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Wisconsin Forests 2019: Summary Report

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Abstract

This summary report provides results of the ninth forest inventory of the forests of Wisconsin conducted by the USDA Forest Service, Forest Inventory and Analysis program. There are an estimated 17 million acres of forest land across the State which is a small decrease from the 2014 estimate. There are 11.5 billion live trees at least 1 inch diameter at breast height (d.b.h.)/diameter at root collar (d.r.c.) on this forest land. Growing-stock volume on timberland totaled 22.4 billion cubic feet, led by sugar maple and red maple with 2.5 billion cubic feet and 2.3 billion cubic feet, respectively. By forest type, white oak/red oak/hickory is the most abundant at 4.1 billion cubic feet with the next most common forest type being sugar maple/beech/yellow birch at 3.5 billion cubic feet. The full, interactive report is available at https://doi.org/10.2737/NRS-RB-127-INT .

KEY WORDS: inventory, forest statistics, forest land, land use, ownership, volume, forest health

Cover photo: Northwoods lake in winter. USDA Forest Service photo by Cassandra M. Kurtz.

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Foreword

Forests are an important part of Wisconsin's past and present. Wisconsin's forests cover over 40 percent of the total land area, encompassing nearly 17 million acres. Since the cutover of forests in the 19th and early 20th centuries, Wisconsin's forests have been expanding consistently in terms of acreage, volume, and annual growth rate. Those trends largely continue today.

The USDA Forest Service Forest Inventory and Analysis (FIA) Program has been taking inventories of Wisconsin's forests—and the nation's forests as a whole—since the 1930s. This key inventory program provides critical information on Wisconsin's forest to inform how we manage, utilize, and conserve our forest land. This annual program is administered through the USDA Forest Service in close cooperation with the Wisconsin Department of Natural Resources (DNR), Division of Forestry. This serves as the latest 5-year report, covering the current status of Wisconsin's forests as well as key changes over that same—and greater—time period.

FIA collects, analyzes, and reports information on the status and trends of America's forests: how much forest exists, where it exists, who owns it, and how it is changing, as well as how the trees and other forest vegetation are growing and how much has died or has been removed in recent years. Since 1968, Wisconsin has provided funding to intensify the inventory by doubling the number of permanent plots from which data are collected. The reason for intensifying the inventory is to provide more reliable data on areas smaller than on a statewide basis and given the considerable heterogeneity and great number of important forest types in Wisconsin.

The data collected through the FIA program can be used in a variety of ways: for decisions around forest management and planning by a wide variety of ownerships; assessing the sustainability of forest management practices like harvest volumes over time; taking stock of trends in forest health such as mortality related to emerald ash borer and oak wilt; and evaluating wildlife habitat conditions at landscape scales such as ruffed grouse habitat. Combined with other data sources, analyses on forest health, harvesting, and species compositional changes provide important feedback on how we are managing our forests, and changes that are occurring that we should be aware of.

Wisconsin's forest industries are a key part of Wisconsin's overall economy. We produce more value from forest products than any other state and employ over 60,000 people. FIA data is used frequently for decision-making regarding timber resource quantity, quality, and availability in a given area, and can be provided at limited local scales. This information, whether for a traditional wood processing plant or a biomass facility, is invaluable in determining whether there will be an adequate supply of the desired species and size in the area to sustain both the current or proposed operation, and the forest itself.

The Wisconsin DNR Division of Forestry has a strong partnership with the USDA Forest Service FIA program, enabling us to be a key partner in the beginning of the urban FIA program in 2015. What began as 75 plots in Madison and Milwaukee quickly expanded to a statewide inventory program across numerous cities across Wisconsin in 2016. Implemented at five times the intensity of the base Urban FIA program in Wisconsin, we will be able to garner important information and track changes in Wisconsin's vast urban forests.

In addition to these two inventory programs, Wisconsin also benefits from two other programs administered by the FIA program: the Timber Products Output Survey (TPO) and the National Woodland Owners Survey (NWOS). The TPO provides information on the amount of wood products that are produced in Wisconsin, where raw materials originate from, and where wood products are exported. The NWOS supplies insight into the attitudes,

goals, and objectives of private forest land owners for their forests, enabling the Division of Forestry to best serve private forest land owners.

This report highlights the current status of Wisconsin's forests, as well as trends and changes over recent and historical time horizons. The goal is to provide information for the general use and consumption by the various stakeholders in Wisconsin's forests, as well as generate discussion and awareness about one of Wisconsin's greatest natural assets: our forests.

Heather Berklund

Chief State Forester

Wisconsin

Yellow lady slipper (*Cypripedium parviflorum*) in flower. USDA Forest Service photo by Cassandra Kurtz.

Contents

Highlights

Many of the issues listed here are not addressed in this summary report of Wisconsin Forests, but can be found in the interactive report, available at https://doi.org/10.2737/NRS-RB-127-INT.

- Wisconsin has an estimated 17 million acres of forest land which has not changed substantially since the previous inventory in 2014.
- Urban tree cover is estimated at 27.7 percent, with an estimated 69 million trees.
- Approximately 77 percent of Wisconsin's forest land is privately owned and of this land, the majority are family forests. Of the family forest land, 17 percent have a written management plan and 22 percent received advice.
- Seventy-four species of trees were tallied on FIA inventory plots with quaking aspen being the most numerous species at 1.6 billion live trees, closely followed by red maple (1.3 billion) and balsam fir (1.2 billion).
- Sugar maple and red maple have the greatest sound bole volume of trees with each species having over 3 billion cubic feet of sound bole volume.
- The most common forest-type group is oak/hickory, representing an estimated 4.5 million acres of forest land.
- Wisconsin's forests continue to mature with the largest area of forest land held in the 61- to 80-year stand-age class. Since 2004, the amount of forest land with a stand age of over 80 years has increased by 1.8 million acres.
- Nearly half of the forest land area is in the large stand-size class which requires a d.b.h. of 9.0 inches or larger for softwoods and 11.0 inches or larger for hardwoods. Only 19 percent of the stand area is in the small diameter stand-size which is a class of trees less than 5.0 inches d.b.h.
- Forest regeneration is facing challenges due to maturing forests, relatively few stand replacing events (such as timber harvests), invasive plants, and deer browsing.
- The annual growth of trees is estimated to be 573 million cubic feet with a growth-to-removal ratio at nearly 2.2.
- Overall, tree crown health is good. However, the increase in black ash with poor crowns is concerning. From 2014 to 2019, the proportion of black ash with poor crowns increased from 11 to 18 percent. Future monitoring of this trend is important.
- The forests continue to face threats from invasive insects (such as emerald ash borer) and invasive plants (in particular, nonnative bush honeysuckle, common buckthorn, and reed canarygrass).
- Nonnative invasive plants continue to be persistent throughout the State with nonnative bush honeysuckle being observed on the greatest number of plots.

- The forests contain an estimated 1.8 billion tons of carbon. This is a slight increase since 2014.
- There are an estimated 71.2 billion board feet of sawtimber on timberland with the highest sawlog volume in the eastern white and red pine group at 17.1 billion board feet (International 1/4-inch rule).
- Forests offer critical habitat for many plants and animals. The mature forests provide snags, or standing dead trees, that are important to many species, but there is a paucity of young forests that many species rely on for at least some of their needs.

What is this Report

This is a summary of the results of an inventory of the forests of Wisconsin. The inventory was conducted from 2013 to 2019 and is referred to as the 2019 inventory. The inventory was conducted by the USDA Forest Service, Forest Inventory and Analysis program in cooperation with Wisconsin Department of Natural Resources, Division of Forestry.

Periodic inventories were conducted roughly every 10 to 20 years. These inventories were completed in 1936 (Cunningham and Moser 1938), 1956 (Stone and Thorne 1961), 1968 (Spencer and Thorne 1972), 1983 (Spencer et al. 1988), and 1996 (Schmidt 1998).

Wisconsin is now under an annual inventory system where a percentage of plots are measured each year. The first annual inventory for Wisconsin spanned the 5-year period from 2000-2004 with the inventory identified by the last year of the full cycle, 2004 (Perry et al. 2008). Five-year annual inventories, where 20 percent of plots were measured annually, were completed in 2009 (Perry et al. 2012) and 2014 (Kurtz et al. 2017). In 2014, FIA changed to a 7-year cycle where about 14 percent of the plots are measured annually. Despite the change in cycle length, FIA maintains a 5-year reporting period and with each report covering a full data cycle. For this report, inventory years 2013 to 2019 are used and identified as 2019. This results in a summarization of 6,397 forested plots.

More detailed results are available in an interactive digital collection available at https://doi.org/10.2737/NRS-RB-127-INT. The results presented in the interactive report are divided into sections that focus on forest features, forest health and sustainability, ecosystem indicators and services, and resource attributes (Fig. 1). Graphics, including interactive maps and charts, summarize data and illustrate trends that make it easier for readers to make comparisons between inventory periods, geographic locations, and ecological divisions. This document offers a summary of those results.

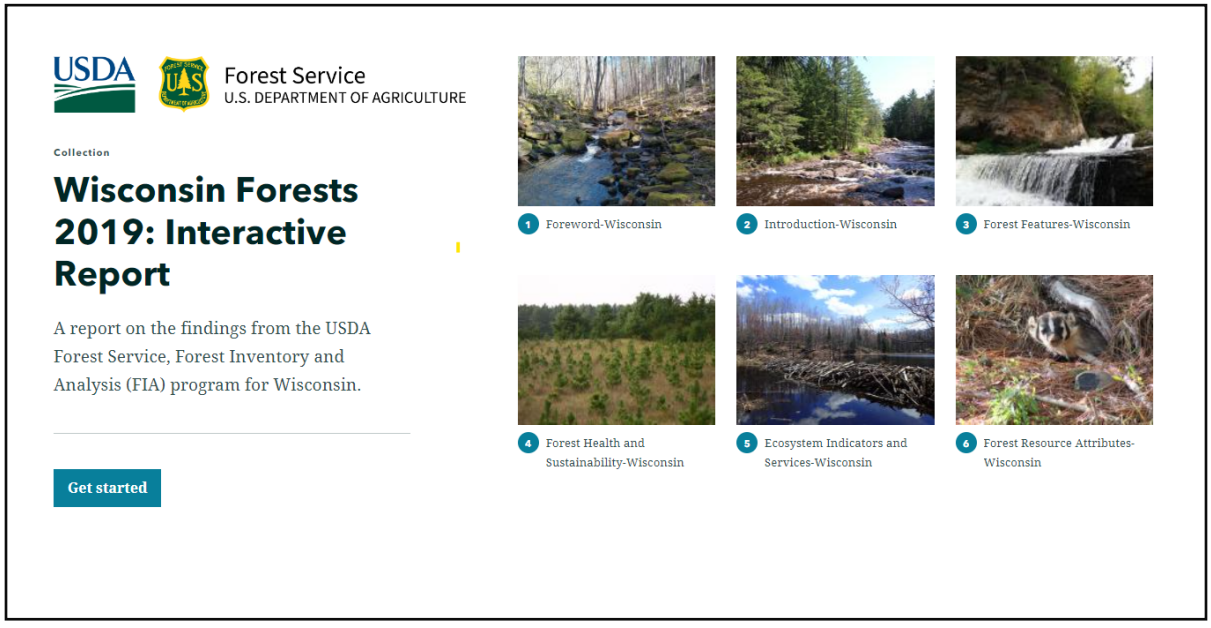

Figure 1.—Wisconsin Forests 2019: Interactive Report is a digital collection that focuses on different forest aspects.

What is FIA?

The Forest Inventory and Analysis program (FIA) was established by the U.S. Congress to "make and keep current a comprehensive inventory and analysis of the present and prospective conditions of and requirements of the forest and range lands of the United States" (Forest and Rangeland Renewable Resources Planning Act of 1974). For additional information on the FIA program, visit https://www.nrs.fs.usda.gov/fia.

Forest Area

The most basic forest statistic is the total area of forest land. FIA defines forest land based on tree cover and how land is used. Estimates based on land use versus land cover can be very different, especially in urban and suburban areas where trees are located on lands used predominantly for commercial or residential purpose.

FIA separates forest land into timberland, reserved, and unproductive categories. The vast majority of forest land in the region, 96.6 percent, is classified as timberland, meaning the land is available for and capable of producing commercial timber. The remaining forest land is comprised of lands that are legislatively reserved or classified as unproductive. These distributions have not changed substantially over the past few decades.

What we found

An estimated 43.9 percent of the region is covered by forest land. There are an estimated 17 million acres of forest land across the State (Fig. 2). The forest land is concentrated in the more rural areas in the region, away from the major metropolitan areas and transportation corridors.

The area of forest land has remained fairly stable over the past few decades. After a loss of forest land and timberland in the mid 20th century, the acreage of both categories has rebounded to nearly the area reported in 1936.

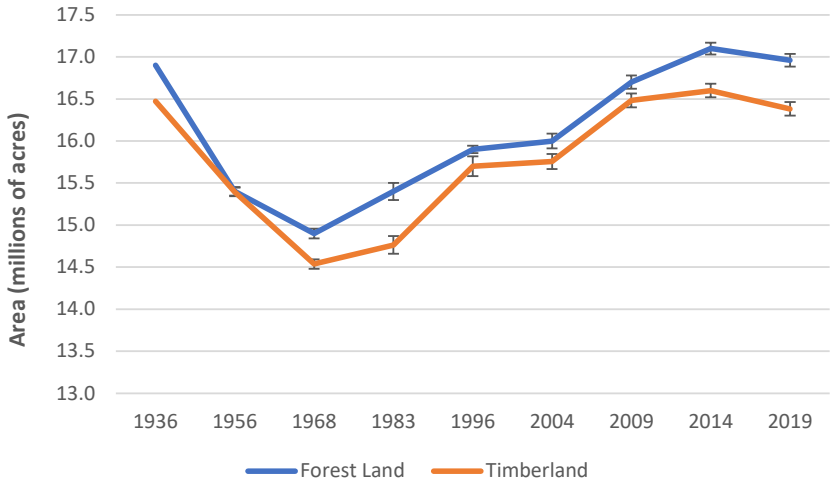

Figure 2. —Area of forest land and timberland in Wisconsin from 1936 to 2019. Error bars represent one standard error, the 68 percent confidence interval.

What this means

Keeping forests as forests is the first step in forest conservation. Forest land is still abundant across much of Wisconsin and will presumably continue to be so. Although the net change in forest land is small, there are some losses and gains as discussed in the next section. The distribution of the forest land is not even across the region, and this influences who directly and indirectly benefits from the forests.

Species Composition

Trees are the dominant feature of forests. They can be described in many ways, including composition, structure, growth, mortality, and removals. Forest composition is described here based on the species of trees encountered on FIA inventory plots, in terms of numbers of species and distribution of species in terms of numbers and volumes of trees. These last two metrics, numbers and volume, give somewhat different views of the forests in part due to the fact that numbers of trees include trees 1+ inch diameter at breast height (d.b.h.) or diameter at the root collar (d.r.c.) and volumes only include trees 5+ inches d.b.h./d.r.c.

What we found

Seventy-four tree species were tallied on FIA inventory plots in 2019 (species are listed in appendix). This is slightly lower than was encountered in the 2014 inventory where 83 species of trees were encountered. There are estimated 11.5 billion live trees at least 1 inch d.b.h./d.r.c. in Wisconsin's forests. The most common species are quaking aspen, red maple, and balsam fir.

Another way to look at the forests is by looking at the live, growing-stock trees at least 5 inches d.b.h./d.r.c. Looking at the growing-stock trees, red maple is most abundant followed by quaking aspen and sugar maple (Fig. 3). The order of most common species has remained similar between 2009 and 2019 with the number of growing-stock trees staying relatively stable.

The sound bole volume of live trees at least 5 inches d.b.h./d.r.c. across the region have a combined, estimated volume of 28.1 billion cubic feet. The order of the top species varies somewhat depending on what forest aspect is being examined, number of trees, volume, or growing-stock trees.

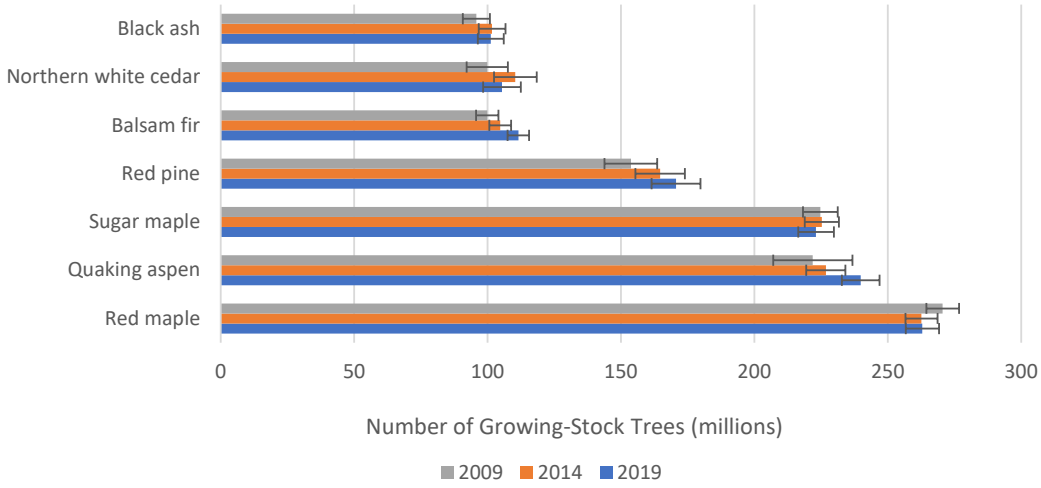

Figure 3. —Number of live growing-stock trees (at least 5 inches d.b.h./d.r.c.) on forest land, 2019, 2014, and 2009. Error bars represent one standard error, the 68 percent confidence interval.

What this means

Changes in forest composition are inevitable as trees grow and die. Anthropogenic influences (e.g., harvesting and development) along with natural processes (e.g., storms) alter forest ecosystems. Generally, it takes a long time to see major shifts at the landscape level. As a result, the forest composition has remained relatively stable over the past decades.

The forests of Wisconsin are diverse and offer a wide variety of habitat for various species. They are also economically important providing jobs and valuable tourism dollars. In terms of the number of growing-stock trees, the forests are dominated by red maple and this species will continue to be dominant for the foreseeable future. In terms of volume of live trees over 5 inches, sugar maple is dominant (3.0 billion cubic feet) but is closely followed by red maple (3.0 billion cubic feet). These two species are likely to continue to dominate and these two are likely to continue to dominate as the next closest in volume is Northern red oak at 2.4 billion cubic feet.

It should be noted that while there are at least 74 species of trees across the forests of the region, FIA methods are designed to capture the major species, but rare species may be missed. The number of species is inclusive of trees in areas that meet the FIA definition of forest land. Trees species in areas that do not qualify as forest land, such as wooded strips or urban areas that often contain diverse horticultural plantings, are not included.

Forest Insects and Disease

Insect and disease activity impact the structure and composition of forest ecosystems. Monitoring their status helps determine forest health and assess the current state and changing trends of Wisconsin's forests. Over the past 5 years, various insects have impacted the forests with many that were previously notable having a less significant effect in 2019. Distribution has remained the same for spongy moth (formerly known as European gypsy moth, *Lymantria dispar*) and beech bark disease (*Nectria* spp.). Some of the other insects and diseases found in Wisconsin are highlighted below.

Emerald Ash Borer

Native to Asia, the invasive emerald ash borer (*Agrilus plannipenis*) was first detected in Wisconsin in 2008. EAB is difficult to detect at low abundance. Natural spread is enhanced by human-mediated transportation of infested materials, such as craft and firewood; therefore, spread of EAB has outpaced detection, with population establishment occurring 3 to 8 years prior to identification (Herms and McCullough 2014). All three species of ash (white, green, and black ash) found in Wisconsin are hosts of EAB. While ash mortality due to EAB varies by infestation level, a mortality-to-gross-growth ratio above 0.6 is indicative of an acute forest health issue (Conkling et al. 2005).

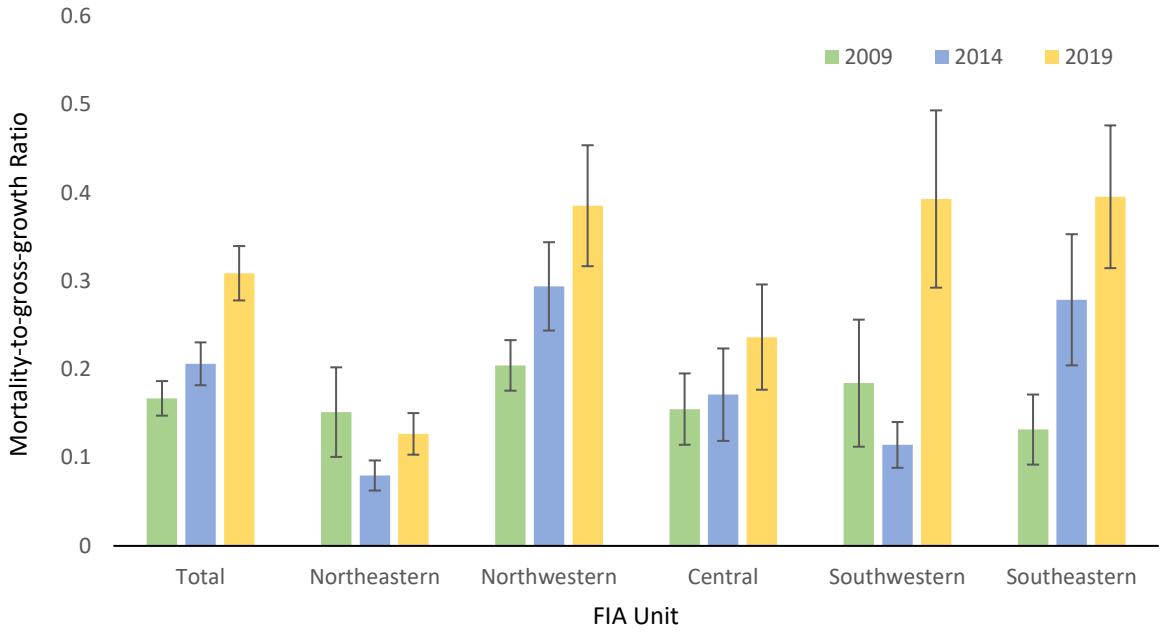

Figure 4.—Ratio of average annual mortality volume to gross growth volume for ash on forest land, by FIA Unit and inventory year, Wisconsin. Error bars represent a 68 percent confidence interval. FIA Units refer to the geographic regions of the inventory process.

There are an estimated 904.9 million ash trees (≥1.0 inch d.b.h.) on forest land in Wisconsin. Black ash represents 51 percent of the ash trees, followed by white ash (25 percent) and green ash (23 percent). Between 2009 and 2019, the mortality-to-gross growth ratio for ash increased from 0.19 to 0.31 (Fig. 4); this is likely an indicator of mortality due to EAB. The Southwestern and Southeastern counties have experienced significant mortality and decline of ash due to EAB. Mortality of ash is expected to increase further as EAB persists. The loss of ash in forested ecosystems will affect species composition and alter community dynamics. Continued monitoring will help to identify the long-term impacts of EAB in forested settings.

Oak Wilt

The causal agent of oak wilt is the fungus *Bretziella fagacearum*. Oak wilt is common in the southern two-thirds of the State with infected oaks in the red oak group typically experiencing a rather rapid mortality. In the white oak group, trees generally have slower mortality and sometimes can wall off infection and recover. With an estimated 747.5 million oaks on forest land, oak wilt is a concern throughout the State. Northern pin and black oak, both in the red oak group, comprise about 44 percent of the oaks, northern red oak accounts for 30 percent, and white oak accounts for 26 percent. Oak wilt has been detected in 65 of 72 counties in Wisconsin, 2019 (Fig. 5). Statewide, the mortality-to-gross growth ratios for trees in the "other red oak" species group (northern pin and black oak) have remained closes to 0.6 for the last decade.

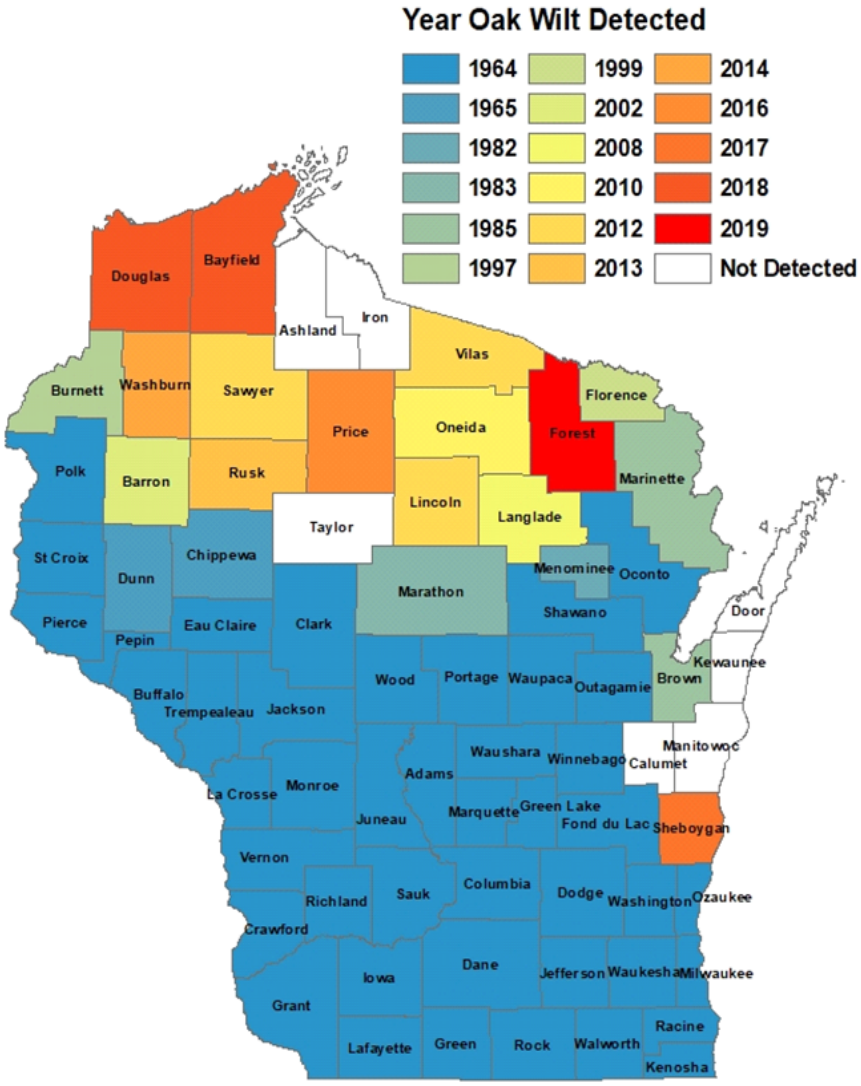

Figure 5.—Oak wilt detections by year and county, Wisconsin.

Spruce Budworm

Eastern spruce budworm (SBW; *Choristenaura fumiferana*)) is a primary defoliator of balsam fir, white spruce, and black spruce (Bouchard and Auger 2014, Robert et al. 2018). SBW outbreaks occur every 30 to 50 years in Wisconsin and last around 10 years. The most recent outbreak began in 2012. During an outbreak, repeated defoliation affects tree growth and vigor, and can cause mortality within 5 years (Wagner et al. 2015). Forest age is tied to SBW with increased risk in forests where the majority of overstory host species are aged over 60 years (Wagner et al. 2015). The forest land area of SBW host-forest types greater than 60 years has increased from 31 percent in 2004 to 44 percent in 2019.

Invasive Species

The forests of Wisconsin provide multiple benefits to people living in the region and beyond. Invasive plant species (IPS), which are both native and nonnative species, can negatively affect ecosystems. Once established, IPS can quickly take over an area, displace native species, and affect habitat suitability. They often form dense monocultures that alter light, nutrient, and water availability. IPS can be so aggressive that they can eliminate tree regeneration by forming dense monocultures. They also impact tourism and the economy through diminishing aesthetic beauty and agriculture productivity. To gain an understanding of the presence of invasive plants in Wisconsin, FIA monitors the presence and cover of 40 IPS (39 species and one undifferentiated genus).

What we found

We found Wisconsin has a higher percentage of plots with the monitored IPS observed (45.7 percent) than neighboring Michigan (39.2 percent), but a lower percentage than Illinois (88.6 percent) and Minnesota (58.2 percent). The percentage of plots with one or more IPS increased slightly from 2014. Twenty of the 40 monitored IPS were observed, with nonnative bush honeysuckle being the most common (Table 1).

There were a few differences in species recorded since the last inventory. Tree of heaven and Japanese knotweed were not present this inventory but were observed in 2014. European privet was inventoried in 2019 but not in 2014. On a per-plot basis, the number of IPS ranged from zero to six.

Table 1.—Number of plots monitored for invasives where each of the invasive plant species of interest occurred in Wisconsin, 2014 and 2019

	2019		2014	
Species	Observances	Percentage of plots	Observances	Percentage of plots
Nonnative bush honeysuckle	68	19.3	136	16.8
Common buckthorn	57	16.2	126	15.5
Reed canarygrass	45	12.8	111	13.7
Garlic mustard	32	9.1	55	6.8
Multiflora rose	26	7.4	63	7.8
Canada thistle	20	5.7	29	3.6
Autumn olive	14	4.0	14	1.7
Glossy buckthorn	14	4.0	42	5.2
Bull thistle	11	3.1	18	2.2
Siberian elm	5	1.4	9	1.1
Black locust	3	0.9	5	0.6
Common barberry	3	0.9	1	0.1
Common reed	3	0.9	1	0.1
Creeping jenny	3	0.9	15	1.8
Japanese barberry	3	0.9	12	1.5
Spotted knapweed	3	0.9	8	1.0
European cranberrybush	2	0.6	2	0.2
Dames rocket	1	0.3	3	0.4
European privet	1	0.3	--	--
Oriental bittersweet	1	0.3	5	0.6
Tree of heaven	--	--	1	0.1
Japanese knotweed	--	--	1	0.1

What this means

Wisconsin's forests provide valuable benefits that directly improve human well-being. These include carbon sequestration, timber and nontimber forest products, and various recreation opportunities. Though less than half of the plots have IPS present, their presence is widespread throughout the State and is inclusive of all ownership categories and stand ages. To aid in mitigation of IPS spread, Wisconsin has enacted laws that regulate the possession, transport, transfer, or introduction of certain invasive plant species. Careful management and outreach are critical to mitigate spread.

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Appendix

List of tree species, greater than or equal to 5 inches d.b.h, found on FIA inventory plots, Wisconsin, 2019.

Common name	Genus	Species
Paper birch	*Betula*	*papyrifera*
Butternut	*Juglans*	*cinerea*
Eastern hophornbeam	*Ostrya*	*virginiana*
White oak	*Quercus*	*alba*
Bebb willow	*Salix*	*bebbiana*
American mountain-ash	*Sorbus*	*americana*
Chinkapin oak	*Quercus*	*muehlenbergii*
Bigtooth aspen	*Populus*	*grandidentata*
Redcedar/juniper spp.	*Juniperus*	*spp.*
Yellow birch	*Betula*	*alleghaniensis*
Eastern redcedar	*Juniperus*	*virginiana*
Hackberry	*Celtis*	*occidentalis*
Black oak	*Quercus*	*velutina*
Balsam willow	*Salix*	*pyrifolia*
Canada plum	*Prunus*	*nigra*
Red mulberry	*Morus*	*rubra*
Russian-olive	*Elaeagnus*	*angustifolia*
Silver poplar	*Populus*	*alba*
Black cherry	*Prunus*	*serotina*
Northern mountain-ash	*Sorbus*	*decora*
Black spruce	*Picea*	*mariana*
Blue spruce	*Picea*	*pungens*
Flowering dogwood	*Cornus*	*florida*
Pin cherry	*Prunus*	*pensylvanica*
Northern pin oak	*Quercus*	*ellipsoidalis*
Mountain-ash spp.	*Sorbus*	*spp.*
Shagbark hickory	*Carya*	*ovata*
Red maple	*Acer*	*rubrum*
Silver maple	*Acer*	*saccharinum*
White mulberry	*Morus*	*alba*
White willow	*Salix*	*alba*
White ash	*Fraxinus*	*americana*
Red pine	*Pinus*	*resinosa*

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Appendix (continued).

Common name	Genus	Species
Black locust	*Robinia*	*pseudoacacia*
Eastern white pine	*Pinus*	*strobus*
American beech	*Fagus*	*grandifolia*
Black ash	*Fraxinus*	*nigra*
Balsam poplar	*Populus*	*balsamifera*
Eastern cottonwood	*Populus*	*deltoides*
Quaking aspen	*Populus*	*tremuloides*
American basswood	*Tilia*	*americana*
Boxelder	*Acer*	*negundo*
Ohio buckeye	*Aesculus*	*glabra*
River birch	*Betula*	*nigra*
Black willow	*Salix*	*nigra*
American elm	*Ulmus*	*americana*
Siberian elm	*Ulmus*	*pumila*
Slippery elm	*Ulmus*	*rubra*
Peachleaf willow	*Salix*	*amygdaloides*
Willow spp.	*Salix*	*spp.*
Other or unknown live tree		
Swamp white oak	*Quercus*	*bicolor*
Bur oak	*Quercus*	*macrocarpa*
Northern red oak	*Quercus*	*rubra*
Bitternut hickory	*Carya*	*cordiformis*
Pignut hickory	*Carya*	*glabra*
Hickory spp.	*Carya*	*spp.*
Black maple	*Acer*	*nigrum*
Norway maple	*Acer*	*platanoides*
Sugar maple	*Acer*	*saccharum*
Green ash	*Fraxinus*	*pennsylvanica*
Black walnut	*Juglans*	*nigra*
Honeylocust	*Gleditsia*	*triacanthos*
Rock elm	*Ulmus*	*thomasii*
Mountain maple	*Acer*	*spicatum*
Serviceberry spp.	*Amelanchier*	*spp.*
American hornbeam, musclewood	*Carpinus*	*caroliniana*
Hawthorn spp.	*Crataegus*	*spp.*
Apple spp.	*Malus*	*spp.*
American plum	*Prunus*	*americana*
Chokecherry	*Prunus*	*virginiana*

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Appendix (continued).

Common name	Genus	Species
Scotch pine	*Pinus*	*sylvestris*
Jack pine	*Pinus*	*banksiana*
Balsam fir	*Abies*	*balsamea*
White spruce	*Picea*	*glauca*
Eastern hemlock	*Tsuga*	*canadensis*
Tamarack	*Larix*	*laricina*
Larch spp.	*Larix*	*spp.*
Norway spruce	*Picea*	*abies*
Northern white-cedar	*Thuja*	*occidentalis*

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