



# Forests of Minnesota, 2013

This science update provides an overview of forest resources in Minnesota based on an inventory conducted by the U.S. Forest Service, Forest Inventory and Analysis (FIA) program at the Northern Research Station in cooperation with the Minnesota Department of Natural Resources. Estimates are based on field data, collected using the FIA annualized sample design, for the measurement years 2009-2013 with comparisons made to field data collected using the annual design in 2004-2008. The 2009-2013 sample data consist of 6,221 field measured plots on forest land, with about 20 percent collected per year. Data used in this publication were accessed from the FIA Database in April 2014.

## Overview

The area of forest land in Minnesota increased by 388 thousand acres (2.3 percent) from 2008 to 2013 (Table 1). Just over one-third of Minnesota’s land area is now classified as forest land. The number of live trees on Minnesota’s forest land in 2013 was estimated at 14.2 billion trees, an increase of 9.0 percent from 2008. Live tree aboveground biomass and net volume increased on both forest land and timberland. Average annual net growth, net harvest removals, and annual other removals (e.g., land use change) decreased, while average annual mortality increased from 2008 (Table 1).

**Table 1.—Minnesota forest statistics, change between 2004-2008 and 2009-2013**

	2008 Estimate	Sampling error (percent)	2013 Estimate	Sampling error (percent)	Change since 2008 (percent)
<b>Forest Land</b>					
Area (thousand acres)	16,990.3	0.5	17,378.3	0.5	2.3
Number of live trees ≥1 in diameter (million trees)	13,058.0	1.2	14,229.4	1.2	9.0
Aboveground biomass of live trees ≥1 in (thousand oven-dry tons)	458,244.4	1.1	484,427.2	1.0	5.7
Net volume of live trees ≥5 in diameter (million cubic ft)	18,105.3	1.2	19,052.7	1.2	5.2
Annual net growth live trees ≥5 in (thousand ft <sup>3</sup> /yr)	434,571.9	3.7	397,622.0	3.3	-8.5
Annual mortality of live trees ≥5 in (thousand ft <sup>3</sup> /yr)	338,881.4	2.9	362,191.0	2.7	6.9
Annual harvest removals of live trees ≥5 in (thousand ft <sup>3</sup> /yr)	278,227.2	6.1	199,158.0	6.6	-28.4
Annual other removals of live trees ≥5 in (thousand ft <sup>3</sup> /yr)	9,460.2	26.6	7,990.8	28.9	-15.5
<b>Timberland</b>					
Area (thousand acres)	15,264.2	0.6	15,647.7	0.6	2.5
Number of live trees ≥1 in diameter (million trees)	11,872.9	1.3	12,776.4	1.2	7.6
Aboveground biomass of live trees ≥1 in (thousand oven-dry tons)	417,956.3	1.1	442,798.1	1.1	5.9
Net volume of live trees ≥5 in diameter (million ft <sup>3</sup> )	16,419.9	1.3	17,340.6	1.2	5.6
Net volume of growing stock trees (million ft <sup>3</sup> )	14,149.3	1.3	14,984.0	1.3	5.9
Annual net growth of growing stock trees (million ft <sup>3</sup> /yr)	384,236.5	3.2	375,268.9	2.6	-2.3
Annual mortality of growing stock trees (million ft <sup>3</sup> /yr)	235,717.3	2.7	237,408.5	2.7	0.7
Annual harvest removals of growing stock trees (million ft <sup>3</sup> /yr)	252,839.9	6.2	168,467.0	6.9	-33.4
Annual other removals of growing stock trees (million ft <sup>3</sup> /yr)	23,310.6	17.9	9,195.1	22.9	-60.6



# Forest Area



Schoolcraft State Park. Photo by Minnesota Dept. of Natural Resources, used with permission.

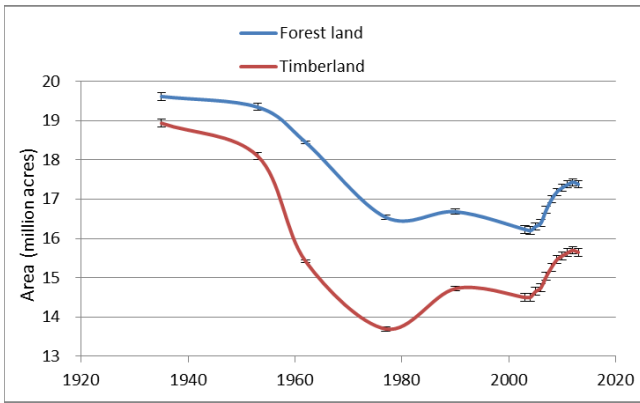


Figure 1.—Area of forest land and timberland in Minnesota, by year. Sampling errors and error bars shown in the tables and figures in this report represent 68% confidence intervals for the estimated values.

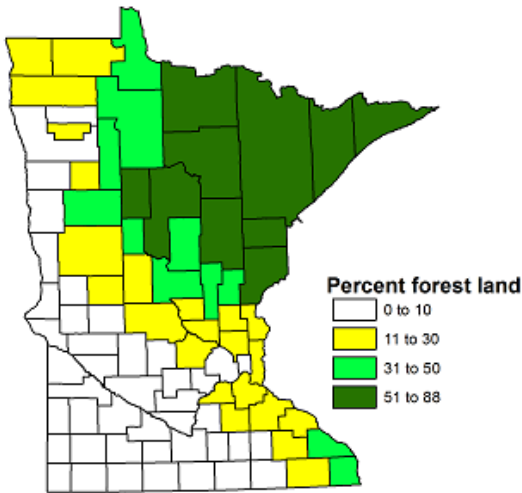


Figure 2.—Percent forest land by county, Minnesota, 2013.

Minnesota’s presettlement area of forest land was estimated to be 31.5 million acres (Marschner 1930). By the time of the first forest inventory in the mid-1930s the area of forest land had declined to 19.6 million acres (Fig. 1). For the most part, the area of forest land declined over the next 70 years. Over the past decade the area of forest land has increased by 1.15 million acres. Some of the increase in estimated forest land area is due to improved digital imagery and remote sensing techniques (Miles and VanderSchaaf 2012) rather than actual reversion to forest land.

Most forest land in Minnesota is in the northern and eastern parts of the State (Fig. 2). The western and southern parts of Minnesota were primarily in prairie and oak savannah in presettlement times.

The aspen/birch and spruce/fir forest-type groups occupy the largest proportion of forest land in Minnesota at 6.5 and 4.0 million acres respectively (Fig.3). About 43 percent of the aspen/birch type is in private ownership while only 22 percent of the spruce/fir type is privately owned. The next most common forest-type groups are oak/hickory (2.2 million acres) and elm/ash/cottonwood at 1.6 million acres.

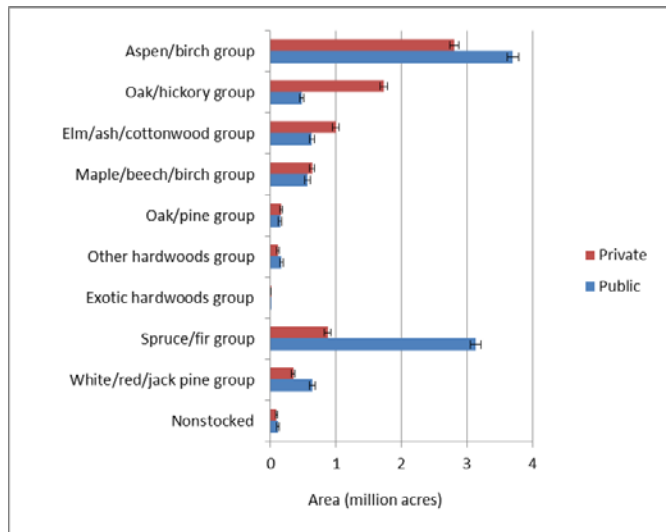


Figure 3.—Area of forest land by forest-type group and major ownership group, Minnesota, 2009-2013. Note: Forest type definitions have changed and may not be directly comparable with published estimates from previous years. Composition of forest-type groups varies geographically. In Minnesota, maple/beech/birch forest-type group is referred to as ‘maple/birch’ due to the absence of beech.

## Volume, Biomass, and Trends

FIA field crews recorded trees of 71 species on Minnesota forest land during 2009-2013. More than two-thirds of Minnesota’s 19.0 billion cubic feet of live tree volume on forest land is represented by just 10 species (Table 2). Quaking aspen (*Populus tremuloides*) has a plurality of the volume in Minnesota followed by red pine (*Pinus resinosa*) and northern white-cedar (*Thuja occidentalis*). The sawtimber volume of quaking aspen declined by 3 percent from 2008 to 2013 while the sawtimber volume of red pine increased by 20 percent over the same period. Quaking aspen is a short-lived species while red pine has a much longer life span so these sawtimber volume changes are not surprising, especially given the large amount of red pine planting in the 1970s and 1980s.

The aboveground live tree biomass on forest land increased from 458.2 million short tons in 2008 to 484.4 million short tons in 2013. The majority of aboveground tree biomass is in the bole (64 percent), followed by tops and limbs (16 percent), saplings (16 percent), and stumps (4 percent) (Fig. 4).

The ratio of average annual net growth on forest land to all live volume on forest land declined from 2.4 percent to 2.1 percent over the period from 2004-2008 to 2009-2013. Over the same period the ratio of average annual mortality to live volume remained steady at 1.9 percent while the ratio of average annual removals to all live volume declined from 1.6 percent to 1.1 percent. The mortality to volume ratio for Wisconsin in 2012 was 1.2 percent and Michigan 1.1 percent. Higher mortality rates in Minnesota are partially due to a higher concentration of short-lived pioneer species such as aspen.

Mortality rates, as a percent of all live volume on lands that remained in forest land, vary by ownership and species. Rates are highest (3.6 percent) on National Park Service lands where harvesting is prohibited. Rates are also high (2.3 percent) on National Forests where harvesting is precluded in some areas (Boundary Waters Canoe Area Wilderness) and timberland stands are slightly older. Mortality rates are lower on State and county lands (1.9 percent) and on private lands (1.9 percent).

Mortality rates are higher for hardwoods (2.2 percent) than for softwoods (1.5 percent). The highest mortality rates for the top 10 species (Table 2) are balsam fir (4.0 percent), paper birch (3.6 percent) and aspen (3.5 percent). Rates are lowest for red pine (0.3 percent) and northern white-cedar (0.3 percent).

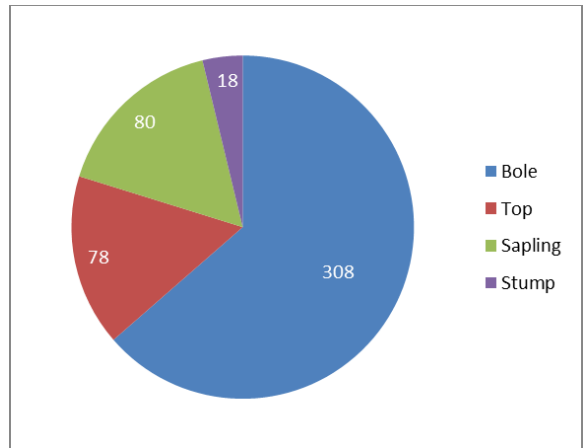


Figure 4.—Aboveground dry weight of live trees (at least 1 inch d.b.h./d.r.c.), in million dry short tons, on forest land by tree component, Minnesota, 2013.

Table 2.—Top 10 tree species by statewide volume estimates on forest land and timberland, Minnesota, 2009-2013

Rank	Species	Volume of live trees on forest land (1,000,000 ft <sup>3</sup> )	Sampling error (%)	Change since 2008 (%)	Volume of sawtimber trees on timberland (1,000,000 board feet)	Sampling error (%)	Change since 2008 (%)
1	quaking aspen	3,494.7	2.6	0.8	6,355.5	4.0	-3.0
2	red pine	1,215.7	6.6	18.8	4,680.8	7.4	20.3
3	northern white-cedar	1,177.8	6	9.6	2,987.2	7.6	7.1
4	paper birch	1,116.5	3.4	-8.9	1,186.6	5.9	-7.6
5	bur oak	1,093.1	4.5	8.4	2,206.8	6.5	16.9
6	black ash	1,029.5	4.5	6.4	1,494.7	6.8	16.4
7	American basswood	1,006.0	4.8	3.9	2,639.4	6.3	20.0
8	northern red oak	948.2	5.3	-1.2	2,826.0	6.4	8.7
9	black spruce	924.1	4.7	4.8	894.8	7.9	7.9
10	balsam fir	726.7	3.3	8.1	1,169.2	5.5	1.8
	Other softwood species	2,245.4	3.7	7.2	5,789.6	4.6	5.6
	Other hardwood species	4,075.0	2.6	8.3	6,384.4	4.3	16.9
	All species	19,052.7	1.2	5.2	38,615.0	1.9	9.0

# Harvest Levels: Timber Products Output versus FIA Field Plots

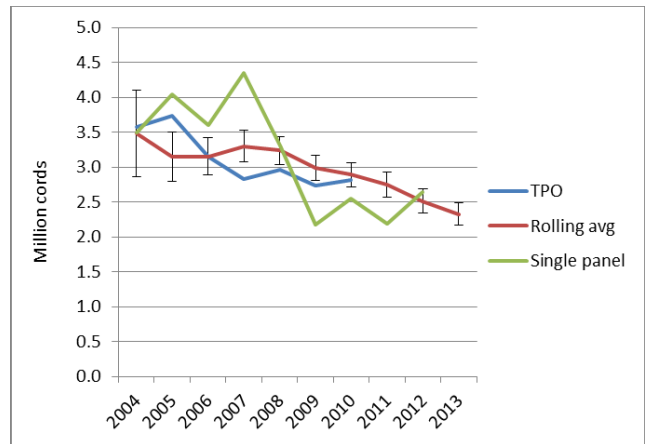
Harvest levels are currently reported using two methods: 1) Timber Product Output (TPO) reports from mill canvasses and fuelwood surveys, and 2) statistical estimates based on remeasured FIA field plots.

The TPO reports are based on annual pulpwood scale receipts from pulp and composite panel mills, mill scale receipts from sawmills, and periodically updated residential and commercial firewood estimates. The TPO estimates can essentially be considered the true value, but in Minnesota the sawlog scale receipts are only collected every three years. Often a more current estimate is desired. At the time of this writing, the most recent TPO estimate was in 2010.

The statistical estimate is based on a sample and therefore confidence intervals can be derived for these estimates. The confidence intervals around these estimates can be rather large as only about 1 in 18,000 trees 5 inches d.b.h. or larger is remeasured in Minnesota. Still, since approximately 1 percent of the trees in Minnesota are harvested each year and approximately 24,000 trees 5 inches d.b.h. and larger are remeasured every year, it should not be surprising that the statistical estimates track well with the TPO numbers (the blue line in Figure 5).

Although FIA produces annual harvest estimates of utilized live trees on forest land, there are some caveats associated with the timing of those harvests. For instance, the 2013 rolling average estimate (the red line in Figure 5) is calculated from plots measured during the 2004, 2005, 2006, 2007, and 2008 panels and then respectively remeasured during the 2009, 2010, 2011, 2012, and 2013 panels. Therefore, if a harvest occurred on a plot measured in 2013, there is no way to tell conclusively in what year that harvest occurred. The harvest could have occurred anytime after the previous measurement in 2008 till the day before the current measurement in 2013. Hence, harvest estimates reported for the year 2013 have the potential to be based on harvest operations occurring from 2004 to 2013. Thus, the rolling average has the effect of dampening fluctuations in harvest levels from year to year, but does present the general trend.

Even if an estimate was based solely on those plots measured in 2008 and remeasured in 2013 and then multiplied by five (the single panel approach – the green line in Figure 5) there would be no way to tell when during that 5-year period trees were harvested. The estimates from the single panel approach, while more timely than those from the rolling average approach, are based on only one-fifth of the inventory plots and therefore would have a wider confidence interval.



**Figure 5.—Harvest estimates obtained using TPO survey (blue line) and FIA field data (5 year rolling average – red line, and single year single panel - green line). (VanderSchaaf 2014).**

The TPO reports, which are conducted jointly by the Minnesota Department of Natural Resources and the FIA program, provide the best estimate of current harvest removals. Estimates based on FIA field surveys are useful for verifying these numbers and for providing additional plot and tree-level information about removals that is not available from the TPO study.

## References

- Marschner, F.J. 1930. **The original vegetation of Minnesota.** Map derived from General Land Office field notes. Bureau of Agricultural Economics.
- Miles, P.D.; VanderSchaaf, C.L. 2012. **Minnesota's forest resources, 2012.** Res.Note NRS-175. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 4 p.
- VanderSchaaf, C.L. 2014. **Comparison of using FIA estimated harvest levels to those from Timber Product Output and the DNR.** Resource Assessment Unit Forest Biometrics Report Number 42. St. Paul, MN: Minnesota Department of Natural Resources. 26 p.

## Metadata

Information published in this report and in related tables is based on Forest Inventory and Analysis database (FIADB), collected under field guides 3.0 to 6.0 and compiled in National Information Management System (NIMS) version 6.0, installed on November 15, 2012. Due to occasional changes to NIMS and FIADB, trend analyses should be made using FIA's online estimation tools, not by comparing published reports or tables. FIA estimates, tabular data, and maps may be generated at <http://fiatools.fs.fed.us>

### How to Cite This Publication

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### Contact Information

Patrick D. Miles, Research Forester  
 USDA Forest Service, Northern Research Station  
 1992 Folwell Ave.  
 St. Paul, MN 55108  
 Ph: 651-649-5146 / Fax: 651-649-5140  
[pmiles@fs.fed.us](mailto:pmiles@fs.fed.us)

Northern FIA: <http://nrs.fs.fed.us/fia/>

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