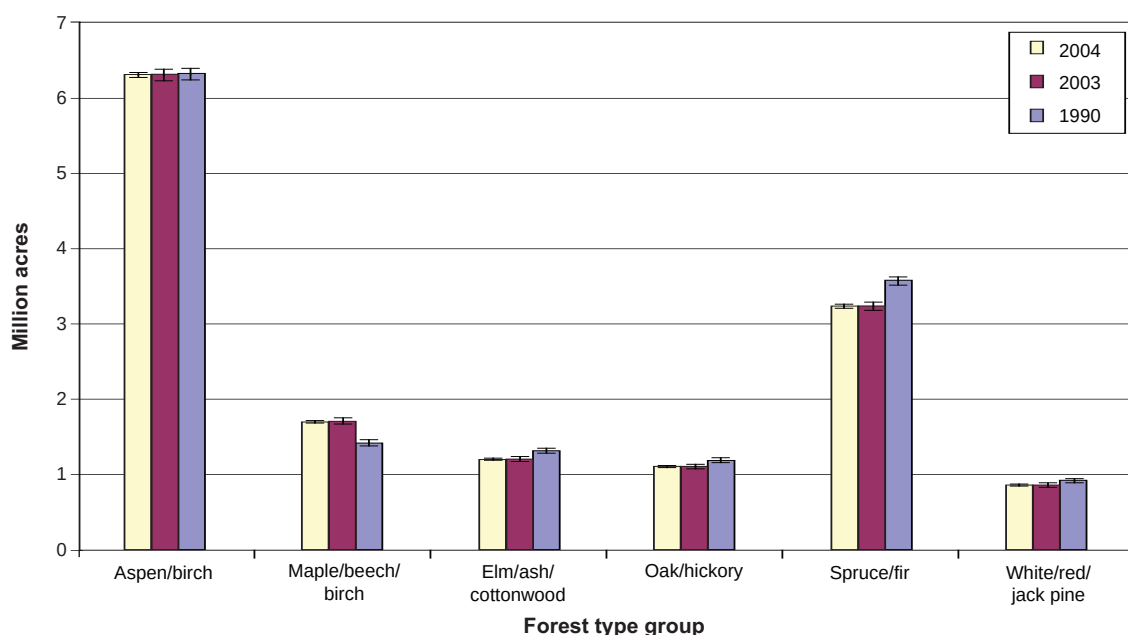


Figure 3.—Area of timberland in Minnesota in 1990, 2003, and 2004 by forest type.

resource for Minnesota's forest industries. Nearly four-fifths of all the coniferous timberland in the State is in the spruce/fir forest type (3.2 million acres). The estimate of hardwood forest types increased from 10.2 million acres in 1990 to 10.5 million acres in 2004, while the estimate for conifer forest types decreased from 4.4 million acres in 1990 to 4.1 million acres in 2004. This appears to be the result of new stocking and forest typing algorithms used in conjunction with a new plot configuration rather than a change in species composition because roughly 31 percent of the State's growing-stock volume was in softwood tree species in both 1990 and 2004.

The area of timberland by stand-size class showed a consistent trend from 1962 to 1990 (fig. 4). The area of medium-size stands declined from 8.5 million acres in 1962 to 5.3 million acres in 1990 while the area in large stands increased from 2.4 million to 4.9 million acres.

Changes to the stand-size class algorithm along with the new plot configuration make comparisons of the 2003 and 2004 stand-size numbers to earlier years difficult at best. From 1990 to 2004, the area classified as medium stands rose from 5.3 million to 5.7 million acres, despite a 14-percent decline in the number of poletimber-size trees. Over the same period, the area classified as large stands³ decreased by 19 percent (944 thousand acres), from 4,890 thousand acres to 3,946 thousand acres, even though there was only a 5-percent decrease in the number of sawtimber-size trees.

³ Sawtimber stands where a plurality of the stocking is in trees at least 9 inches d.b.h. for conifers or 11.0 inches d.b.h. for deciduous trees.

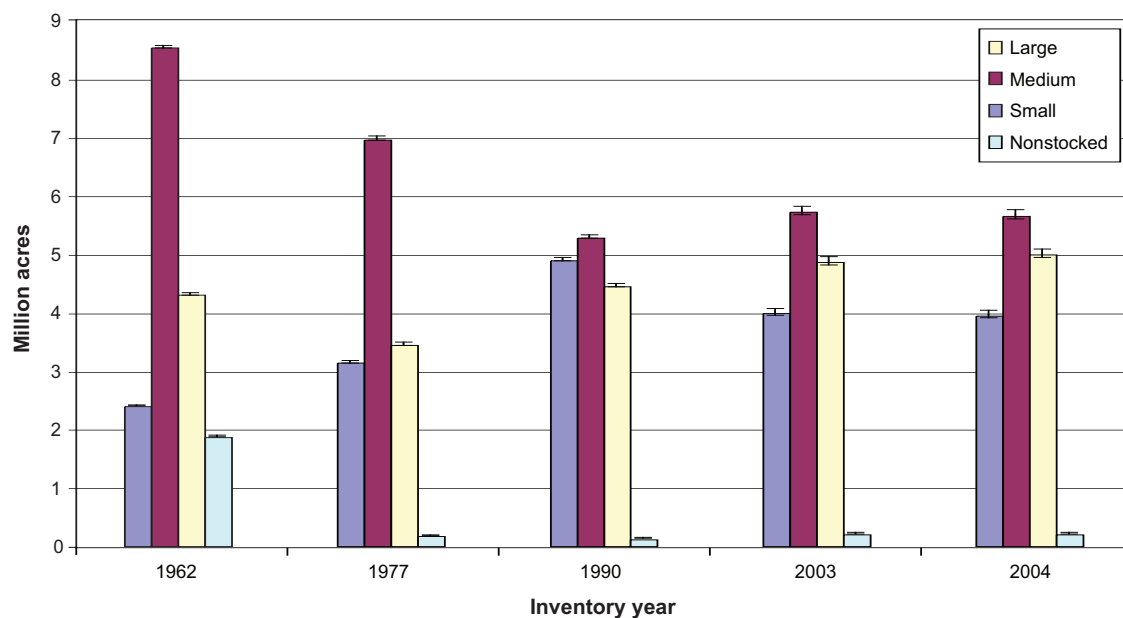


Figure 4.—Area of timberland in Minnesota by stand-size class and inventory year.

Volume

Historically, volume has been reported as either growing stock or sawtimber. However, there are volumes in noncommercial trees, rough trees, and rotten trees that do not qualify as growing stock but that are often utilized for wood fiber and fuelwood. Such trees also make important ecological contributions (such as for wildlife habitat and for soil and water protection). With the annualized inventory system and increased interest in FIA data from an ecological perspective, a greater focus has been placed on all live volume. In 2004, Minnesota had 17.6 billion cubic feet of all live volume on its 16.2 million acres of forest land (table 4). This equates to an average of 1,086 cubic feet for each forest land acre in Minnesota.

The net volume of growing stock on timberland in Minnesota was estimated at 15.3 billion cubic feet on 14.8 million acres in 2003 (table 5) or 1,032 cubic feet of growing stock per acre (fig. 5). The 1990 inventory estimates were 15.1 billion cubic feet of growing stock on 14.7 million acres of timberland or 1,028 cubic feet of growing stock per acre. While growing-stock volume increased, all live volume on timberland decreased from 17.1 billion cubic feet in 1990 to 16.3 billion cubic feet in 2004 due in part to

a decrease in the volume of rough and rotten cull trees from 1.6 billion cubic feet in 1990 to 1.1 billion cubic feet in 2004.

In 2004 hardwoods made up 69 percent of the growing-stock volume and 65 percent of the sawtimber volume in the State (figs. 5 and 6). The cottonwood/aspen species group accounted for 39 percent of the hardwood growing-stock volume, followed by other eastern soft hardwoods (14 percent), ash (11 percent), select white oaks (8 percent), basswood (8 percent), select red oaks (7 percent), hard maple (5 percent), and soft maple (5 percent) (table 6).

Softwood growing-stock volume was estimated at 4.7 billion cubic feet in 2004. The spruce and balsam fir species group accounted for 35 percent of the softwood volume, followed by other eastern softwoods (32 percent), eastern white and red pines (24 percent), and jack pine (9 percent).

The growing-stock volume of poletimber-size trees decreased from 7.8 billion cubic feet in 1990 to 7.3 billion cubic feet in 2004 (table 7); the growing-stock volume of sawtimber-size trees increased from 7.4 billion cubic feet in 1990 to 8.1 billion cubic feet in 2004.

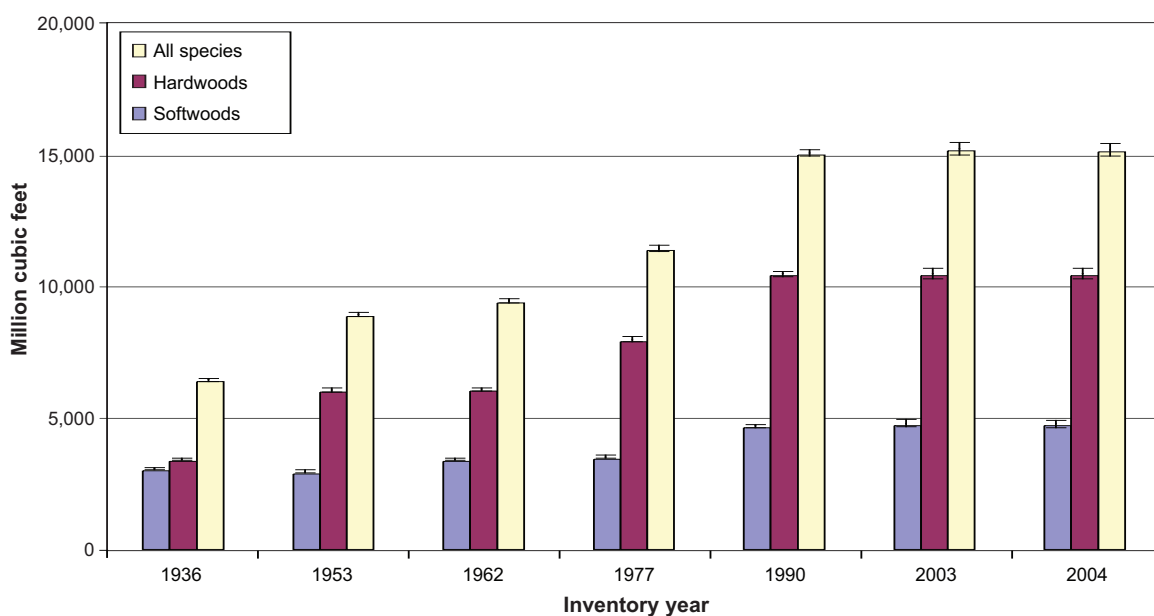


Figure 5.—Growing-stock volume in Minnesota by inventory year.

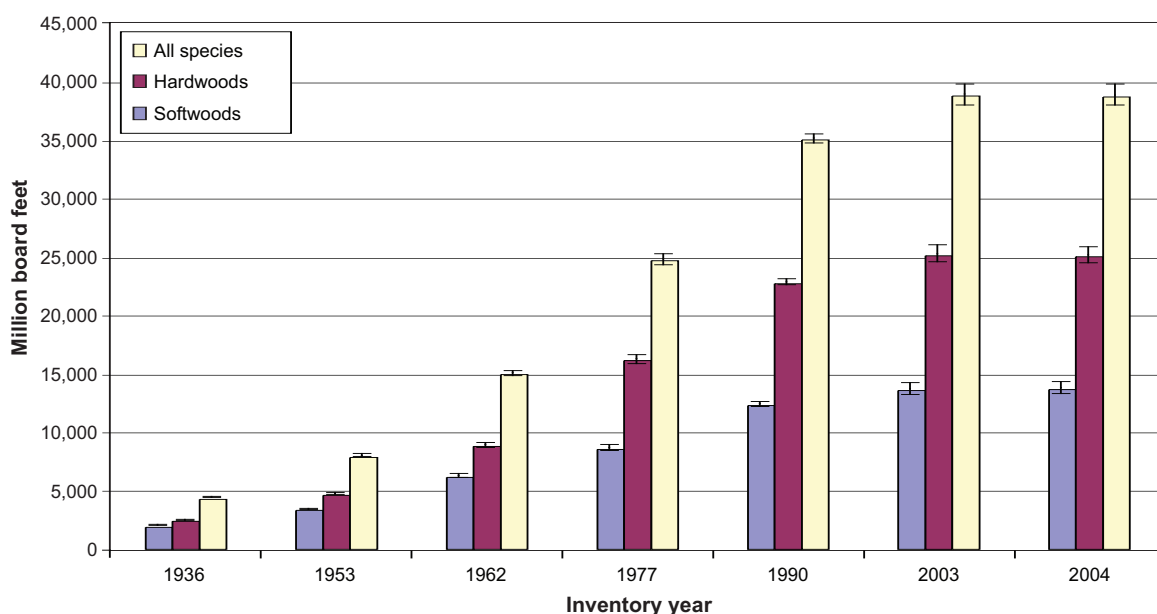


Figure 6.—Sawtimber volume in Minnesota by inventory year.

Biomass

Biomass, measured as all live aboveground tree biomass on timberlands, was estimated at 433 million dry tons in 2004 (an average of 29.3 dry tons per acre) (table 9). Biomass estimates are increasing in importance for analyses of carbon sequestration, wood fiber availability for fuel, and other issues. In 2004, 78 percent of the total biomass was in growing-stock trees, an additional 15 percent was in trees less than 5 inches d.b.h., and the remaining 8 percent was in non-growing-stock trees. Three-quarters of the total biomass was composed of hardwood species. Although total biomass was almost evenly split on private (217 million dry tons) and public (216 million dry tons) timberlands, softwoods made up 35 percent of the total biomass on public lands, but only 15 percent on private lands.

Growth, Removals, and Mortality

The three components of change (growth, removals, and mortality) provide trend information that helps to describe forest changes that have occurred between inventories. For the first time, growth, removals, and mortality estimates for Minnesota are based solely on annual inventory

plots. Annual inventory plots measured in 1999 were remeasured in 2004. Sampling errors are rather large because the sample includes only those plots measured in 1999 and remeasured in 2004. For more information on sampling errors, see the appendix.

Net average annual growth between the current and previous inventories is equal to gross growth over the period less mortality over the period divided by the number of growing seasons in the period. The net average annual growth of growing stock on timberland from 1999 to 2004 was 540 million cubic feet (table 10) or approximately 3.5 percent of the current growing-stock inventory on timberland.

Average annual removals includes trees cut and utilized (74 percent), trees killed as a result of harvesting (12 percent), and trees removed from the timberland base as a result of land use change (14 percent). Average annual removals of growing-stock on timberland from 1999 to 2004 was 333 million cubic feet (table 11) or approximately 2.2 percent of the current growing-stock inventory on timberland.

Average annual mortality includes trees that died over the period but did not die as a result of timber harvesting (trees that died as a result of timber harvesting are included in removals). Average annual mortality of growing stock on timberland from 1999 to 2004 was 250 million cubic feet (table 12) or approximately 1.6 percent of the current growing-stock inventory on timberland. Average annual mortality is not presented in figure 7 because it has already been removed from gross growth to compute the average net growth number.

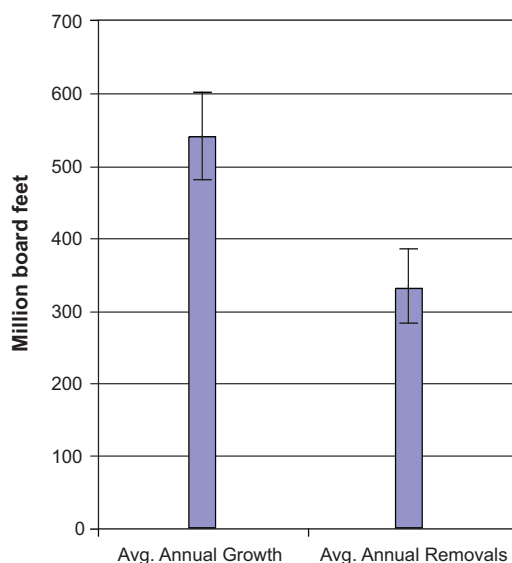


Figure 7.—Average annual net growth and average annual removals, Minnesota, 1999-2004.

Forest Health

The following forest health information was provided by the staff of the Minnesota Department of Natural Resources and the USDA Forest Service Northeastern Area State and Private Forestry.

The 2004 aerial survey identified a number of pest outbreaks (fig. 8 and table 13).

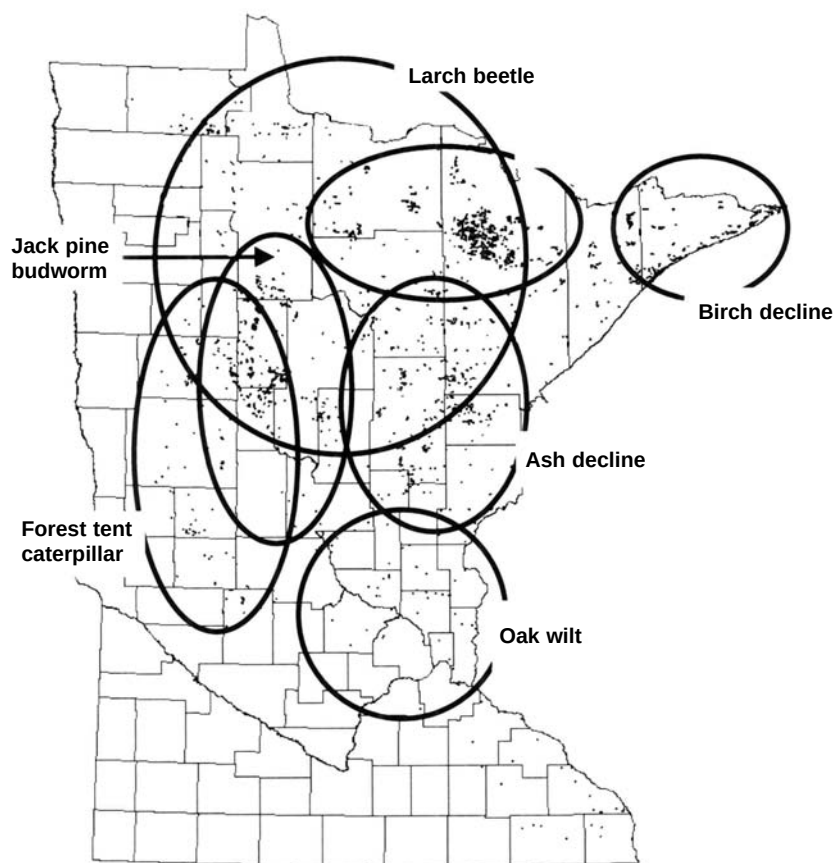


Figure 8.—Results of aerial survey 2004 cooperative effort between the USDA Forest Service and the Department of Natural Resources.

Spruce budworm on the rise

Since 1954 the eastern spruce budworm has defoliated spruce/fir forests annually, establishing itself as the most consistent damaging agent in the State (table 13). For the last 50 years, spruce budworm has been active somewhere in Minnesota. Currently, the main population center is in northern St. Louis County. Between 2003 and 2004, the number of defoliated acres rose fourfold to 83,000 acres, leading to the speculation that the population is on the rise again (fig. 9).

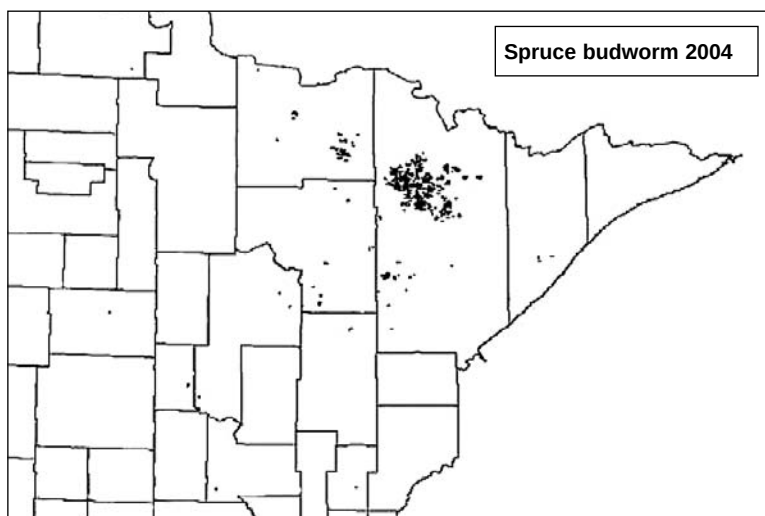


Figure 9.—*Spruce budworm aerial survey results, Minnesota, 2004.*

Jack pine budworm expands in western counties

In July, more than 43,000 acres of jack pine defoliation were mapped in the west central counties (fig. 10).

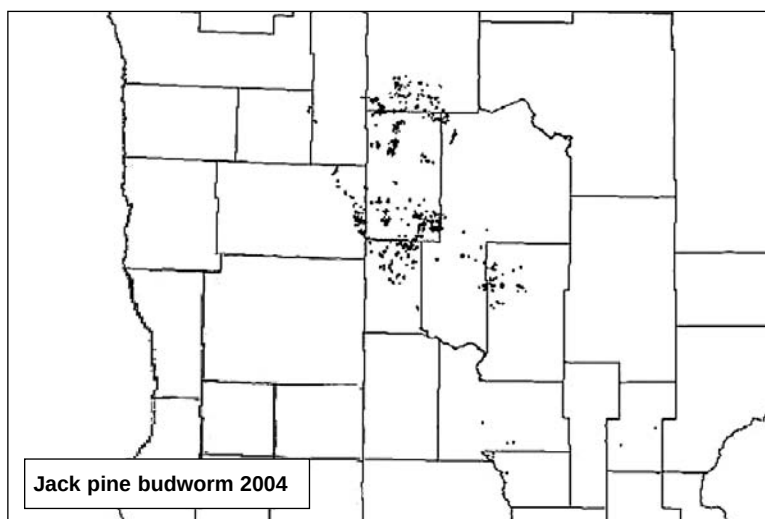


Figure 10.—*Jack pine budworm aerial survey results, Minnesota, 2004.*

Forest tent caterpillar populations finally collapse in 2004

The forest tent caterpillar (FTC) collapsed in 2004 over much of the State. Only 10,500 acres were tallied during the aerial survey. At its peak in 2002, this outbreak covered the highest number of acres ever recorded (7,374,000 ac) for an FTC outbreak in Minnesota. In its wake, this outbreak left thousands of acres of light mortality in both aspen and birch stands all across the northeastern counties. Host trees in these areas were heavily defoliated for 2 or more years and experienced severe drought before, during, and after the defoliation episodes (fig. 11).

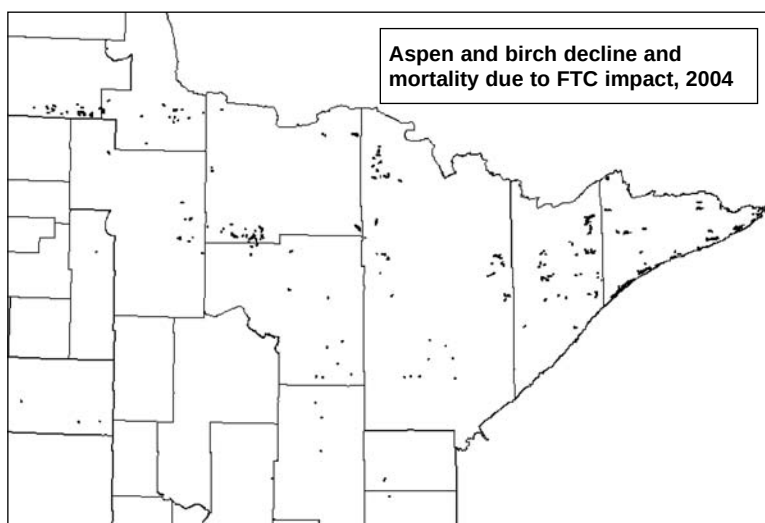


Figure 11.—*Forest tent caterpillar aerial survey results, Minnesota, 2004.*

Oak wilt continues

Oak wilt continues to be the most significant disease problem in the State, killing red oaks particularly in the greater Twin Cities metro area. Studies are underway to evaluate the effectiveness of control activities over the past years (fig. 12).

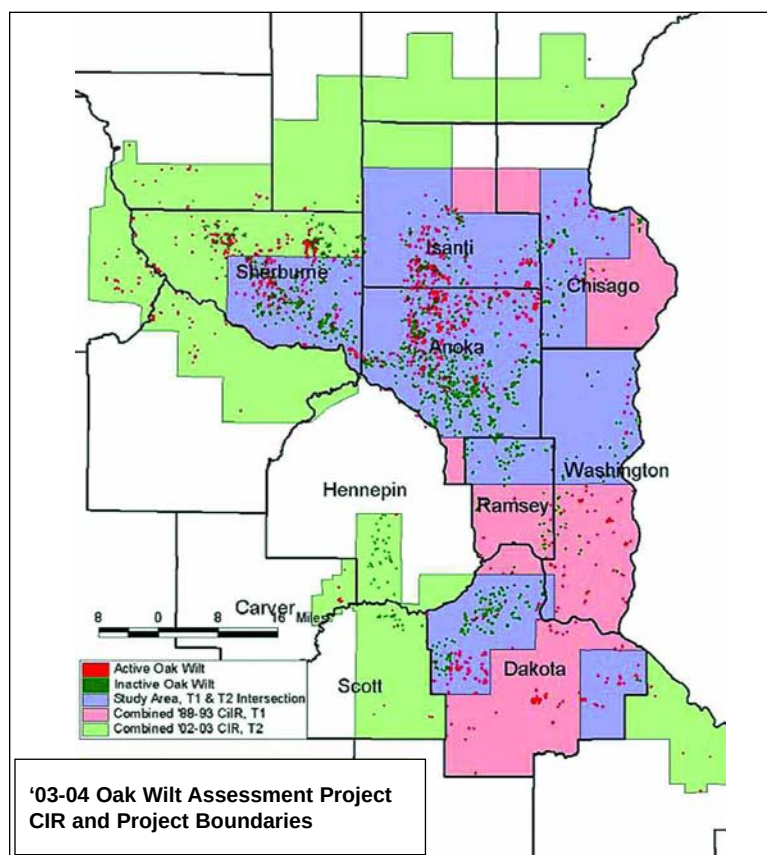


Figure 12.—Oak wilt outbreaks, Minnesota, 2004.

Cause of black ash decline being studied

Black ash decline from unknown causes has occurred over the years. Studies are ongoing to look at a variety of weather and soil moisture related associations with the presence of decline (fig. 13).

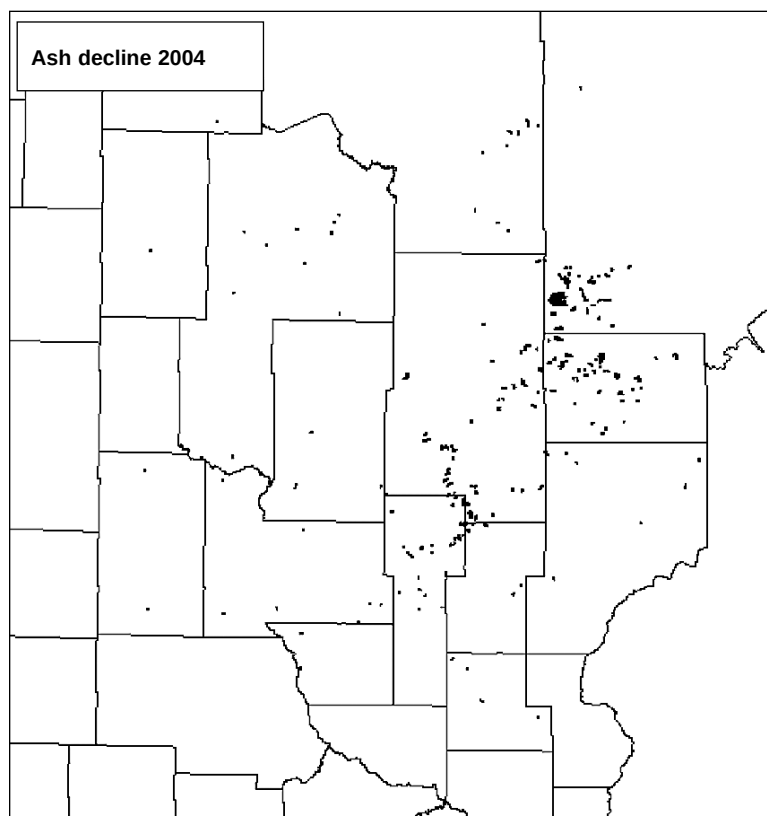


Figure 13.—Black ash decline aerial survey results, Minnesota, 2004.

Gypsy moth surveys find two egg masses

Two egg masses were found north of Tower and one mile south of the Boundary Waters Canoe Area (BWCA) Wilderness boundary in northern St. Louis County. The site was treated with Btk (*Bacillus thuringiensis*) in 2005 (fig. 14).

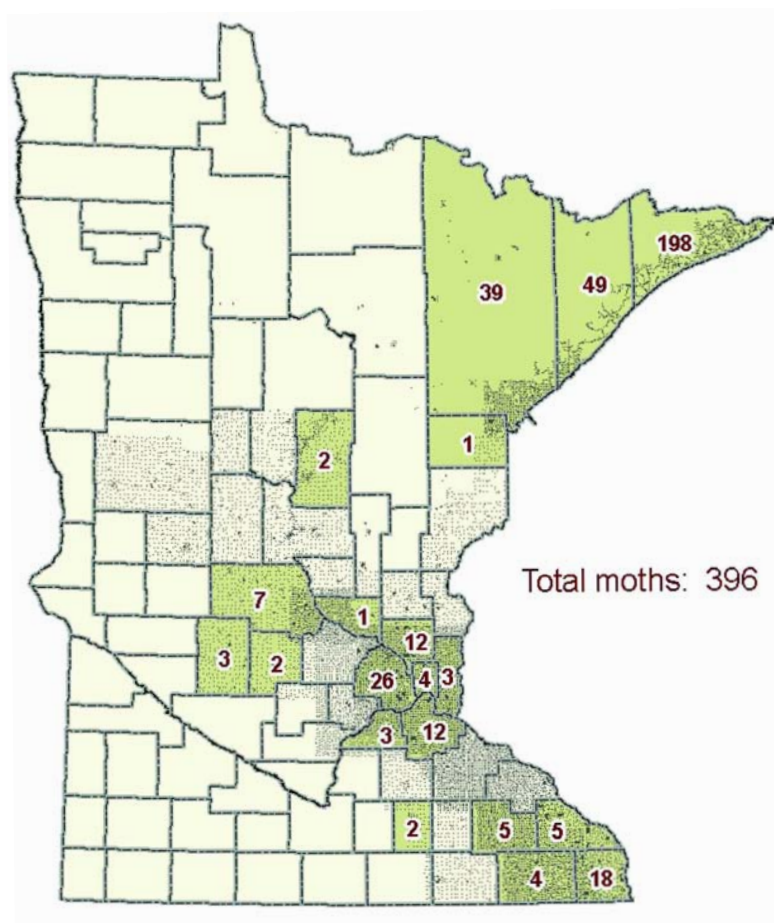


Figure 14.—Gypsy moth survey, Minnesota, 2004.

Eastern larch beetle continues to be a problem

Eastern larch beetle continues to kill tamarack. In 2003, 6,000 acres of tamarack mortality were reported, and in 2004, about 10,000 acres were reported. Mortality in some of the most severely damaged stands where the beetle has been active for a number of years seems to be declining (fig. 15).

Agents completely beyond human control, namely the weather, cause the most significant damage. Periods of drought and flooding, snow, ice, cold, and wind damage are an integral component of the State's forest dynamics.

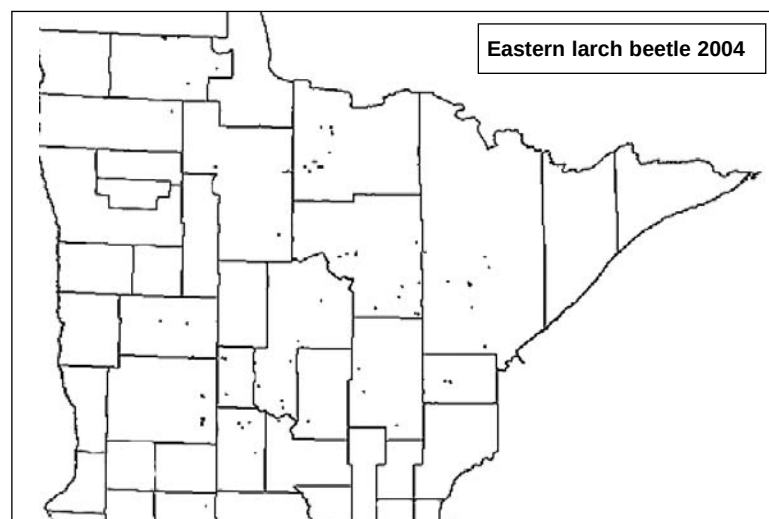


Figure 15.—Eastern larch beetle survey results, Minnesota, 2004.

For Further Information

Additional data related to the most recent four inventories of Minnesota (1977, 1990, 2003, and 2004) are available at: www.fia.fs.fed.us.



Appendix

Inventory Method

Since the 1990 inventory of Minnesota, several changes have been made in NCFIA inventory methods to improve the quality of the inventory as well as meet increasing demands for timely forest resource information. The most significant difference between inventories was the change from periodic inventories to annual inventories. Historically, NCFIA periodically inventoried each State on a cycle that averaged about 12 years for recent inventories. However, the need for timely and consistent data across large geographical regions, combined with national legislative mandates, resulted in NCFIA's implementation of an annual inventory system. Minnesota was one of the first States in the North Central region, and one of the first States in the Nation, to be inventoried with this new system, beginning with the 1999 panel of measurements.

With the NCFIA annual inventory system, about one-fifth of all field plots are measured in any one year. After 5 years, an entire inventory cycle will be completed. After the first 5 years, NCFIA will report and analyze results as a moving 5-year average. For example, NCFIA will be able to generate a report based on inventory results for 1999 through 2003 or for 2000 through 2004. The results presented in this report are estimates based on sampling techniques presented by Bechtold and Patterson, (2005).

For the first time estimates of growth, removals, and mortality for Minnesota are based solely on annual inventory plots. Annual inventory plots measured in 1999 were remeasured in 2004. Sampling errors are rather large because the sample includes only those plots measured in 1999 and remeasured in 2004. Over the next 4 years, sampling errors for growth, removals, and mortality will become smaller as additional annual inventory plots are remeasured. Sampling error estimates for the 2004 inventory results are area of forest land (0.60 percent), area of timberland (0.68 percent), number of growing-stock

trees on timberland (1.19 percent), volume of growing stock on timberland (1.32 percent), volume of sawtimber on timberland (1.88 percent), average annual net growth of growing stock on timberland (11.2 percent), average annual removals of growing stock on timberland (15.4 percent), and average annual mortality of growing stock on timberland (9.7 percent).

Other significant changes between the 1990 and 2004 inventories include the implementation of new remote sensing technology, the implementation of a new field plot configuration, and the gathering of additional remotely sensed and field data. The advent of remote sensing technology since the 1990 inventory has allowed NCFIA to use computer-assisted classifications of Multi-Resolution Land Characterization (MRLC) data and other available remote sensing products to stratify the total area of the State and to improve estimates. Inventories in Minnesota before 1999 used manual interpretation of aerial photos to stratify the sample (1936, 1953, 1962, 1977, and 1990).

New algorithms were used in 1999-2004 to assign forest type and stand-size class to each condition observed on a plot. These algorithms are being used nationwide by FIA to provide consistency among States. The list of recognized forest types, names given to the forest types, grouping of these forest types for reporting purposes, equations used to assign stocking values to individual trees, and definition of nonstocked changed with the new algorithms. The list of recognized forest types, names given to the forest types, grouping of these forest types for reporting purposes, equations used to assign stocking values to individual trees, and definition of nonstocked, changed with the new algorithms. As a result, comparisons between the published 2000-2004 measurement results and those published for the 1990 inventory results may not be valid. For additional details about the algorithms used in both inventories, please contact NCFIA.

Sampling Phases

The 2004 Minnesota survey was based on a three-phase inventory. The first phase used classified satellite imagery to stratify the State and aerial photographs to select plots for measurement. The second phase measured the traditional FIA suite of mensurational variables, and the third phase focused on a suite of variables related to the health of the forest.

The only land that could not be sampled was (1) private land where field personnel could not obtain permission from the owner to measure the field plot and (2) plots that could not be accessed because of a hazard or danger to field personnel. The methods used in the preparation of this report make the necessary adjustments to account for sites where access was denied or hazardous. There were 23 denied access or hazardous plots in 1999, 58 in 2000, 64 in 2001, 66 in 2002, 74 in 2003, and 75 in 2004. The reason there were so few denied access plots in 1999 was that only a single intensity sample was conducted that year, unlike the doubled sampling intensity in 2000 through 2004.

Phase 1

In phase 1 the Minnesota inventory used a computer-assisted classification of satellite imagery. FIA used the classified imagery to form two initial strata—forest and nonforest. Pixels within 60 m (2 pixel widths) of a forest-nonforest boundary formed two additional strata—forest-edge and nonforest-edge. Forest pixels within 60 m on the forest side of a forest-nonforest boundary were classified into forest-edge strata. Pixels within 60 m of the boundary on the nonforest side were classified into nonforest-edge strata. In addition, all strata were divided into public or private ownership based on information available in the Protected Lands Database (DellaSala *et al.* 2001). Stratification and estimation were conducted separately for the Chippewa National Forest, the BWCA Wilderness, the Superior National Forest excluding the BWCA, and Voyageurs National Park. Stratification and

estimation were conducted at the FIA unit level for all other public lands and for private lands. In the national forest stratum, forest and forest-edge strata were combined.

Phase 2

Phase 2 of the inventory consisted of the measurement of the annual sample of field plots in Minnesota. Current FIA precision standards for annual inventories require a sampling intensity of one plot for approximately every 6,000 acres. FIA has established a grid that divides the entire area of the United States into nonoverlapping hexagons, each of which contains approximately 5,937 acres (McRoberts 1999). A grid of field plots was established by selecting one plot from each hexagon based on the following rules: (1) if a Forest Health Monitoring (FHM) plot (Mangold 1998) fell within a hexagon, it was selected as the grid plot; (2) if no FHM plot fell within a hexagon, the existing NCFIA plot from the 1990 inventory nearest the hexagon center was selected as the grid plot; and (3) if neither FHM nor existing NCFIA plots fell within the hexagon, a new NCFIA plot was established in the hexagon (McRoberts 1999). This grid of plots is designated the Federal base sample and is considered an equal probability sample; its measurement in Minnesota is funded by the Federal government. During the 2000 through 2004 field seasons the State of Minnesota contributed resources to double the intensity of phase 2 plots.

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

Phase 3

NCFIA has two categories of field plot measurements—phase 2 field plots and phase 3 plots (FHM plots)—to optimize our ability to collect data when available for measurement. Both types of plots are systematically distributed both geographically and temporally. Phase 3 plots are measured with the full suite of FHM vegetative and health variables collected as well as the full suite of measures associated with phase 2 plots. Phase 3 plots must be measured between June 1 and August 30 to accommodate the additional measurement of nonwoody understory vegetation, ground cover, soils, and other variables.

The complete 5-year annual inventory includes 783 phase 3 plots of which 299 are forested. On the remaining plots, referred to as phase 2 plots, only variables that can be measured throughout the entire year are collected. In Minnesota, the complete 5-year annual inventory includes land inventoried on 17,821 phase 2 plots. Forest land was observed on 5,712 of these plots. Timberland was measured on 5,310 plots, reserved forest land on 238 plots, and other forest land on 195 plots. The above number of field plots represents a double intensification for the standard base Federal sample. This double intensification was made possible by additional resources provided by the State of Minnesota.

The national FIA four-point cluster plot configuration (fig. 16) was used for data collection during the 2000-2004 measurements of Minnesota. The national plot configuration requires mapping forest conditions on each plot.

The overall plot layout for the new configuration consists of four subplots. The centers of subplots 2, 3, and 4 are located 120 feet from the center of subplot 1. The azimuths to subplots 2, 3, and 4 are 0, 120, and 240 degrees, respectively. The center of the new plot is located at the same point as the center of the previous plot if a previous plot existed within the sample unit. Trees with a d.b.h. of 5 inches and larger are measured on a 24-foot-radius (1/24 acre) circular subplot. All trees less than 5 inches d.b.h. are measured on a

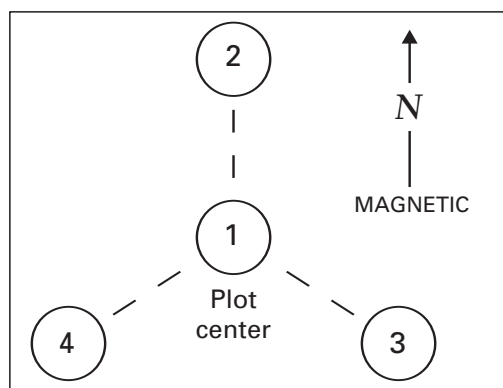


Figure 16.—Current NCFIA field plot configuration.

6.8-foot-radius (1/300 acre) circular microplot located 12 feet east of the center of each of the four subplots. Forest conditions that occur on any of the four subplots are recorded. Factors that differentiate forest conditions are changes in forest type, stand-size class, land use, ownership, and density. Each condition that occurs anywhere on any of the subplots is identified, described, and mapped if the area of the condition meets or exceeds 1 acre in size and 120 feet in width. Field plot measurements are combined with phase 1 estimates in the compilation process and table production. For additional information, contact:

Program Manager
Forest Inventory and Analysis
North Central Research Station
1992 Folwell Ave.
St. Paul, MN 55108

Or

State Forester
Division of Forestry
Minnesota Department of Natural Resources
P.O. Box 44, 500 Lafayette Road
St. Paul, MN 55155

LITERATURE CITED

Bechtold, W.A.; Patterson, P.L., eds. 2005.

The enhanced Forest Inventory and Analysis program-national sampling design and estimation procedures. Gen. Tech. Rep. SRS-80. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 85 p.

DellaSala, D.A.; Staus, N.L.; Stritholt, J.R.; et al. 2001.

An updated protected areas database for the United States and Canada. Natural Areas Journal. 21(2): 124-135.

Mangold, R.D. 1998.

Forest health monitoring field methods guide (National 1998). Research Triangle Park, NC: U.S. Department of Agriculture, Forest Service, National Forest Health Monitoring Program. 429 p. (Revision 0, April 1998).

McRoberts, R.E. 1999.

Joint annual forest inventory and monitoring system, the North Central perspective. Journal of Forestry. 97(12): 27-31.

Miles, P.D.; Chen, C.M.; Leatherberry, E.C. 1995.

Minnesota forest statistics, 1990, revised. Resour. Bull. NC-158. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 139 p.

TABLES

Table 1.—Area of forest land by forest type group, forest type, and owner category, Minnesota, 2000-2004

Table 2.—Area of timberland by major forest type group, stand origin, and owner category, Minnesota, 2000-2004

Table 3.—Area of timberland by forest type group, forest type, and stand-size class, Minnesota, 2000-2004

Table 4.—Net volume of all live trees on forest land by species group, species, and owner category, Minnesota, 2000-2004

Table 5.—Net volume of all live trees and salvable dead trees on timberland by class of timber and softwood/hardwood category, Minnesota, 2000-2004

Table 6.—Net volume of growing stock on timberland by forest type group, forest type and softwood/hardwood species category, Minnesota, 2000-2004

Table 7.—Net volume of growing stock on timberland by species group, species, and diameter class, Minnesota, 2000-2004

Table 8.—Net volume of sawtimber on timberland by species group, species, and diameter class, Minnesota, 2000-2004

Table 9.—All live aboveground tree biomass on timberland by owner category, softwood/hardwood species category, and tree biomass component, Minnesota, 2000-2004

Table 10.—Average annual net growth of growing stock on timberland by species group and owner category, Minnesota, 1999 to 2004

Table 11.—Average annual removals of growing stock on timberland by species group and owner category, Minnesota, 1999 to 2004

Table 12.—Average annual mortality of growing stock on timberland by species group and owner category, Minnesota, 1999 to 2004

Table 13.—Pest detection survey results, Minnesota, 2004 (Forest Health Protection, St. Paul Field Office).

Table 1. — Area of forest land by forest type group, forest type, and owner category, Minnesota, 2000-2004

(In thousand acres)

Forest type group/ forest type	Owner category		
	All owners	Public	Private Unidentified owner
Softwood type groups			
White / red / jack pine group			
Jack pine	458.5	313.7	144.8
Red pine	405.2	260.3	144.9
Eastern white pine	120.4	88.2	32.1
All forest types	984.1	662.3	321.8
Spruce / fir group			
Balsam fir	479.5	322.4	157.1
White spruce	125.2	82.6	42.6
Black spruce	1,578.9	1,316.9	262.0
Tamarack	884.3	712.9	171.4
Northern white-cedar	607.5	480.8	126.6
All forest types	3,675.4	2,915.6	759.8
Pinyon / juniper group			
Eastern redcedar	17.2	2.4	14.7
All forest types	17.2	2.4	14.7
Exotic softwoods group			
Scotch pine	4.2	--	4.2
All forest types	4.2	--	4.2
All softwood groups	4,680.9	3,580.4	1,100.5
Hardwood type groups			
Oak / pine group			
White pine / red oak / white ash	75.5	37.4	38.1
Eastern redcedar / hardwood	13.1	3.3	9.8
Other pine / hardwood	186.1	99.8	86.3
All forest types	274.7	140.5	134.2
Oak / hickory group			
Post oak / blackjack oak	67.6	9.4	58.2
White oak / red oak / hickory	255.3	42.1	213.3
White oak	14.8	--	14.8
Northern red oak	306.3	104.2	202.1
Bur oak	209.3	31.9	177.4
Black walnut	7.5	--	7.5
Red maple / oak	35.8	11.3	24.5
Mixed upland hardwoods	271.1	42.2	228.9
All forest types	1,167.8	241.0	926.7

(Table 1 continued on next page)

(Table 1 continued)

Forest type group/ forest type	Owner category			
	All owners	Public	Private	Unidentified owner
Hardwood type groups				
Elm / ash / cottonwood group				
Elm / ash / cottonwood group	1.4	--	1.4	--
Black ash / American elm / red maple	914.9	434.7	480.2	--
River birch / sycamore	29.2	25.1	4.1	--
Cottonwood	43.9	14.5	29.4	--
Willow	57.7	25.9	31.8	--
Sycamore / pecan / American elm	7.1	3.0	4.1	--
Sugarberry / hackberry / elm / green ash	208.4	28.6	179.8	--
Silver maple / American elm	45.9	11.4	34.6	--
Red maple / lowland	17.3	5.3	12.0	--
Cottonwood / willow	9.6	3.8	5.8	--
All forest types	1,335.4	552.2	783.2	--
Maple / beech / birch group				
Maple / beech / birch group	0.2	0.2	--	--
Sugar maple / beech / yellow birch	613.3	267.1	346.2	--
Black cherry	4.8	--	4.8	--
Cherry / ash / yellow-poplar	6.4	--	6.4	--
Hard maple / basswood	916.0	346.7	569.3	--
Elm / ash / locust	171.4	30.3	141.1	--
Red maple / upland	76.5	35.1	41.5	--
All forest types	1,788.6	679.3	1,109.3	--
Aspen / birch group				
Aspen / birch group	4.2	2.3	1.9	--
Aspen	5,106.8	2,864.6	2,242.2	--
Paper birch	1,150.9	792.8	358.1	--
Balsam poplar	460.1	228.2	231.9	--
All forest types	6,721.9	3,887.9	2,834.1	--
Exotic hardwoods group				
Other exotic hardwoods	3.0	--	3.0	--
All forest types	3.0	--	3.0	--
All hardwood groups	11,291.5	5,500.9	5,790.5	--
Nonstocked	222.6	143.4	79.3	--
All forest groups	16,195.0	9,224.7	6,970.3	--

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

Table 2. — Area of timberland by major forest type group, stand origin, and owner category, Minnesota, 2000-2004

(In thousand acres)

Major forest type group and stand origin	Owner category		
	All owners	Public	Unidentified owner
Softwood type groups			
Natural	3,642.1	2,747.8	894.3
Planted	421.6	266.4	155.2
All softwood types	4,063.8	3,014.3	1,049.5
Hardwood type groups			
Natural	10,348.6	4,794.3	5,554.3
Planted	178.4	90.4	88.0
All hardwood types	10,527.0	4,884.7	5,642.3
Nonstocked	204.0	127.9	76.1
All groups	14,794.8	8,026.9	6,767.9

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

Table 3. — Area of timberland by forest type group, forest type, and stand-size class, Minnesota, 2000-2004

(In thousand acres)

Forest type group/ forest type	Stand-size class				
	All stands	Sawtimber	Poletimber	Sapling- seedling	Non- stocked
Softwood type groups					
White / red / jack pine group					
Jack pine	362.6	161.0	136.6	65.0	--
Red pine	378.3	172.1	139.2	67.0	--
Eastern white pine	76.7	62.6	7.7	6.3	--
All forest types	817.6	395.7	283.6	138.4	--
Spruce / fir group					
Balsam fir	397.7	59.7	118.7	219.3	--
White spruce	111.8	14.3	41.1	56.4	--
Black spruce	1,345.5	22.4	414.4	908.6	--
Tamarack	811.9	71.6	325.0	415.3	--
Northern white-cedar	558.6	243.7	253.8	61.2	--
All forest types	3,225.5	411.7	1,153.0	1,660.9	--
Pinyon / juniper group					
Eastern redcedar	17.2	8.8	--	8.3	--
All forest types	17.2	8.8	--	8.3	--
Exotic softwoods group					
Scotch pine	3.5	1.2	2.2	--	--
All forest types	3.5	1.2	2.2	--	--
All softwood groups	4,063.8	817.4	1,438.8	1,807.5	--
Hardwood type groups					
Oak / pine group					
White pine / red oak / white ash	63.8	32.4	21.5	9.9	--
Eastern redcedar / hardwood	7.5	3.4	3.1	0.9	--
Other pine / hardwood	161.9	79.6	43.0	39.3	--
All forest types	233.2	115.5	67.6	50.0	--
Oak / hickory group					
Post oak / blackjack oak	64.7	42.6	10.6	11.5	--
White oak / red oak / hickory	246.5	161.3	76.9	8.2	--
White oak	14.8	14.8	--	--	--
Northern red oak	280.6	205.4	67.5	7.7	--
Bur oak	168.0	123.6	35.2	9.2	--
Black walnut	7.5	5.8	1.7	--	--
Red maple / oak	35.8	5.4	16.2	14.2	--
Mixed upland hardwoods	264.4	119.8	95.3	49.2	--
All forest types	1,082.2	678.7	303.5	100.0	--

(Table 3 continued on next page)

(Table 3 continued)

Forest type group/ forest type	Stand-size class				
	All stands	Sawtimber	Poletimber	Sapling- seedling	Non- stocked
Hardwood type groups					
Elm / ash / cottonwood group					
Elm / ash / cottonwood group	1.4	--	1.4	--	--
Black ash / American elm / red maple	836.4	116.6	481.5	238.3	--
River birch / sycamore	29.2	2.9	3.8	22.4	--
Cottonwood	41.8	36.3	2.7	2.8	--
Willow	52.3	5.7	2.0	44.6	--
Sycamore / pecan / American elm	7.1	3.9	--	3.2	--
Sugarberry / hackberry / elm / green ash	198.5	76.5	85.3	36.7	--
Silver maple / American elm	42.7	29.1	11.1	2.5	--
Red maple / lowland	17.3	5.3	4.7	7.3	--
Cottonwood / willow	9.6	8.7	--	0.9	--
All forest types	1,236.3	285.1	592.5	358.7	--
Maple / beech / birch group					
Maple / beech / birch group	0.2	--	0.2	--	--
Sugar maple / beech / yellow birch	577.6	236.1	273.0	68.6	--
Black cherry	4.8	--	--	4.8	--
Cherry / ash / yellow-poplar	6.4	2.5	--	3.8	--
Hard maple / basswood	889.1	554.9	299.9	34.3	--
Elm / ash / locust	163.6	66.9	67.8	28.8	--
Red maple / upland	76.5	13.1	47.4	16.0	--
All forest types	1,718.1	873.5	688.3	156.3	--
Aspen / birch group					
Aspen / birch group	4.2	1.0	2.5	0.7	--
Aspen	4,836.3	908.6	1,754.6	2,173.1	--
Paper birch	973.1	208.4	595.0	169.8	--
Balsam poplar	440.5	55.8	208.9	175.8	--
All forest types	6,254.2	1,173.8	2,560.9	2,519.4	--
Exotic hardwoods group					
Other exotic hardwoods	3.0	1.7	1.3	--	--
All forest types	3.0	1.7	1.3	--	--
All hardwood groups	10,527.0	3,128.4	4,214.1	3,184.5	--
Nonstocked	204.0	--	--	--	204.0
All forest groups	14,794.8	3,945.9	5,652.9	4,992.0	204.0

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

Table 4. — Net volume of all live trees on forest land by species group, species, and owner category, Minnesota, 2000-2004

(In thousand cubic feet)

Species group/ species	Owner category			
	All owners	Public	Private	Unidentified owner
Softwoods				
Other yellow pines				
Scotch pine	6,004	--	6,004	--
All species	6,004	--	6,004	--
Eastern white and red pines				
Red pine	868,291	587,188	281,103	--
Eastern white pine	473,078	329,586	143,492	--
All species	1,341,369	916,774	424,595	--
Jack pine				
Jack pine	519,959	356,937	163,022	--
All species	519,959	356,937	163,022	--
Spruce and balsam fir				
Balsam fir	684,990	414,252	270,738	--
White spruce	296,421	199,088	97,333	--
Black spruce	877,418	700,572	176,846	--
All species	1,858,828	1,313,911	544,917	--
Other eastern softwoods				
Redcedar/juniper spp.	100	--	100	--
Eastern redcedar	24,470	2,303	22,167	--
Larch spp.	265	165	100	--
Tamarack (native)	655,048	466,258	188,790	--
Blue spruce	39	--	39	--
Austrian pine	1,478	--	1,478	--
Northern white-cedar	1,002,737	759,353	243,384	--
All species	1,684,139	1,228,079	456,059	--
Total softwoods	5,410,299	3,815,702	1,594,597	--
Hardwoods				
Select white oaks				
White oak	105,838	20,638	85,200	--
Swamp white oak	7,120	5,638	1,482	--
Bur oak	894,782	170,752	724,030	--
All species	1,007,740	197,028	810,712	--
Select red oaks				
Northern red oak	881,599	330,608	550,991	--
All species	881,599	330,608	550,991	--
Other red oaks				
Northern pin oak	85,538	8,904	76,634	--
Black oak	10,291	3,719	6,573	--
All species	95,829	12,623	83,206	--
Hickory				
Hickory spp.	166	81	85	--
Bitternut hickory	9,326	167	9,158	--
Shagbark hickory	19,074	1,304	17,771	--
All species	28,566	1,552	27,014	--

(Table 4 continued on next page)

(Table 4 continued)

Species group/ species	Owner category			
	All owners	Public	Private	Unidentified owner
Hardwoods				
Yellow birch				
Yellow birch	54,832	35,385	19,447	--
All species	54,832	35,385	19,447	--
Hard maple				
Sugar maple	690,519	341,569	348,951	--
All species	690,519	341,569	348,951	--
Soft maple				
Red maple	535,080	266,408	268,672	--
Silver maple	165,895	58,595	107,300	--
All species	700,975	325,003	375,972	--
Beech				
American beech	50	--	50	--
All species	50	--	50	--
Ash				
White ash	11,484	825	10,659	--
Black ash	913,433	438,539	474,894	--
Green ash	355,915	70,756	285,160	--
All species	1,280,833	510,120	770,712	--
Cottonwood and aspen				
Cottonwood and poplar spp.	620	--	620	--
Balsam poplar	446,301	238,409	207,891	--
Eastern cottonwood	126,838	61,788	65,050	--
Bigtooth aspen	368,475	175,217	193,257	--
Quaking aspen	3,688,907	2,091,219	1,597,688	--
All species	4,631,140	2,566,634	2,064,506	--
Basswood				
American basswood	902,075	311,247	590,828	--
All species	902,075	311,247	590,828	--
Black walnut				
Black walnut	32,076	3,680	28,396	--
All species	32,076	3,680	28,396	--

(Table 4 continued on next page)

(Table 4 continued)

Species group/ species	Owner category			
	All owners	Public	Private	Unidentified owner
Hardwoods				
Other eastern soft hardwoods				
Boxelder	132,634	15,380	117,254	--
Paper birch	1,352,796	861,436	491,360	--
Hackberry	17,433	2,233	15,201	--
Butternut	16,938	3,753	13,185	--
Black cherry	30,704	4,300	26,404	--
Black willow	32,230	11,345	20,886	--
White willow	213	213	--	--
Elm spp.	1,603	436	1,167	--
Winged elm	30	30	--	--
American elm	193,551	43,453	150,099	--
Siberian elm	3,636	61	3,574	--
Slippery elm	37,065	2,083	34,983	--
All species	1,818,835	944,723	874,112	--
Other eastern hard hardwoods				
Sweet birch	324	--	324	--
Honeylocust	173	--	173	--
Red mulberry	71	37	34	--
Black locust	3,688	28	3,660	--
Rock elm	6,945	1,453	5,492	--
All species	11,200	1,518	9,682	--
Eastern noncommercial hardwoods				
Mountain maple	176	145	31	--
Serviceberry spp.	--	--	--	--
Common serviceberry	--	--	--	--
American hornbeam, musclewood	1,368	580	788	--
Hawthorn spp.	1,303	--	1,303	--
Apple spp.	450	--	450	--
Eastern hophornbeam	26,863	3,536	23,326	--
Cherry and plum spp.	95	--	95	--
Pin cherry	516	270	246	--
Chokecherry	726	685	41	--
Canada plum	--	--	--	--
American plum	391	72	319	--
Willow spp.	4,576	855	3,721	--
Peachleaf willow	3,026	931	2,095	--
Bebb willow	662	662	--	--
American mountain-ash	628	535	93	--
Russian-olive	29	--	29	--
Other or unknown tree	544	--	544	--
All species	41,353	8,272	33,081	--
Total hardwoods	12,177,623	5,589,962	6,587,661	--
All species groups	17,587,922	9,405,663	8,182,258	--

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

Table 5. — Net volume of all live trees and salvable dead trees on timberland
by class of timber and softwood/hardwood species category, Minnesota, 2000-2004

(In thousand cubic feet)

Class of timber	All species	Softwood species	Hardwood species
Live trees			
Growing-stock trees			
Sawtimber			
Saw log portion	6,279,939	2,300,229	3,979,710
Upper stem portion	1,799,776	312,536	1,487,240
Total	8,079,715	2,612,765	5,466,950
Poletimber	7,183,406	2,129,534	5,053,872
All growing-stock trees	15,263,121	4,742,299	10,520,822
Cull trees			
Rough trees ¹			
Sawtimber size	694,947	60,226	634,721
Poletimber size	209,756	23,851	185,906
Total	904,704	84,077	820,627
Rotten trees ¹			
Sawtimber size	128,364	23,702	104,662
Poletimber size	25,909	5,030	20,879
Total	154,273	28,732	125,541
All live cull trees	1,058,977	112,809	946,168
All live trees	16,322,098	4,855,108	11,466,990
Salvable dead trees			
Sawtimber size	110,163	43,821	66,342
Poletimber size	106,466	46,068	60,398
All salvable dead trees	216,629	89,889	126,740
All classes	16,538,727	4,944,997	11,593,730

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

¹Includes noncommercial species.

Table 6. — Net volume of growing stock on timberland by forest type group, forest type, and softwood/hardwood species category, Minnesota, 2000-2004

(In thousand cubic feet)

Forest type group/ forest type	All species	Softwood species	Hardwood species
Softwood type groups			
White / red / jack pine group			
Jack pine	400,025	349,165	50,860
Red pine	733,765	687,116	46,649
Eastern white pine	158,670	144,702	13,968
All forest types	1,292,460	1,180,983	111,477
Spruce / fir group			
Balsam fir	302,581	218,981	83,600
White spruce	89,009	76,185	12,824
Black spruce	697,814	661,745	36,069
Tamarack	514,498	503,194	11,304
Northern white-cedar	863,883	779,694	84,189
All forest types	2,467,785	2,239,799	227,986
Pinyon / juniper group			
Eastern redcedar	9,125	6,911	2,214
All forest types	9,125	6,911	2,214
Exotic softwoods group			
Scotch pine	5,556	5,478	78
All forest types	5,556	5,478	78
All softwood groups	3,774,927	3,433,171	341,756
Hardwood type groups			
Oak / pine group			
White pine / red oak / white ash	126,829	80,587	46,242
Eastern redcedar / hardwood	3,613	2,662	951
Other pine / hardwood	195,282	113,169	82,113
All forest types	325,724	196,418	129,306
Oak / hickory group			
Post oak / blackjack oak	84,762	1,397	83,365
White oak / red oak / hickory	324,154	7,512	316,643
White oak	20,350	1,272	19,077
Northern red oak	470,921	2,143	468,778
Bur oak	237,887	2,428	235,459
Black walnut	8,058	--	8,058
Red maple / oak	24,414	1,267	23,147
Mixed upland hardwoods	293,684	8,501	285,183
All forest types	1,464,229	24,519	1,439,710

(Table 6 continued on next page)

(Table 6 continued)

Forest type group/ forest type	All species	Softwood species	Hardwood species
Hardwood type groups			
Elm / ash / cottonwood group			
Elm / ash / cottonwood group	1,453	--	1,453
Black ash / American elm / red maple	837,848	103,854	733,994
River birch / sycamore	7,873	1,974	5,898
Cottonwood	107,080	--	107,080
Willow	20,143	4,693	15,451
Sycamore / pecan / American elm	1,768	933	834
Sugarberry / hackberry / elm / green ash	188,156	5,146	183,010
Silver maple / American elm	99,316	1,642	97,674
Red maple / lowland	7,903	2,884	5,019
Cottonwood / willow	20,508	581	19,927
All forest types	1,292,048	121,707	1,170,341
Maple / beech / birch group			
Sugar maple / beech / yellow birch	733,756	57,541	676,215
Black cherry	1,084	--	1,084
Cherry / ash / yellow-poplar	6,153	--	6,153
Hard maple / basswood	1,550,199	38,389	1,511,810
Elm / ash / locust	182,045	5,143	176,903
Red maple / upland	74,129	9,093	65,035
All forest types	2,547,366	110,166	2,437,200
Aspen / birch group			
Aspen / birch group	4,058	406	3,652
Aspen	4,397,859	546,933	3,850,926
Paper birch	1,092,165	250,892	841,273
Balsam poplar	350,546	49,569	300,977
All forest types	5,844,629	847,801	4,996,829
Exotic hardwoods group			
Other exotic hardwoods	2,530	--	2,530
All forest types	2,530	--	2,530
All hardwood groups	11,476,527	1,300,611	10,175,916
Nonstocked	11,667	8,517	3,150
All forest groups	15,263,121	4,742,299	10,520,822

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

Table 7. — Net volume of growing stock on timberland by species group, species, and diameter class, Minnesota, 2000-2004

(In thousand cubic feet)

Species group/ species	All classes	Diameter class (inches at breast height)									
		5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Softwoods											
Other yellow pines											
Scotch pine	5,982	672	1,102	1,268	1,432	937	571	--	--	--	--
All species	5,982	672	1,102	1,268	1,432	937	571	--	--	--	--
Eastern white and red pines											
Red pine	804,333	68,166	131,928	133,158	94,213	88,196	73,692	68,744	66,251	77,494	2,491
Eastern white pine	335,965	8,087	17,585	20,640	26,683	28,195	34,277	37,634	41,096	90,528	31,240
All species	1,140,298	76,253	149,513	153,798	120,896	116,391	107,970	106,378	107,346	168,022	33,732
Jack pine											
Jack pine	412,748	53,773	88,587	104,595	79,515	53,001	22,070	7,273	3,934	--	--
All species	412,748	53,773	88,587	104,595	79,515	53,001	22,070	7,273	3,934	--	--
Spruce and balsam fir											
Balsam fir	643,745	190,176	206,248	133,933	63,671	36,907	10,454	1,429	926	--	--
White spruce	274,145	31,612	46,900	50,578	43,977	31,633	29,927	18,525	5,619	15,374	--
Black spruce	753,570	359,708	240,727	105,592	34,929	8,465	3,228	922	--	--	--
All species	1,671,460	581,496	493,875	290,103	142,577	77,005	43,609	20,876	6,545	15,374	--
Other eastern softwoods											
Redcedar/juniper spp.	100	32	69	--	--	--	--	--	--	--	--
Eastern redcedar	19,636	3,885	4,623	5,173	3,552	2,402	--	--	--	--	--
Larch spp.	130	30	100	--	--	--	--	--	--	--	--
Tamarack (native)	630,900	184,893	184,896	123,855	72,794	31,093	18,735	8,683	2,073	3,878	--
Blue spruce	39	39	--	--	--	--	--	--	--	--	--
Austrian pine	1,170	43	234	163	242	489	--	--	--	--	--
Northern white-cedar	859,835	122,419	183,001	167,514	132,880	110,637	58,230	40,375	21,025	23,756	--
All species	1,511,811	311,340	372,923	296,705	209,467	144,620	76,965	49,058	23,098	27,634	--
Total softwoods	4,742,299	1,023,534	1,106,000	846,469	553,888	391,955	251,184	183,584	140,923	211,030	33,732
Hardwoods											
Select white oaks											
White oak	78,226	2,360	3,580	6,799	11,782	14,176	9,613	9,734	5,550	10,543	4,090
Swamp white oak	6,819	35	--	--	--	--	561	--	1,943	--	4,280
Bur oak	733,764	53,924	84,172	106,125	105,673	84,661	76,868	69,024	42,544	96,433	14,341
All species	818,808	56,319	87,751	112,923	117,454	98,837	87,041	78,757	50,037	106,976	22,711
Select red oaks											
Northern red oak	774,574	20,526	53,651	88,096	112,014	135,816	111,506	72,630	58,607	100,499	21,228
All species	774,574	20,526	53,651	88,096	112,014	135,816	111,506	72,630	58,607	100,499	21,228

(Table 7 continued on next page)

(Table 7 continued)

Species group/ species	All classes	Diameter class (inches at breast height)										29.0+
		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		
Hardwoods												
Other red oaks												
Northern pin oak	66,580	1,452	3,100	3,704	7,136	8,579	10,079	14,046	5,820	10,529	2,135	
Black oak	7,283	119	--	148	1,212	1,100	1,080	1,338	--	2,285	--	
All species	73,863	1,571	3,100	3,852	8,349	9,679	11,159	15,384	5,820	12,814	2,135	
Hickory												
Hickory spp.	166	85	81	--	--	--	--	--	--	--	--	
Bitternut hickory	8,859	1,194	2,413	1,581	1,235	1,244	1,192	--	--	--	--	
Shagbark hickory	17,699	2,722	2,865	3,737	4,379	3,996	--	--	--	--	--	
All species	26,723	4,000	5,359	5,318	5,613	5,241	1,192	--	--	--	--	
Yellow birch												
Yellow birch	40,560	4,054	4,807	4,416	2,699	5,939	4,840	5,848	3,544	4,411	--	
All species	40,560	4,054	4,807	4,416	2,699	5,939	4,840	5,848	3,544	4,411	--	
Hard maple												
Sugar maple	571,347	84,444	117,518	109,032	86,036	54,717	46,488	35,821	13,738	23,554	--	
All species	571,347	84,444	117,518	109,032	86,036	54,717	46,488	35,821	13,738	23,554	--	
Soft maple												
Red maple	440,166	103,264	126,829	95,933	54,357	25,488	13,653	5,273	7,555	5,370	2,444	
Silver maple	128,274	4,172	8,241	10,690	12,786	13,574	11,832	7,370	5,618	33,742	20,250	
All species	568,440	107,436	135,070	106,623	67,143	39,062	25,484	12,642	13,173	39,112	22,695	
Beech												
American beech	50	50	--	--	--	--	--	--	--	--	--	
All species	50	50	--	--	--	--	--	--	--	--	--	
Ash												
White ash	9,821	239	657	1,409	957	522	1,282	3,710	1,045	--	--	
Black ash	836,773	158,500	208,587	192,442	120,850	75,150	49,307	12,373	12,358	7,206	--	
Green ash	328,074	30,699	49,034	53,207	43,654	37,818	32,217	19,328	24,718	31,559	5,841	
All species	1,174,668	189,437	258,278	247,058	165,461	113,490	82,806	35,411	38,122	38,765	5,841	
Cottonwood and aspen												
Cottonwood and poplar spp.	345	62	65	218	--	--	--	--	--	--	--	
Balsam poplar	417,723	71,810	96,149	93,373	69,341	39,328	29,032	7,398	8,462	2,828	--	
Eastern cottonwood	100,653	1,075	2,054	3,291	5,930	4,146	8,067	7,725	4,893	31,658	31,816	
Bigtooth aspen	329,012	17,540	32,424	53,506	79,688	60,229	41,592	25,834	8,724	9,474	--	
Quaking aspen	3,284,778	409,502	533,589	630,875	593,099	529,725	297,407	163,060	67,506	57,125	2,889	
All species	4,132,509	499,989	664,281	781,263	748,059	633,428	376,098	204,016	89,585	101,085	34,705	
Basswood												
American basswood	814,159	57,867	108,600	139,802	129,949	127,445	95,230	58,093	45,857	43,459	7,858	
All species	814,159	57,867	108,600	139,802	129,949	127,445	95,230	58,093	45,857	43,459	7,858	

(Table 7 continued on next page)

(Table 7 continued)

Species group/ species	All classes	Diameter class (inches at breast height)										29.0+
		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		
Hardwoods												
Black walnut												
Black walnut	30,985	1,624	1,806	4,445	5,880	3,826	5,904	2,512	1,016	3,972	--	
All species	30,985	1,624	1,806	4,445	5,880	3,826	5,904	2,512	1,016	3,972	--	
Other eastern soft hardwoods												
Boxelder	78,493	13,573	17,521	17,439	9,006	9,209	5,481	999	3,855	1,411	--	
Paper birch	1,137,810	173,793	301,415	294,794	196,804	96,055	51,372	16,358	3,146	4,074	--	
Hackberry	15,862	3,202	3,877	3,324	2,217	1,314	1,193	736	--	--	--	
Butternut	11,742	1,045	2,458	3,835	2,412	497	572	--	922	--	--	
Black cherry	23,006	4,550	4,850	5,175	2,642	1,740	4,049	--	--	--	--	
Black willow	22,600	568	1,376	2,649	3,044	1,574	1,833	1,320	2,912	2,325	4,998	
White willow	213	--	--	213	--	--	--	--	--	--	--	
Elm spp.	436	41	200	195	--	--	--	--	--	--	--	
Winged elm	30	30	--	--	--	--	--	--	--	--	--	
American elm	162,569	33,970	40,291	30,259	20,402	12,197	12,479	5,110	938	6,922	--	
Siberian elm	2,577	152	271	180	--	1,354	620	--	--	--	--	
Slippery elm	31,512	3,889	7,506	6,776	6,190	2,408	1,090	2,248	--	1,404	--	
All species	1,486,850	234,814	379,765	364,838	242,717	126,348	78,888	26,771	11,773	16,137	4,998	
Other eastern hard hardwoods												
Sweet birch	324	48	276	--	--	--	--	--	--	--	--	
Honeylocust	173	--	--	173	--	--	--	--	--	--	--	
Red mulberry	71	71	--	--	--	--	--	--	--	--	--	
Black locust	1,237	171	122	--	--	433	511	--	--	--	--	
Rock elm	5,480	1,124	1,404	698	690	874	690	--	--	--	--	
All species	7,285	1,413	1,803	871	690	1,307	1,201	--	--	--	--	
Total hardwoods												
	10,520,822	1,263,545	1,821,791	1,968,536	1,692,064	1,355,135	927,637	547,886	331,273	490,784	122,170	
All species groups	15,263,121	2,287,079	2,927,791	2,815,006	2,245,952	1,747,089	1,178,821	731,470	472,196	701,814	155,902	
All table cells without observations in the inventory sample are indicated by --. Table value of 0 indicates that the volume rounds to less than 1 thousand cubic feet. Columns and rows may not add to their totals due to rounding.												

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

Table 8. — Net volume of sawtimber on timberland by species group, species, and diameter class, Minnesota, 2000-2004

(In thousand board feet)¹

Species group/ species	All classes	Diameter class (inches at breast height)							
		9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Softwoods									
Other yellow pines									
Scotch pine	20,654	5,929	6,934	4,800	2,991	--	--	--	--
All species	20,654	5,929	6,934	4,800	2,991	--	--	--	--
Eastern white and red pines									
Red pine	3,253,168	670,009	483,515	466,359	400,953	383,800	378,609	454,644	15,277
Eastern white pine	1,661,330	95,171	126,259	138,634	175,440	199,120	222,481	516,945	187,279
All species	4,914,498	765,181	609,774	604,993	576,394	582,920	601,090	971,589	202,556
Jack pine									
Jack pine	1,340,546	497,935	391,134	271,412	117,876	39,971	22,218	--	--
All species	1,340,546	497,935	391,134	271,412	117,876	39,971	22,218	--	--
Spruce and balsam fir									
Balsam fir	1,216,622	642,737	315,319	190,082	55,595	7,732	5,158	--	--
White spruce	1,053,681	257,173	229,878	170,628	165,853	105,469	32,853	91,828	--
Black spruce	809,100	551,102	187,454	46,843	18,305	5,397	--	--	--
All species	3,079,403	1,451,011	732,650	407,553	239,752	118,597	38,011	91,828	--
Other eastern softwoods									
Eastern redcedar	58,818	26,782	18,886	13,150	--	--	--	--	--
Tamarack (native)	1,352,002	620,550	377,667	166,531	103,304	48,972	12,073	22,903	--
Austrian pine	4,448	756	1,154	2,537	--	--	--	--	--
Northern white-cedar	2,882,600	845,882	675,659	575,164	310,691	221,034	117,473	136,698	--
All species	4,297,868	1,493,971	1,073,367	757,383	413,995	270,006	129,546	159,601	--
Total softwoods	13,652,969	4,214,026	2,813,860	2,046,141	1,351,009	1,011,494	790,866	1,223,018	202,556
Hardwoods									
Select white oaks									
White oak	301,687	--	47,940	62,085	43,926	45,724	26,918	53,365	21,728
Swamp white oak	35,287	--	--	--	2,533	--	9,367	--	23,388
Bur oak	2,243,788	--	431,107	370,128	350,792	325,158	205,705	485,283	75,615
All species	2,580,763	--	479,047	432,213	397,251	370,883	241,989	538,649	120,731
Select red oaks									
Northern red oak	2,814,695	--	455,198	594,112	511,691	344,404	286,012	509,721	113,557
All species	2,814,695	--	455,198	594,112	511,691	344,404	286,012	509,721	113,557
Other red oaks									
Northern pin oak	274,887	--	29,811	37,950	46,536	67,015	28,688	53,511	11,377
Black oak	32,743	--	5,001	4,830	4,976	6,378	--	11,559	--
All species	307,630	--	34,812	42,779	51,511	73,393	28,688	65,070	11,377

(Table 8 continued on next page)

(Table 8 continued)

Species group/ species	All classes	Diameter class (inches at breast height)										29.0+
		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				
Hardwoods												
Hickory												
Bitternut hickory	14,960	--	4,636	5,083	5,241	--	--	--	--	--	--	--
Shagbark hickory	33,304	--	16,594	16,710	--	--	--	--	--	--	--	--
All species	48,264	--	21,230	21,793	5,241	--	--	--	--	--	--	--
Yellow birch												
Yellow birch	135,284	--	12,001	28,287	23,714	29,604	18,331	23,347	--	--	--	--
All species	135,284	--	12,001	28,287	23,714	29,604	18,331	23,347	--	--	--	--
Hard maple												
Sugar maple	1,188,878	--	360,856	246,137	219,370	173,816	68,275	120,424	--	--	--	--
All species	1,188,878	--	360,856	246,137	219,370	173,816	68,275	120,424	--	--	--	--
Soft maple												
Red maple	501,095	--	221,715	113,055	63,376	25,355	37,318	27,294	12,982	--	--	--
Silver maple	504,939	--	50,882	58,754	53,726	34,687	27,307	170,783	108,800	--	--	--
All species	1,006,034	--	272,597	171,810	117,102	60,043	64,624	198,077	121,782	--	--	--
Ash												
White ash	35,155	--	3,887	2,361	5,962	17,820	5,125	--	--	--	--	--
Black ash	1,277,404	--	527,899	350,548	237,773	61,312	62,439	37,432	--	--	--	--
Green ash	905,609	--	181,604	169,295	149,858	92,700	121,174	159,730	31,247	--	--	--
All species	2,218,168	--	713,390	522,204	393,593	171,833	188,738	197,163	31,247	--	--	--
Cottonwood and aspen												
Balsam poplar	698,073	--	292,430	177,963	136,006	35,801	41,732	14,140	--	--	--	--
Eastern cottonwood	459,165	--	21,747	16,592	34,379	34,324	22,641	156,546	172,936	--	--	--
Bigtooth aspen	1,035,826	--	341,393	275,679	198,503	127,053	43,815	49,382	--	--	--	--
Quaking aspen	7,791,499	--	2,529,819	2,415,010	1,407,613	794,528	336,045	292,824	15,659	--	--	--
All species	9,984,563	--	3,185,389	2,885,244	1,776,501	991,706	444,234	512,893	188,595	--	--	--
Basswood												
American basswood	2,361,855	--	554,829	581,237	450,487	282,692	228,068	222,396	42,148	--	--	--
All species	2,361,855	--	554,829	581,237	450,487	282,692	228,068	222,396	42,148	--	--	--
Black walnut												
Black walnut	109,686	--	25,603	17,730	28,396	12,387	5,105	20,465	--	--	--	--
All species	109,686	--	25,603	17,730	28,396	12,387	5,105	20,465	--	--	--	--

(Table 8 continued on next page)

(Table 8 continued)

Species group/ species	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+	
Hardwoods										
Other eastern soft hardwoods										
Boxelder	136,732	--	38,179	41,626	25,518	4,798	19,130	7,480	--	--
Paper birch	1,585,488	--	811,366	424,616	236,306	77,678	15,139	20,383	--	--
Hackberry	23,673	--	8,998	5,702	5,492	3,480	--	--	--	--
Butternut	20,534	--	10,663	2,373	2,795	--	4,703	--	--	--
Black cherry	37,966	--	11,272	7,860	18,834	--	--	--	--	--
Black willow	83,114	--	11,105	6,246	7,912	5,874	13,575	11,034	27,368	--
American elm	249,804	--	80,103	51,906	55,567	23,455	4,443	34,331	--	--
Siberian elm	8,696	--	--	5,899	2,797	--	--	--	--	--
Slippery elm	56,961	--	24,617	10,148	4,899	10,392	--	6,904	--	--
All species	2,202,969	--	996,303	556,376	360,121	125,678	56,990	80,132	27,368	--
Other eastern hard hardwoods										
Black locust	4,295	--	--	1,952	2,343	--	--	--	--	--
Rock elm	9,641	--	2,745	3,758	3,137	--	--	--	--	--
All species	13,936	--	2,745	5,710	5,480	--	--	--	--	--
Total hardwoods	24,972,725	--	7,114,001	6,105,632	4,340,458	2,636,438	1,631,054	2,488,336	656,805	--
All species groups	38,625,694	4,214,026	9,927,861	8,151,773	5,691,467	3,647,931	2,421,920	3,711,354	859,361	--

All table cells without observations in the inventory sample are indicated by --. Table

value of 0 indicates the volume rounds to less than 1 thousand board feet. Columns and rows may not add to their totals due to rounding.

¹ International 1/4-inch rule.

Table 9. — All live aboveground tree biomass on timberland by owner category, softwood/hardwood species category, and tree biomass component, Minnesota, 2000-2004

(In dry tons)

Owner category and softwood/hardwood category	All components	Tree biomass component					
		All live 1-5 inch trees			Non-growing-stock trees		
		Growing-stock trees			Stumps, tops, and limbs		
		Total	Boles	Stumps, tops, and limbs	Total	Boles	Stumps, tops, and limbs
Public							
Softwoods	75,141,896	16,191,665	43,781,797	13,316,343	1,852,091	1,382,611	469,480
Hardwoods	141,187,492	20,804,230	79,752,142	30,041,797	10,589,323	7,882,266	2,707,057
Total	216,329,388	36,995,895	123,533,938	43,358,140	12,441,414	9,264,877	3,176,537
Private							
Softwoods	32,962,079	5,102,194	21,018,818	6,032,021	809,045	622,142	186,903
Hardwoods	183,585,998	20,849,893	103,566,383	39,187,972	19,981,750	14,845,662	5,136,088
Total	216,548,077	25,952,087	124,585,201	45,219,993	20,790,795	15,467,803	5,322,992
All ownerships							
Softwoods	108,103,975	21,293,860	64,800,615	19,348,364	2,661,136	2,004,753	656,383
Hardwoods	324,773,490	41,654,123	183,318,524	69,229,769	30,571,073	22,727,928	7,843,145
Total	432,877,465	62,947,983	248,119,139	88,578,133	33,232,209	24,732,680	8,499,529

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

Table 10. — Average annual net growth of growing stock on timberland by species group and owner category, Minnesota, 1999 to 2004

(In thousand cubic feet per year)

Species group	Owner category		
	All owners	Public	Unidentified owner
Softwoods			
Other yellow pines	5,693	--	5,693
Eastern white and red pines	61,869	44,837	17,032
Jack pine	2,840	5,746	-2,906
Spruce and balsam fir	47,577	27,967	19,611
Other eastern softwoods	19,456	19,431	26
Total softwoods	137,435	97,980	39,455
Hardwoods			
Select white oaks	35,992	2,389	33,603
Select red oaks	32,553	20,312	12,241
Other red oaks	-2,740	--	-2,740
Hickory	447	--	447
Yellow birch	-935	-968	33
Hard maple	17,547	8,646	8,901
Soft maple	35,904	10,717	25,187
Ash	66,111	21,578	44,534
Cottonwood and aspen	172,779	87,784	84,994
Basswood	11,786	1,753	10,033
Black walnut	1,889	--	1,889
Other eastern soft hardwoods	31,341	13,545	17,796
Total hardwoods	402,674	165,757	236,917
All species groups	540,109	263,737	276,372

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

Table 11. — Average annual removals of growing stock on timberland by species group and owner category, Minnesota, 1999 to 2004

(In thousand cubic feet per year)

Species group	Owner category			
	All owners	Public	Private	Unidentified owner
Softwoods				
Eastern white and red pines	35,910	15,751	20,160	--
Jack pine	7,279	692	6,587	--
Spruce and balsam fir	42,387	37,126	5,260	--
Other eastern softwoods	7,300	6,328	971	--
Total softwoods	92,876	59,898	32,978	--
Hardwoods				
Select white oaks	8,243	4,091	4,151	--
Select red oaks	10,366	1,917	8,449	--
Other red oaks	1,047	--	1,047	--
Yellow birch	66	66	--	--
Hard maple	4,371	3,027	1,344	--
Soft maple	4,836	1,081	3,755	--
Ash	16,767	12,364	4,402	--
Cottonwood and aspen	149,107	99,572	49,535	--
Basswood	12,212	3,570	8,642	--
Other eastern soft hardwoods	32,731	19,453	13,279	--
Total hardwoods	239,745	145,141	94,604	--
All species groups	332,621	205,039	127,582	--

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

Table 12. — Average annual mortality of growing stock on timberland by species group and owner category, Minnesota, 1999 to 2004

(In thousand cubic feet per year)

Species group	Owner category		
	All owners	Public	Unidentified owner
Softwoods			
Other yellow pines	--	--	--
Eastern white and red pines	7,061	1,676	5,385
Jack pine	13,737	7,160	6,577
Spruce and balsam fir	57,294	51,361	5,932
Other eastern softwoods	8,429	8,429	--
Total softwoods	86,520	68,626	17,894
Hardwoods			
Select white oaks	2,005	1,285	720
Select red oaks	9,824	470	9,353
Other red oaks	2,310	--	2,310
Hickory	719	--	719
Hard maple	1,716	1,357	359
Soft maple	3,140	651	2,488
Ash	3,937	3,421	516
Cottonwood and aspen	109,350	50,850	58,500
Basswood	2,517	543	1,975
Other eastern soft hardwoods	27,843	13,129	14,714
Total hardwoods	163,362	71,707	91,655
All species groups	249,882	140,333	109,549

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

Table 13. - Pest detection survey results, Minnesota, 2004

Casual Agent	Acres
Spruce budworm	83,200
Jack pine budworm	47,700
Aspen mortality (due to FTC)	27,500
Ash decline	27,000
Aspen decline (due to FTC)	22,900
Forest tent caterpillar	10,500
Larch beetle	10,000
Larch casebearer	6,700
Flooding damage	4,000
Birch mortality (due to FTC)	3,200
Oak wilt	3,000
Red pine mortality	600
Wind damage	500
Two-lined chestnut borer	250
Birch decline (due to FTC)	200
Wildfire damage	200
Dutch elm disease (not in Twin Cities)	160
Herbicide damage	60

Miles, Patrick D.; Brand, Gary J.; Mielke, Manfred E.

2006. **Minnesota's forest resources in 2004**. Resour. Bull. NC-262. St. Paul, MN:
U.S. Department of Agriculture, Forest Service, North Central Research Station.
36 p.

This report presents forest statistics based on the five annual inventory panels measured from 2000 through 2004. Forest area is estimated at 16.2 million acres or 32 percent of the total land area in the State. Important pests in Minnesota forests include the forest tent caterpillar and spruce budworm.

KEY WORDS: Annual inventory, forest area, forest type, volume, biomass,
Minnesota

The Forest Inventory and Analysis Web site is: www.fia.fs.fed.us

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, and marital or family status. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).

To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, Room 326-W, Whitten Building, 14th and Independence Avenue, SW, Washington, DC 20250-9410, or call (202) 720-5964 (voice or TDD). USDA is an equal opportunity provider and employer.

MISSION STATEMENT

We believe the good life has its roots in clean air, sparkling water, rich soil, healthy economies and a diverse living landscape. Maintaining the good life for generations to come begins with everyday choices about natural resources. The North Central Research Station provides the knowledge and the tools to help people make informed choices. That's how the science we do enhances the quality of people's lives.

For further information contact:



North Central
Research Station
USDA Forest Service
1992 Folwell Ave.
St. Paul, MN 55108

Or visit our web site:

www.ncrs.fs.fed.us