



# Forests of Michigan, 2016

## Overview

This resource update provides an overview of forest resources in Michigan based on inventories conducted by the U.S. Forest Service, Forest Inventory and Analysis (FIA) program of the Northern Research Station. Estimates are based on field data collected using the FIA annualized sample design and are updated yearly. The annual inventory started in 1999. For the 2016 inventory, estimates for current variables such as area, volume, and biomass are based on 6,662 plot samples collected from 2011 to 2016. Change variables, such as net growth, removals, and mortality, are based on 6,076 samples collected in 2006 to 2011 and 2011 to 2016. Estimates from earlier annual and periodic inventories are shown for comparison. See Bechtold and Patterson (2005) and O’Connell et al. (2015) for definitions and technical details.

Currently, Michigan is home to over 20 million acres of forest land (Table 1). Since the 1980 inventory, the estimate of forest land has increased by nearly 2 million acres (Fig. 1). Accompanying this increase, the total number of trees, volume, and biomass also have risen. Average annual net growth, mortality, and removals have higher sampling errors, which creates uncertainty in associated trends. Despite this uncertainty, the latest inventory shows a notable increase in average annual mortality on forest land at 23.4 percent (Table 1). The statewide mortality increase is primarily driven by a 230-percent increase in ash (*Fraxinus americana*, *pennsylvanica*, and *nigra*) mortality.

**Table 1.—Michigan forest statistics, 2016 and 2011. Volumes are for trees 5 inches and larger in diameter. Number of trees and biomass are for trees 1 inch and larger in diameter. Sampling errors and error bars shown in tables and figures in this report represent 68-percent confidence intervals.**

	2016 Estimate	Sampling error (percent)	2011 Estimate	Sampling error (percent)	Change since 2011 (percent)
<b>Forest Land</b>					
Area (thousand acres)	20,353	0.6	20,127	0.5	1.1
Number of live trees (million trees)	14,220	1.4	14,046	1.2	1.2
Aboveground biomass of live trees (thousand oven-dry tons)	873,107	1.0	837,911	0.9	4.2
Net volume of live trees (million ft <sup>3</sup> )	35,118	1.1	33,333	0.9	5.4
Annual net growth live trees (thousand ft <sup>3</sup> /yr)	729,902	2.8	758,272	2.2	-3.7
Annual mortality of live trees (thousand ft <sup>3</sup> /yr)	433,991	3.5	351,636	2.8	23.4
Annual harvest removals of live trees (thousand ft <sup>3</sup> /yr)	393,044	6.3	339,501	5.8	15.8
Annual other removals of live trees (thousand ft <sup>3</sup> /yr)	14,734	28.4	14,845	26.4	-0.7
<b>Timberland</b>					
Area (thousand acres)	19,349	0.7	19,050	0.6	1.6
Number of live trees (million trees)	13,491	1.5	13,305	1.3	1.4
Aboveground biomass of live trees (thousand oven-dry tons)	826,478	1.1	791,820	0.9	4.4
Net volume of live trees (million ft <sup>3</sup> )	33,218	1.2	31,440	1.0	5.7
Net volume of growing stock trees (million ft <sup>3</sup> )	30,453	1.2	28,932	1.1	5.3
Annual net growth of growing stock trees (thousand ft <sup>3</sup> /yr)	644,276	2.8	681,453	2.0	-5.5
Annual mortality of growing stock trees (thousand ft <sup>3</sup> /yr)	339,664	4.0	262,051	3.0	29.6
Annual harvest removals of growing stock trees (thousand ft <sup>3</sup> /yr)	347,670	6.4	295,705	5.9	17.6
Annual other removals of growing stock trees (thousand ft <sup>3</sup> /yr)	14,022	27.2	15,766	22.8	-11.1



# Forest Area

Michigan’s current area of forest land is the highest estimate since the 1930s. Timberland accounts for 95 percent of this forest land or 19.3 million acres. Nearly 4 percent of forest land is reserved from timber production and 1 percent is other forest land identified as not being able to meet minimum productivity standards. Michigan’s total area is 37.4 million acres (land and water, excluding Great Lakes).

The Upper Peninsula accounts for only 29 percent of Michigan’s area but has 45 percent of the forests (Fig. 2). The southern Lower Peninsula is the largest region with 14.8 million acres but only accounts for 18 percent of forests in Michigan. The northern Lower Peninsula accounts for 37 percent of Michigan’s forest land.

Maple/beech/birch is the predominant forest-type group (Fig. 3). Sixty-nine percent of it is privately owned and 44 percent of it occurs in the western Upper Peninsula.

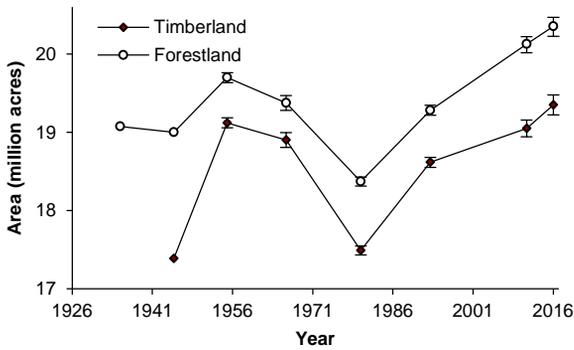


Figure 1.—Forest land and timberland by year, Michigan.

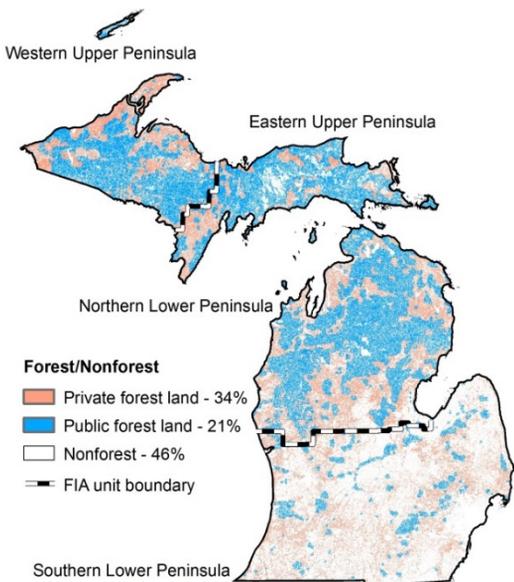


Figure 2.—FIA unit boundaries and area of forest/nonforest with forest identified by major ownership group, Michigan 2016.

Spruce/fir is the most abundant softwood forest-type group and the northern white-cedar forest type accounts for 52 percent of the group. Forty-seven percent of the spruce/fir group occurs in the eastern Upper Peninsula and 54 percent of it is privately owned.

Most of forest land is privately owned by families and individuals, corporations, and other private entities (44.1, 14.4, and 3.5 percent, respectively). The State of Michigan, U.S. Forest Service, National Park Service, and other public groups own the remainder (20.8, 13.6, 1.1, and 2.6 percent, respectively).

Michigan’s forests have been maturing as can be seen in the distribution of timberland by stand-size classes (Fig. 4). The acreage of large-diameter stands has been increasing, in contrast to the acreage in small-diameter stands. Small-diameter acreage leveled over the 2011 and 2016 inventories. The acreage of medium-diameter stands has been declining since the 1966 inventory.

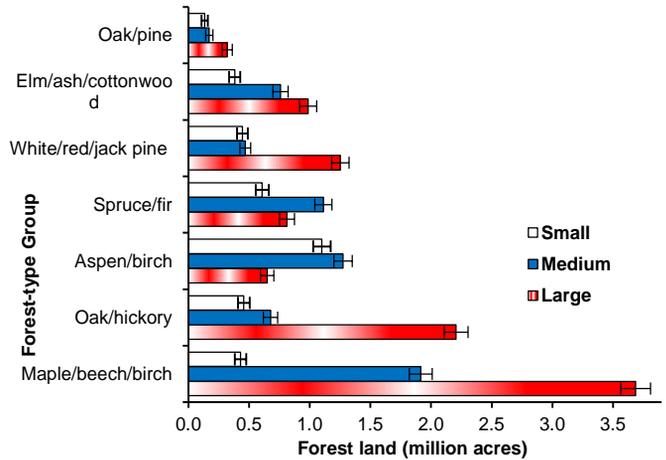


Figure 3.—Forest land by stand-size class (based on tree size) for top seven forest-type groups, Michigan 2016. Large trees are at least 11.0 and 9.0 inches in diameter for hardwoods and softwoods, respectively. Medium trees are at least 5.0 inches in diameter but smaller than large trees. Small trees are less than 5.0 inches in diameter.

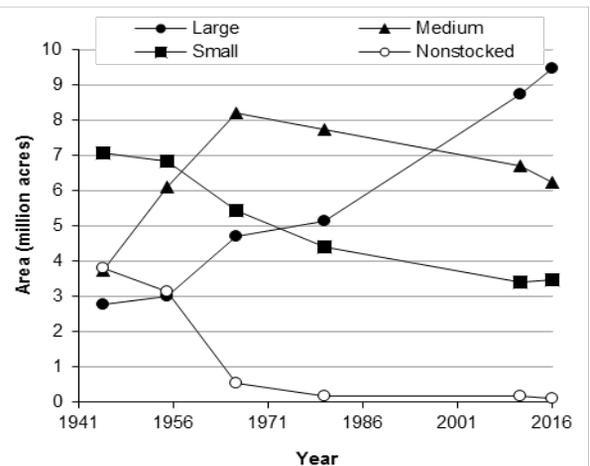


Figure 4.—Timberland by stand-size class and year, Michigan.

## Volume, Biomass, and Trends

Increases in volume, biomass, and number of large-diameter trees have accompanied the increase in area of forest land and large-diameter stands in Michigan.

There are approximately 3,514 million live trees (at least 5-inch diameter) on forest land accounting for approximately 35,118 million ft<sup>3</sup> of volume and 789.2 million oven-dry tons of aboveground biomass. Estimates for volume and biomass each increased by 5.4 and 4.6 percent, respectively, since the 2011 inventory.

Contributing to this increase, notable gains in volume were observed for balsam fir (9 percent; *Abies balsamea*), red maple (11 percent; *Acer rubrum*), black cherry (27 percent; *Prunus serotina*), eastern white pine (23 percent; *Pinus strobus*), and red pine (11 percent; *P. resinosa*). These gains helped to offset notable losses in volume in green ash (-35 percent), white ash (-26 percent), and black ash (-21 percent).

Total net growth has decreased slightly since the 2011 inventory (Table 1). Disregarding net growth attributed by reversions (change from nonforest to forest), net growth for live trees on forest land has not changed substantially from the 2011 to 2016 inventory (667.6 to 673.9 million ft<sup>3</sup>). In contrast, reversion growth declined by 38 percent due to an overestimation in the 2011 inventory. Some reversions that occurred in the 1990s to early 2000s were not identified until the 2010 inventory (see Pugh 2013). Mortality has reduced net growth for some species.

Negative net growth estimates indicate that mortality was greater than growth for some species (Table 2). Since the 2011 inventory, ash and American beech (*Fagus grandifolia*) have experienced large increases in mortality at 230 and 89 percent, respectively. The emerald ash borer (EAB; *Agrilus planipennis* Fairmaire) and beech bark disease (*Cryptococcus fagisuga* and *Neonectria*) are the primary agents affecting ash and American beech, respectively. EAB has noticeably increased the statewide mortality estimate inclusive of all species; excluding ash, the statewide mortality estimate remained level since the 2011 inventory.

Affected by an outbreak of spruce budworm (*Choristoneura fumiferana*), the estimate for white spruce (*Picea glauca*) mortality has increased 130 percent since the 2011 inventory.

Eastern hemlock (*Tsuga canadensis*), eastern white pine and balsam fir, each shade-tolerant species, experienced gains in net growth since the 2011 inventory (57, 31 and 84 percent). There were also gains in red maple (11 percent) and bigtooth aspen (29 percent; *Populus grandidentata*).

Given the variability in estimates of removals it is difficult to determine if total average annual removals actually differed from the 2011 to 2016 inventory. However, harvest removal estimates increased for private land in the southern Lower Peninsula and State-owned land in the Upper Peninsula by 59 and 69 percent, respectively. Statewide, red maple and quaking aspen annual harvest removal estimates increased by 37 and 46 percent, respectively, and decreased for jack pine (*P. banksiana*) and yellow birch (*Betula allegheniensis*) by 39 and 55 percent, respectively.

**Table 2.—Number, net volume, aboveground biomass (oven-dry), net growth, mortality, and harvest removals of live trees on forest land, Michigan 2016 (for selected prominent species)**

Species	Trees <sup>a</sup> (million trees)	Net volume <sup>a</sup> (million ft <sup>3</sup> )	Aboveground biomass <sup>b</sup> (thousand tons)	Net growth <sup>a</sup> (thousand ft <sup>3</sup> /yr)	Mortality <sup>a</sup> (thousand ft <sup>3</sup> /yr)	Harvest removals <sup>a</sup> (thousand ft <sup>3</sup> /yr)
Sugar maple	442	5,127	158,526	104,432	18,712	63,832
Red maple	477	4,846	130,508	127,284	20,754	58,444
Northern white-cedar	460	2,911	46,954	45,715	12,315	12,867
Red pine	221	2,464	44,429	69,281	7,527	35,794
Eastern white pine	109	1,848	31,633	66,683	6,696	5,206
Northern red oak	93	1,736	52,997	55,555	2,745	15,599
Quaking aspen	183	1,610	36,343	38,686	43,006	42,717
Bigtooth aspen	123	1,318	28,707	38,295	20,581	15,848
Black cherry	95	1,144	29,245	34,609	10,346	12,296
Eastern hemlock	76	1,116	21,517	21,593	4,742	6,159
Yellow birch	56	626	18,566	1,127	10,758	5,480
Green ash	53	443	13,696	-49,514	72,258	4,482
American beech	38	539	16,185	-4,961	16,547	8,754
White ash	28	365	10,954	-13,204	28,848	9,766
Black ash	57	300	9,984	-6,437	17,061	883

<sup>a</sup> At least 5-inch diameter trees. <sup>b</sup> At least 1-inch diameter trees.

# Invasive Plant Species

The invasive plants species (IPS) protocol provides statistically valid estimates of the distribution and abundance of some of the most damaging IPS over time (U.S. Forest Service 2016). IPS are having tremendous economic and ecological impacts on our nation’s forests with inspection, management, and mitigation of IPS costing billions of dollars annually (Pimentel et al. 2005). The IPS protocol combined with ancillary information provide managers and policymakers a better understanding of the problem.

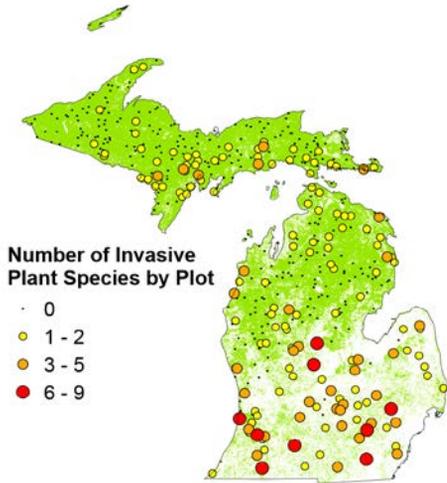


Figure 5. —Number of IPS observed on IPS plots on forest land, Michigan, 2016. Plot locations are approximate.

In the 2016 inventory, 40 species were monitored (honeysuckles counted as one species) on 823 plots. Three hundred twenty-six plots were nonforest and not sampled. On the remaining forest plots, 153 had at least one IPS (Table 3 and Fig. 5). The maximum number of IPS found on a plot was 9.

Of the species monitored, 22 were found in Michigan. The largest percentage of IPS is found in the southern Lower Peninsula. (Fig. 5) Canada thistle, the most commonly observed IPS, is found throughout the state, while autumn olive, the second most observed IPS, is primarily found in the Lower Peninsula. (Fig. 6)

Table 3. —Species or genus observed on IPS plots on forest land, Michigan, 2016

Invasive Plant Species	No. Plots
Canada thistle ( <i>Cirsium arvense</i> )	54
Autumn olive ( <i>Elaeagnus umbellata</i> )	43
Honeysuckle (nonnative bush) ( <i>Lonicera spp</i> )	40
Multiflora rose ( <i>Rosa multiflora</i> )	38
Reed canarygrass ( <i>Phalaris arundinacea</i> )	25
Garlic mustard ( <i>Alliaria petiolata</i> )	22
Spotted knapweed ( <i>Centaurea stoebe spp. micranthos</i> )	20
Common buckthorn ( <i>Rhamnus cathartica</i> )	14
Glossy buckthorn ( <i>Frangula alnus</i> )	12
Other species	64

## References

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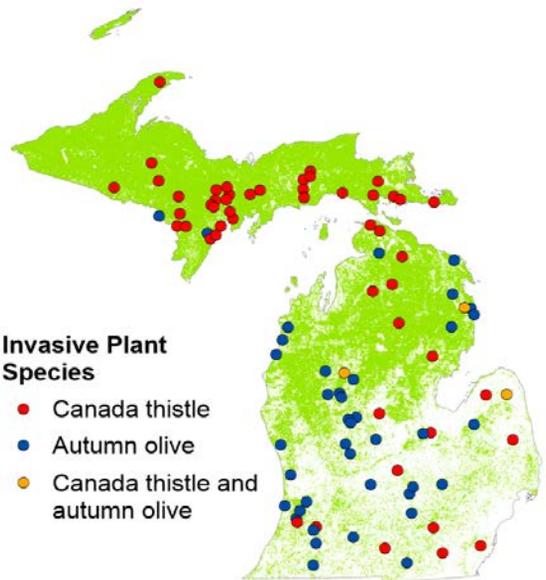


Figure 6. —Distribution of IPS plots where Canada thistle and autumn olive were observed on forest land, Michigan, 2016. Plot locations are approximate.

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