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Forest Resources within the Lake States Ceded Territories 1980 - 2013

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Abstract

The Lake States ceded territories are the portions of northern Michigan, northeastern Minnesota, and northern Wisconsin that were ceded by tribes of the Ojibwe to the government of the United States of America in the treaties of 1836, 1837, 1842, and 1854. The tribes retain rights to hunt, fish, and gather in the 1837, 1842, and 1854 treaty areas. This report summarizes the results of a series of forest inventories in the region between 1980 and 2013. Inventory results show the region has 30.7 million acres of forest land with forests covering 65.3 percent of the total land area. Forest features reported here focus on the status of six species of trees (sugar maple [*Acer saccharum*], black ash [*Fraxinus nigra*], paper birch [*Betula papyrifera*], northern white-cedar [*Thuja occidentalis*], hophornbeam [*Ostrya virginiana*], and balsam fir [*Abies balsamea*]) that have special historic and cultural value to the Ojibwe in addition to the standard reporting of volume, biomass, growth, removals, and mortality of all trees that are typically included in the state-level reports produced by the Forest Inventory and Analysis program of the U.S. Forest Service. Sections of this report also focus on carbon, standing dead trees, invasive plant species, and ground flora.

Cover Photo

Porcupine Mountains Wilderness State Park, Michigan. Photo by Cassandra M. Kurtz, U.S. Forest Service.

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PREFACE

Understanding forest inventory information is essential to having a greater knowledge of complex forest conditions and the interdependent plants, animals, and human uses and opportunities. This report summarizes data collected over 34 years (1980 through 2013) in the Lake States ceded territories (LSCT), and provides both quantifiable information and a discussion of what the findings mean. Resource professionals and interested readers benefit from this reliable inventory. We invite you to read and consider this report hoping it will stimulate additional discussion, analyses, and education about some of the LSCT greatest treasures. This report represents the first time that forest conditions have been reported by the U.S. Forest Service using the boundaries of the ceded territories and as such presents an opportunity for tribes, the U.S. Forest Service, and natural resource managers in the region to come together around the management and resources of these forests.

Turtle Lake, Itasca County, Minnesota. Photo by Christie L. Kurtz, used with permission.

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Trickling stream. Photo by Cassandra M. Kurtz, U.S. Forest Service.

HIGHLIGHTS

- The amount of forest land in the Lake States ceded territories (LSCT) is estimated at 30.7 million acres, covering 65.3 percent of the total land area.
- Timberland is estimated at 28.5 million acres of which 16.4 million acres are privately held (57.5 percent; private ownership includes tribal reservation lands).
- Eighty tree species were found on inventory plots in the LSCT and include 64 hardwood species and 16 softwood species.
- Forest types vary across the region with aspen being the dominant forest type (5.8 million acres; 20.3 percent of timberland).
- Abundance of snags (i.e., standing dead trees) has remained relatively stable over the last decade.
- Since 1980 there has been a 10.6 percent increase in sugar maple trees on timberland.
- Black ash volume is increasing but these trends are not expected to continue due to the emerald ash borer (EAB).
- There are now about half as many paper birch trees (5 inches diameter and greater) on timberland as there were in 1980; the area also saw a 10 to 38 percent decline in the number of paper birch trees 9 inches in diameter and larger, varying by treaty area.
- The northern white-cedar population is aging and there has been a modest decrease in the small diameter trees.
- Hophornbeam trends suggest this species will continue to be present throughout the region in the future, however its status should be monitored in the 1842 Treaty area where there has been a 20 percent decrease in large trees (7 inches in diameter and greater) between 2008 and 2013.
- Balsam fir dominates the softwoods 1 inch diameter or larger while northern white-cedar dominates the trees 5 inches in diameter and greater.
- Since 2008, there has been a roughly 9 percent increase in sawtimber volume.
- The overall net growth to removal ratio is 1.7 indicating growth exceeds removals by 70 percent.
- The total forest land carbon stock is estimated at 3.2 billion tons.
- Nine hundred and fifty-one plant species were observed on the subset of plots on which ground flora were monitored; Canada mayflower was the most common species.
- Twenty-eight of the 44 monitored invasive plant species were observed with 26.4 percent of plots having one or more of these plants present.

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BACKGROUND

Forest road, Bigfork, Minnesota. Photo by Cassandra M. Kurtz, U.S. Forest Service.

INTRODUCTION

Great Lakes Indian Fish and Wildlife Commission (GLIFWC) member tribes and the U.S. Forest Service negotiated a Memorandum of Understanding (MOU) in 1998, which was ratified by nine GLIFWC member tribes: Bay Mills, Bad River, Lac Courte Oreilles, Lac du Flambeau, Lac Vieux Desert, Mille Lacs, Mole Lake, St. Croix, and Red Cliff. Two additional GLIFWC member tribes, Keweenaw Bay and Fond du Lac, signed the MOU in 2000 and 2012, respectively. Through interactions among the parties to this MOU, the idea of writing this report was developed; it is modeled after similar state-level reports. The collaboration is an effort to support the tribes view of managing resources to the seventh generation, sustainable natural resource management, and the federal trust responsibility to American Indian tribes. The report uses information routinely compiled by the U.S. Forest Service Northern Research Station's Forest Inventory and Analysis (FIA) program, yet it is presented here to maximize its usefulness for tribes and resource managers responsible for managing natural resources within the ceded territories.

The area covered by this report, the Lake States ceded territories (LSCT), represents four territories ceded by the Ojibwe people to the United States in four cession treaties: the 1836 Treaty covering a portion of Michigan's lower peninsula and the eastern half of the Upper Peninsula, the 1837 Treaty covering a portion of northern Wisconsin and east central Minnesota, the1842 Treaty covering a portion of northern Wisconsin and the western half of Michigan's Upper Peninsula, and the 1854 Treaty covering northeast Minnesota and creating the current reservations (Fig. 1). GLIFWC represents 11 Ojibwe tribes in Minnesota, Wisconsin, and Michigan.

The Ojibwe people have a long history of living in the Great Lakes region in what now comprises portions of the states of Minnesota, Wisconsin, and Michigan. They have managed

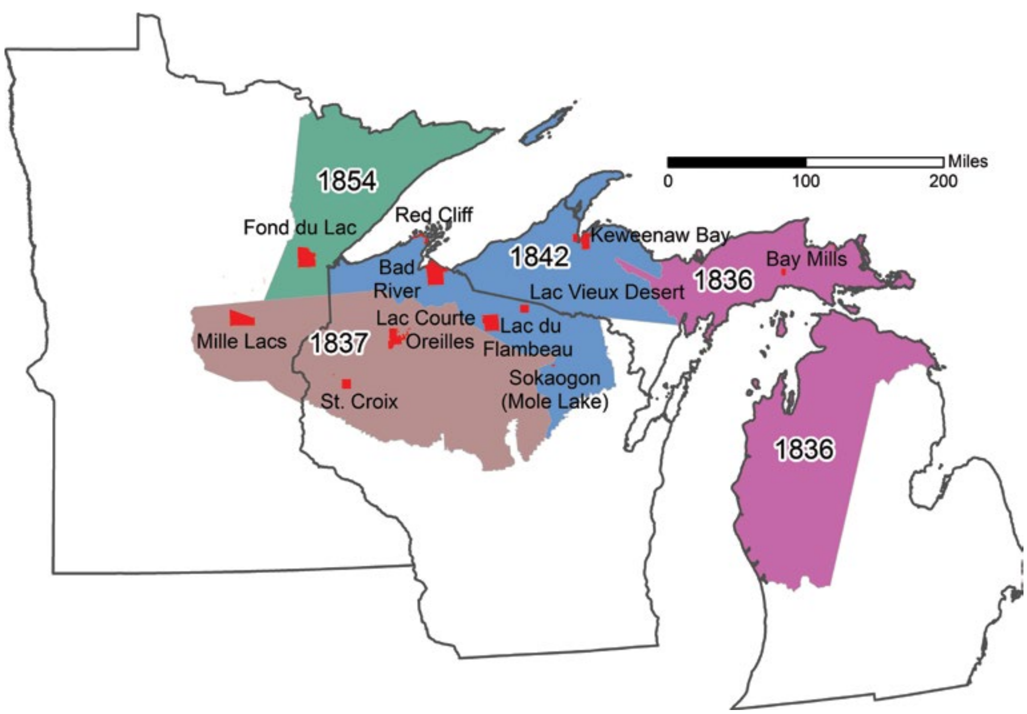

Figure 1.—Lake States ceded territories boundaries (by color) and the 11 Ojibwe member tribes and approximate locations (red).

the forests and natural resources throughout the region for many generations. Prior to European settlers, the Ojibwe people lived a semi-nomadic lifestyle, moving seasonally among camps harvesting and cultivating foods, medicines, utility supplies, and ceremonial items.

The French were the first Europeans in the Great Lakes area in the 1600s. During the next two centuries, more Europeans continued to move into the Great Lakes region, including the Ojibwe territories, in search of fur, timber, minerals, and eventually land for settlement and agriculture. In the 1800s, the United States government exerted control over vast areas of Ojibwe and other tribal territories through cession treaties. Treaties are legal agreements between two sovereign governments and are considered the "supreme law of the land" in the U.S. Constitution. In many of these treaties, the Ojibwe ceded the land to the United States but retained their rights to hunt, fish, and gather in the ceded territories to sustain their ways of living. In other words, the tribes ceded land but not their rights to use the land and natural resources. Tribal leaders approached treaty negotiations with caution and skepticism and often only agreed to sign if there was a guaranteed reservation of tribal rights. These reserved usufructuary rights are often referred to as treaty rights (Danielsen and Gilbert 2002). The tribes reserved hunting, fishing, and gathering rights in the 1837, 1842, and 1854 Treaties with the United States government.

Today, the Ojibwe tribes continue to exercise their treaty rights within the ceded territories. The landscapes comprising these four ceded territories are diverse, perhaps more diverse than that found in any individual state, ranging from prairie fringe at the southern and western portions to mixed laurentian forests more to the north and the boreal forests of northern Minnesota. In order for the Ojibwe tribes to sustain their lifestyle and their harvesting traditions, it is imperative that the forests in the ceded territories be well cared for and managed. Knowing current conditions and forest resource trends are the first steps in ensuring that all resources remain for at least seven generations, a long-term value held by many GLIFWC tribal members.

A BEGINNER'S GUIDE TO FOREST INVENTORY

Forest Inventory

Information on the condition and status of LSCT forests was obtained from the data collected by the U.S. Forest Service, Northern Research Station's Forest Inventory and Analysis (FIA) program. Resource data tables are available on the CD included with this report; table titles are listed beginning on page 82. For detailed information on inventory methods, see the "Statistics, Methods, and Quality Assurance" sections on the DVDs of Minnesota (Miles et al. 2011), Wisconsin (Perry et al. 2012), and Michigan (Pugh et al. 2012) forest inventory reports. Additional information on the inventory design can be found in Bechtold and Patterson (2005).

What is a tree?

We know a tree when we see one and we can generally agree on some common tree attributes. A problem arises when differentiating which species should be classified as shrubs and which should be classified as trees. In general, FIA defines a tree as any perennial woody plant species that can attain a height of 15 feet at maturity. Throughout this report, the size of a tree is expressed as diameter which refers to diameter at breast height (d.b.h.) in inches taken at 4.5 feet, outside bark.

A complete list of tree species of the LSCT measured in this inventory can be found in the appendix.

What is a forest?

FIA defines forest land as land that is at least 10 percent stocked by trees of any size or formerly having such tree cover and not currently developed for nonforest use. In general, forest land must be at least 1 acre in size, and 120 feet in width.

Sampling Phases

Inventories are conducted in three phases. During the first phase (Phase 1 or P1), aerial photographs, digital orthophoto quadrangles (DOQs), and satellite imagery are used for initial plot measurement via remotely sensed data and stratification. Analysts determine a digitized geographic location for each field plot and a land cover/use is assigned to the plot. All plot locations that could possibly contain accessible forest lands that satisfy FIA's definition of forest land are selected for further measurement via field crew visits.

The second phase (Phase 2 or P2) of the inventory consists of measuring the annual sample of field plots. Current FIA procedures require a sampling intensity of approximately one forest inventory plot for every 6,000 acres, with some regions having intensified sampling due to stakeholder interest and funding. FIA has divided the entire area of the United States into nonoverlapping hexagons, each of which contains 5,937 acres (McRoberts 1999). The total Federal base sample of plots is systematically divided into five interpenetrating, nonoverlapping subsamples or panels. Each year the plots in a single panel are measured, and panels are revisited on a rotating, 5-year basis. For estimation purposes, the measurement of each panel of plots may be considered an independent systematic sample of all land in a region and can be used to generate unbiased estimates and associated sampling errors for attributes such as total forest land area.

The overall P2 plot layout consists of four subplots. The centers of subplots 2, 3, and 4 are located 120 feet from the center of subplot 1 (Fig. 2). The azimuths from subplot 1 to subplots 2, 3, and 4 are 0, 120, and 240 degrees, respectively. Trees with a d.b.h. 5 inches

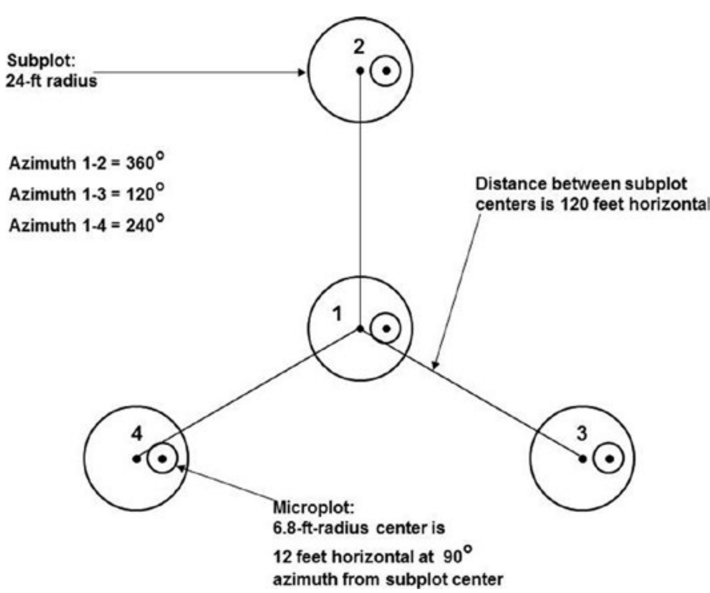

Figure 2.—Forest Inventory and Analysis plot layout.

and larger are measured on a 24-foot radius (1/24 acre) circular subplot. All trees 1.0 to 4.9 inches d.b.h. are measured on a 6.8-foot radius (1/300 acre) circular microplot located 12.0 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 tree density.

Measuring diameter. Photo by U.S. Forest Service.

The third phase of the inventory (Phase 3 or P3) focuses on forest health. For this report, the P3 plots measured were a 1/16 subset of P2 plots with approximately one P3 plot for every 96,000 acres. Measurements on these plots are obtained by field crews during the growing season and include an extended suite of ecological data such as the forest flora and down woody material. Further information about P2 and P3 data collection can be found at http://fia.fs.fed.us/library/fact-sheets/.

What is the difference between timberland, reserved forest land, and other forest land?

FIA categorizes three types of forest land: timberland, reserved forest land, and other forest land. In the LSCT, 93 percent of the forest land is timberland, 5.5 percent is reserved forest land, and 1.4 percent is other forest land (values do not total 100 due to rounding).

- Timberland is forest land that is capable of producing at least 20 cubic feet of industrial wood per acre per year and is not withdrawn from timber utilization. Inaccessible and inoperable areas are included.
- Reserved forest land is land withdrawn from timber utilization through legislation or administrative regulation without regard to productive status, e.g., designated natural and wilderness areas.
- Other forest land is land that is not capable of producing 20 cubic feet of industrial wood per acre per year (e.g., some northern white-cedar swamps or infertile jack pine barrens) and is not restricted from harvesting.

How many trees are in the LSCT?

It is estimated the LSCT forest land contains nearly 5 billion trees that are 5 inches d.b.h. or larger. Including the smaller trees, at least 1 inch d.b.h., the number increases to nearly 23.8 billion. These are estimates of the number of trees; we do not know the exact number since the estimates were derived from samples of the forest area.

How do we estimate a tree's volume?

FIA has typically expressed volumes in terms of cubic feet. However, most people may be more familiar with cords (a stack of wood 8 feet long, 4 feet wide, and 4 feet high). A cord has approximately 79 cubic feet of solid wood and 49 cubic feet of bark and air.

Volume can be precisely determined by immersing a tree in a pool of water and measuring the amount of water displaced. Less precise, but much less expensive, is the method used by FIA. Several hundred cut trees were measured by taking detailed diameter measurements along their lengths to accurately determine their volumes (Hahn 1984). Regression lines were then fit to these data by species group. Using these regression equations, we produce individual tree volume estimates based on species, diameter, and tree site index.

The same method is used to determine sawtimber volumes. FIA reports sawtimber volumes in ¼-inch International board foot scale. Conversion factors for converting to Scribner board foot scale are also available (Smith 1991).

How much does a tree weigh?

The U.S. Forest Service's Forest Products Laboratory and others developed specific gravity estimates for a number of tree species (Miles and Smith 2009). These specific gravities are applied to tree volume estimates to derive estimates of merchantable tree biomass (the weight of the bole). To estimate live biomass, the weight of the stump (Raile 1982), limbs, and bark (Heath et al. 2009) are added. The live biomass of roots or foliage is not currently reported in FIA inventories.

Forest inventories report biomass as green or oven-dry weight. Green weight is the weight of a freshly cut tree; oven-dry weight is the weight of a tree with 0 percent moisture content. On average, 1 ton of oven-dry biomass is equal to 1.9 tons of green biomass.

How do we estimate all the forest carbon pools?

FIA does not directly measure the carbon in standing trees or belowground pools. Instead, FIA assumes that half the biomass in trees consists of carbon. The remaining carbon pools (e.g., soil, understory vegetation, belowground biomass) are modeled based on stand/site characteristics (e.g., stand age and forest type).

How do we compare data from different inventories?

Data from new inventories are often compared with data from earlier inventories to determine trends in forest resources. For comparisons to be valid, the procedures used in the two inventories must be similar. As a result of FIA's ongoing efforts to improve efficiency and reliability of the inventory, several changes in procedures and definitions have occurred over time. Although these changes will have little effect on statewide and regional estimates of forest area, timber volume, and tree biomass, they may significantly affect plot classification variables such as forest type and stand size class. Because of the changes that have taken place over time, some variables are inappropriate to compare between inventories.

In this report we present inventory estimates primarily for the years 1980, 1990, 2008, and 2013. For some variables, we present estimates for years between 2003 and 2013. All of these estimates are based on FIA field plot measurements taken over a period of several years. Data for the 1980 estimates are derived from measurements taken on 14,330 forest plots measured between 1975 and 1982. Data for the 1990 estimates are derived from measurements taken on 16,563 forest plots measured between 1986 and 1995. In 1999 FIA began implementation of an annual inventory system where plots are permanently established and measured every fifth year with one-fifth (20 percent) of the plots being measured each year and inventory estimates for a specific year based on those plots measured in the 5-year period ending with that year. Under this new system, data for the 2013 estimates are from measurements taken on 8,747 forest plots measured between 2009 and 2013 and for the 2008 estimates are from measurements taken on 11,859 forest plots measured between 2004 and 2008.

A Word of Caution on Suitability and Availability

FIA does not attempt to identify which lands are suitable or available for timber harvesting, particularly because such suitability and availability are subject to changing laws, economic/market constraints, physical conditions, adjacency to human populations, and ownership objectives. The classification of land as timberland does not necessarily mean it is suitable or available for timber production.

FIA endeavors to be precise in definitions and implementation. The program tries to minimize changes to these definitions and collection procedures, but that is not always possible or desirable. Although change is inevitable, we hope that through clarity and transparency the forest inventory data collected will be of use to analysts for decades to come.

Lake of the Clouds, Porcupine Mountains Wilderness State Park, Michigan.
Photo by Cassandra M. Kurtz, U.S. Forest Service.

FOREST FEATURES

Sugar maple stand. Photo by Christie L. Kurtz, used with permission.

FOREST AND TIMBERLAND AREA

Background

Area estimates are the most basic, easily understood, and frequently cited of all forest inventory estimates. They are essential in assessing the status of a region's forest ecosystems. Fluctuations in forest land area estimates may indicate changing land use or forest health. The LSCT is a heavily forested area (Fig. 3) with a matrix of farmland, residential areas, recreational areas, and industrial land uses such as mining and metallurgy.

What we found

The LSCT forest land area is estimated to be 30.7 million acres (Fig. 4) with forests covering 65.3 percent of the total land area. Timberland area is estimated at 28.5 million acres, accounting for 93 percent of the forest land. Reserved forests make up an estimated 1.7 million acres. Other forest land that has very low productivity, does not meet standards for timberland, and is not reserved from harvesting, makes up an estimated 437,000 acres (1.4 percent of the total forest land area). The number of forested acres in the LSCT increased by about 1.8 million acres between 1980 and 2013.

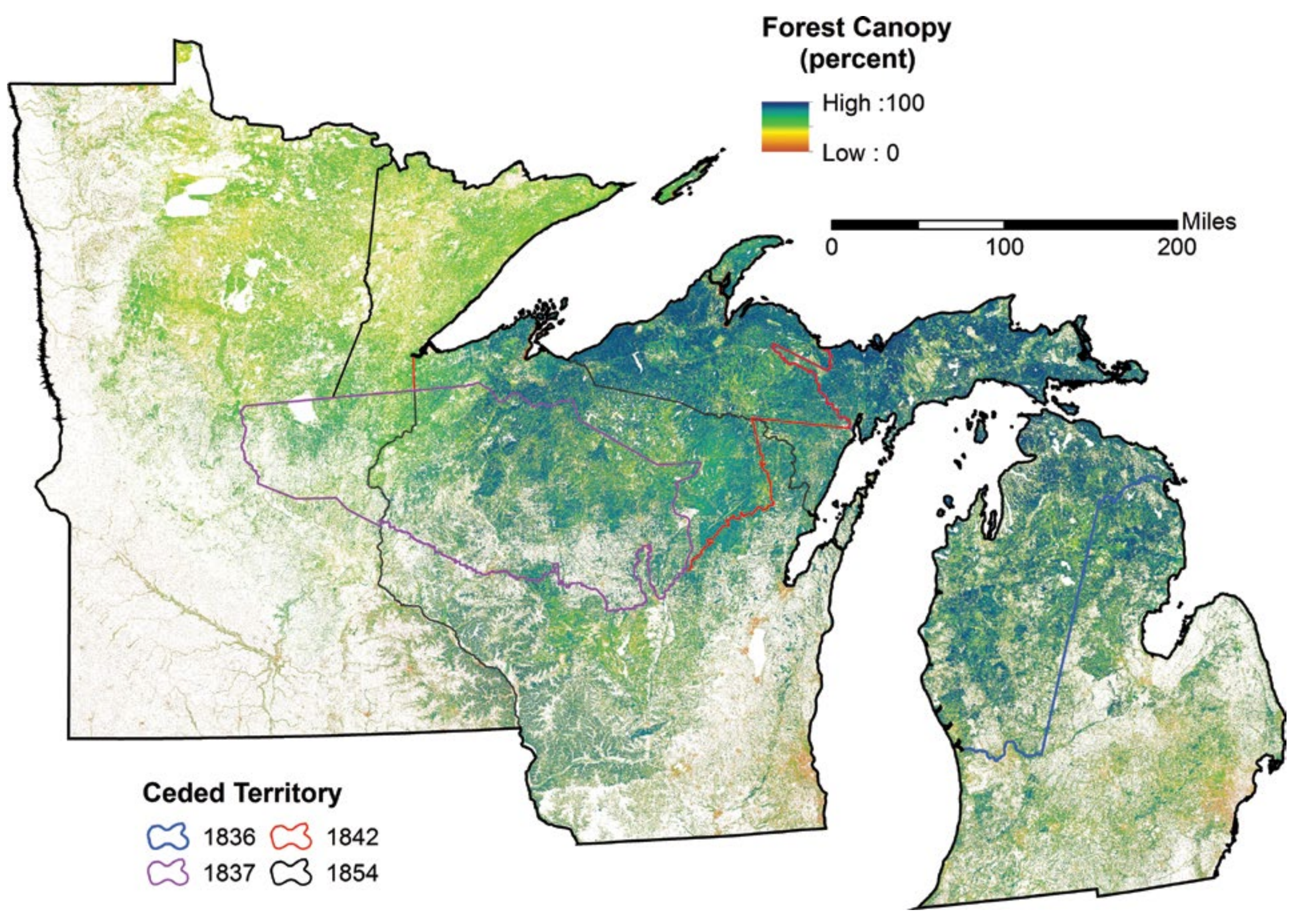

Figure 3.—Canopy cover (Coulston et al. 2012) within the Lake States ceded territories. Canopy cover is a measure of forest density.

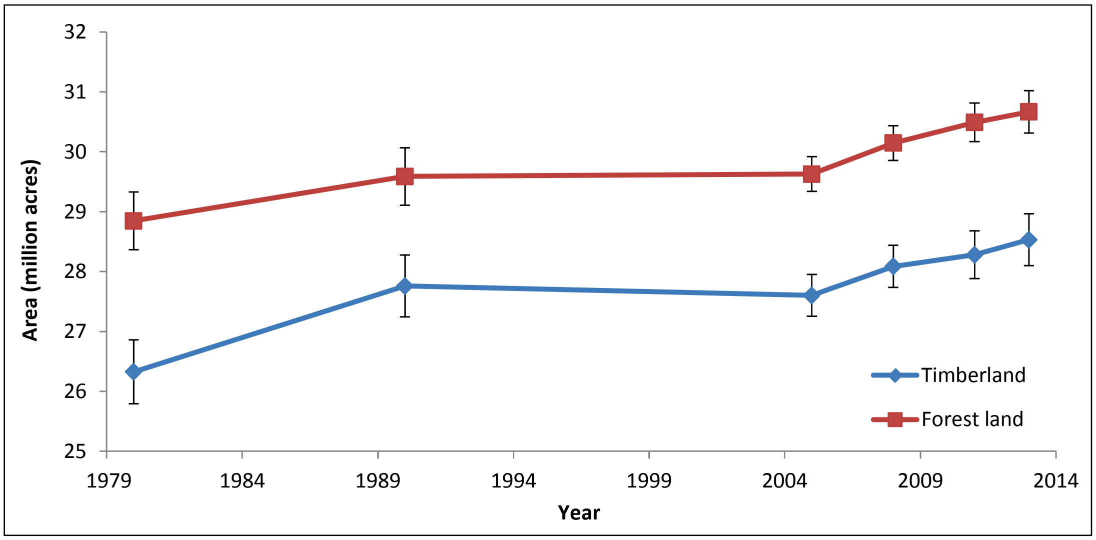

Figure 4.—Area of timberland and forest land in the Lake States ceded territories by inventory year. Error bars represent a 68 percent confidence interval around the estimated mean.

Assessing timberland by treaty area, there are about 8.3 million acres of timberland in the 1842 Treaty area, 7.1 million acres in the 1837 Treaty area, 5.4 million acres in the 1836 Lower Peninsula Treaty area, 3.9 million acres in the 1854 Treaty area, and 3.8 million acres in the 1836 Upper Peninsula treaty area.

What this means

In the 34 years of monitoring the LSCT, forest land area has remained relatively stable across the region with increases in forest and timberland since the 1980 inventory. Some increase is due to areas reverting from nonforest to forest while other increases are due to improved digital and aerial imagery and advancements in geographic information systems, which resulted in the ability to identify forest land that was previously given a nonforest classification. The current forest land and timberland estimates are at the highest level since 1980, however agriculture and development may cause a loss of these forested areas in the future.

OWNERSHIP

Background

Forest ownership has a large impact on how land is managed. It is the forest owners who ultimately control their forests' management and fate. FIA conducts the National Woodland Owner Survey (NWOS) to better understand who owns the forests, why they own them, and how they are used (Butler et al., in press).

What we found

Most forested land in the LSCT is privately owned. Of the 28.5 million acres of timberland, 16.4 million acres (57.5 percent) are held by private landowners (2013) (Table 1). The private landowner category includes corporate, nongovernmental conservation/natural resources organizations, unincorporated partnerships/associations/clubs, Native American lands within the reservation boundaries, and individual owners. The States and Federal

Table 1.—Acres and percent of timberland by ownership, Lake States ceded territories, 2008 and 2013

Ownership	2008 Area (% of total timberland)		2013 Area (% of total timberland)	
	Acres	*(%)*	*Acres*	*(%)*
Federal	4,582,626	(16.3)	4,582,700	(16.1)
State	4,275,165	(15.2)	4,584,820	(16.1)
County	3,028,931	(10.8)	2,962,330	(10.4)
Private	16,245,861	(57.7)	16,402,360	(57.5)
Total	28,132,585	(100%)	28,532,212	(100%)

government each own 16.1 percent of the timberland and the counties own 10.4 percent. The total area of timberland remained relatively stable between 2008 and 2013 with all ownership classes increasing in acreage, except for counties, which saw a decrease of 66,600 acres (Table 1). Considering ownership area as a percentage of the total timberland, all ownership classes declined, except for State land, due to a large increase in State ownership (309,700 acres of timberland) while the other ownership classes held relatively stable.

What this means

Management objectives vary by ownership class. Due to more intense harvesting on State and county lands, the percentage of early succession aspen forest type in relation to the total acres of timberland is greater on State and county land (21.6 and 30.0 percent of the total acreage, respectively) than on Federal or private land (18.5 and 18.6 percent of the total acreage, respectively). With most timberland held by private individuals, each owner can manage his or her land as desired. Both private forests (which include reservations) and public forests have immense social, cultural, ecological, and economic value to tribal members. Sound management helps ensure that the desired resources are available and protected for future generations to harvest trees and other forest products for spiritual, ceremonial, medicinal, subsistence, and economic needs. It is important that harvesting of these gifts from the earth is done in a sustainable manner as healthy natural resources are of critical importance and enhance the quality of life for the tribal community by feeding the body and spirits.

FOREST TYPE DISTRIBUTION

Background

Forest types are logical ecological groupings of species mixes as defined by Eyre (1980). Forest type is determined by the stocking (relative density) that tree species contribute to a sampled condition. In stands with a mixture of size classes, the assignment of forest types is weighted toward the larger trees, which contribute more to stocking. The forest type is influenced by many factors ranging from competition between species, natural succession, and natural and manmade disturbances. Related forest types are combined into forest-type groups (e.g., white/red/jack pine group).

What we found

This area supports a diverse mix of forest-type groups. Distribution of forest-type groups across the Lake States is shown in Figure 5. Aspen/birch predominates the northwestern part of the LSCT, maple/beech/birch the middle, and a mix of aspen/birch and white/red/jack pine at the eastern edge. The top four forest types (aspen, sugar maple-beech-yellow birch, oak, and hard maple-basswood) cover over half of the timberland area. (Common names and Latin names for all tree species found in the LSCT are listed in the appendix.)

Most of the timberland in the LSCT is hardwood forest (71.2 percent), followed by softwood (28 percent), and nonstocked (<1 percent). Aspen is the dominant forest type, occupying 5.8 million acres or 20.3 percent of the timberland area (Fig. 6) and is closely followed by the sugar maple-beech-yellow birch forest type, which grows on 5 million acres or 17.5 percent of the timberland area. Other forest types that are found on over 5 percent of the timberland in the LSCT include: oak, hard maple-basswood, lowland hardwoods, and red pine. Since 2003, there has been a decrease in the acreage of aspen, black spruce, and tamarack and an increase in the other forest types. These trends are important to monitor as forests change over time due to succession, insects, disease, and other forest threats.

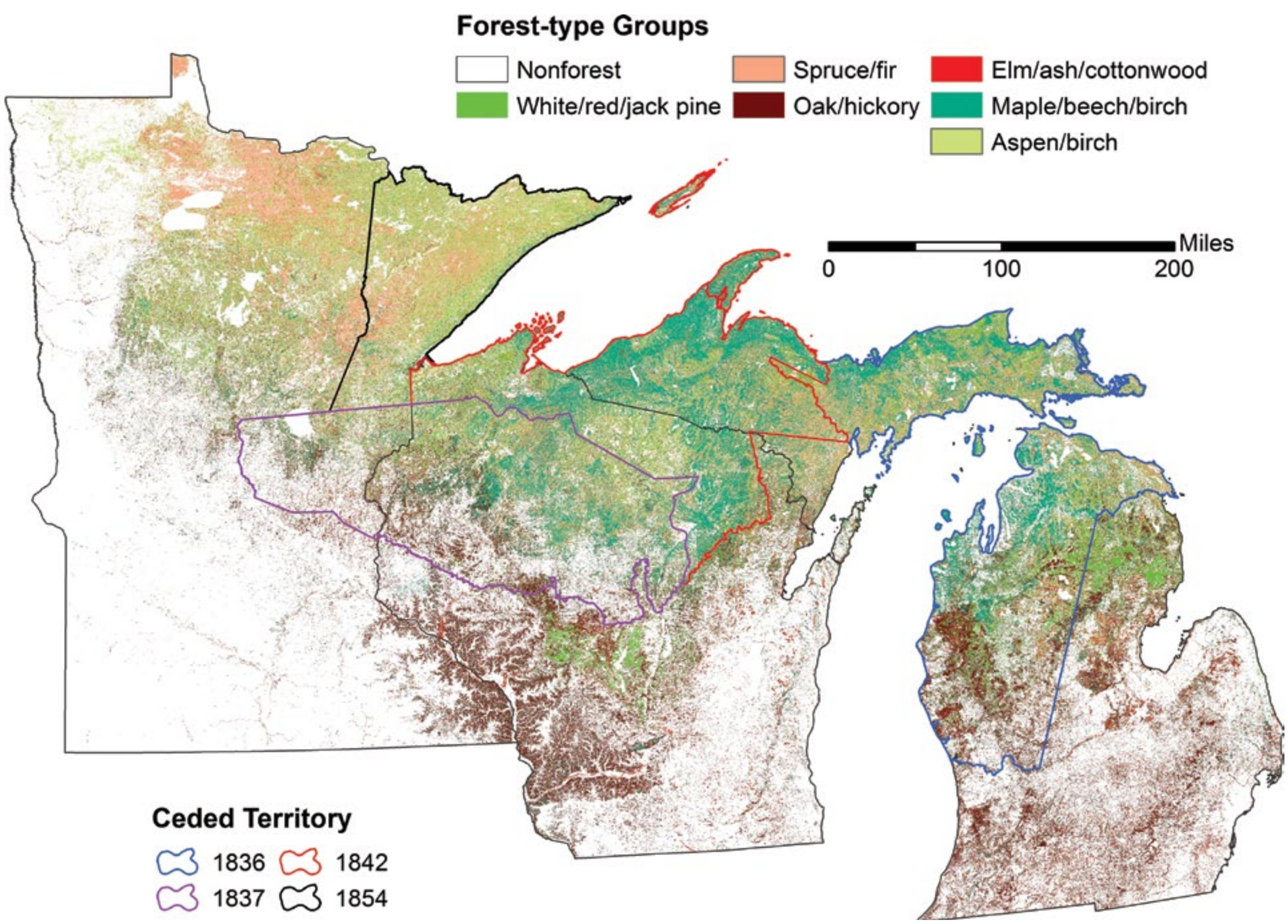

Figure 5.—Forest-type groups (Wilson et al. 2012) in the Lake States ceded territories.

Forest types vary by treaty area (Fig. 7). Oak (1.0 million acres) is the most common forest type on timberland of the 1836 Lower Peninsula Treaty area, followed by aspen (0.7 million acres), and sugar maple-beech-yellow birch (0.7 million acres). In the 1836 Upper Peninsula Treaty area, the top three forest types are sugar maple-beech-yellow birch (1.0 million acres), northern white-cedar (0.6 million acres), and aspen (0.5 million acres). The

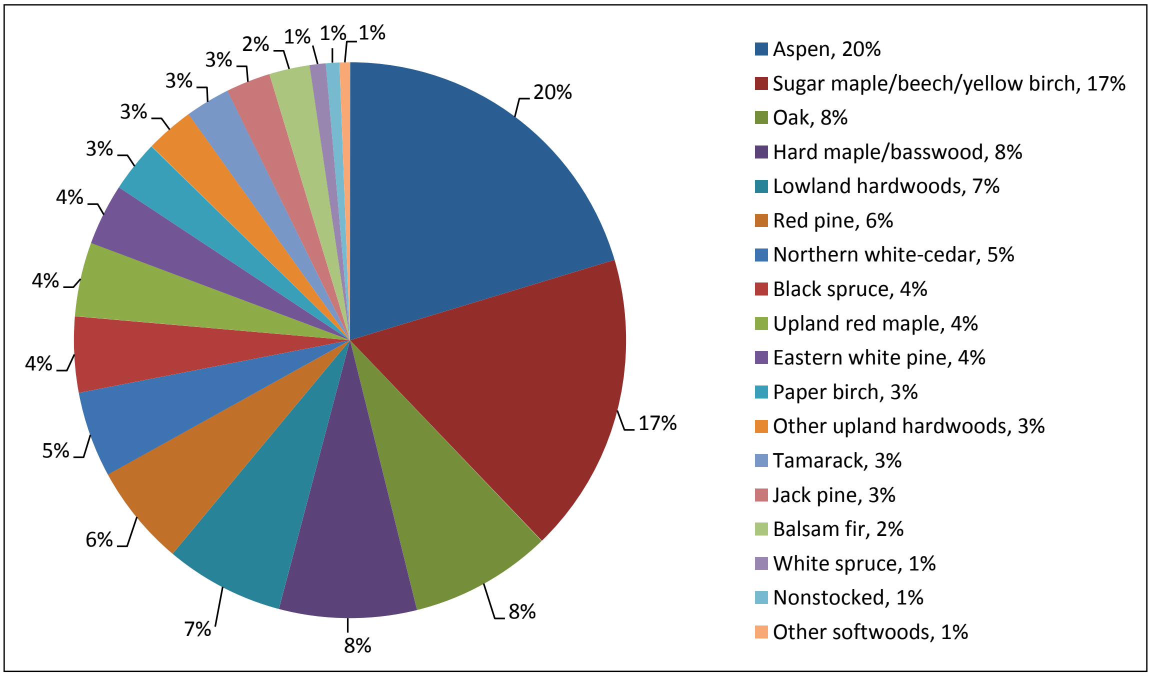

Figure 6.—Proportion of timberland by forest type, Lake States ceded territories, 2013.

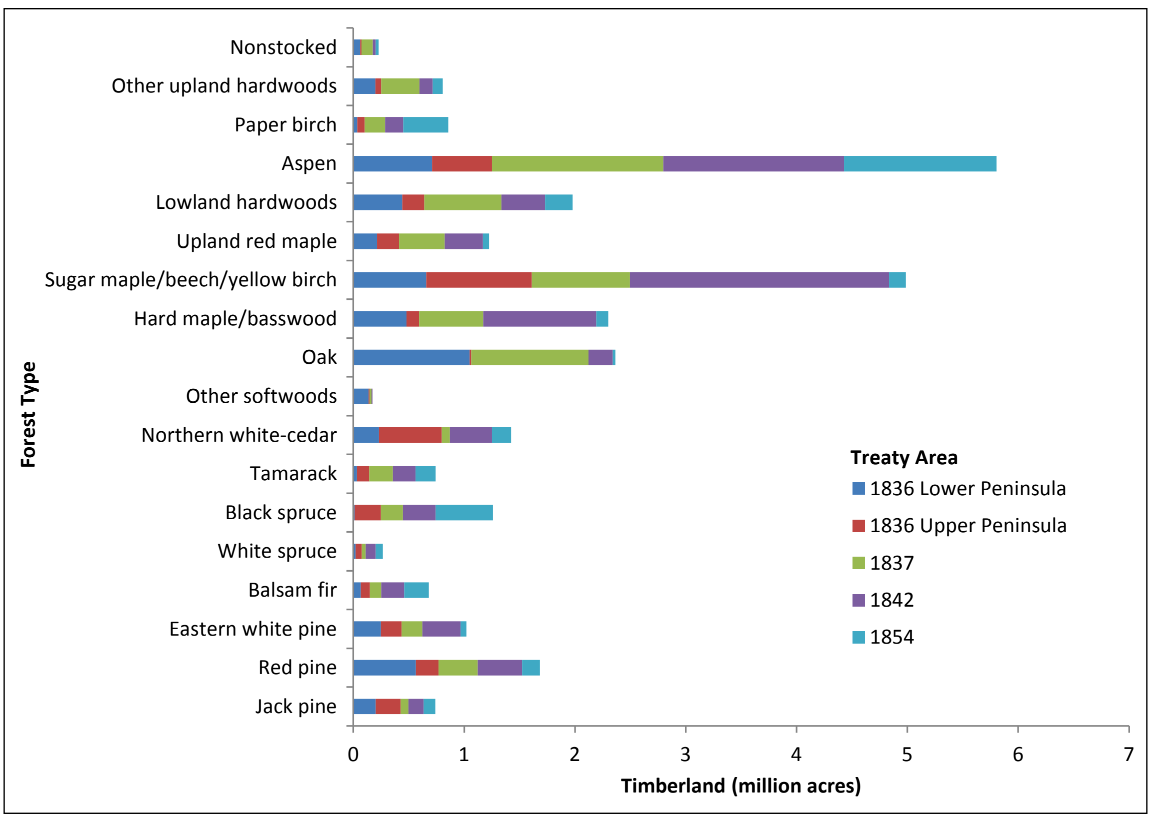

Figure 7.—Timberland area by forest type and treaty area, Lake States ceded territories, 2013.

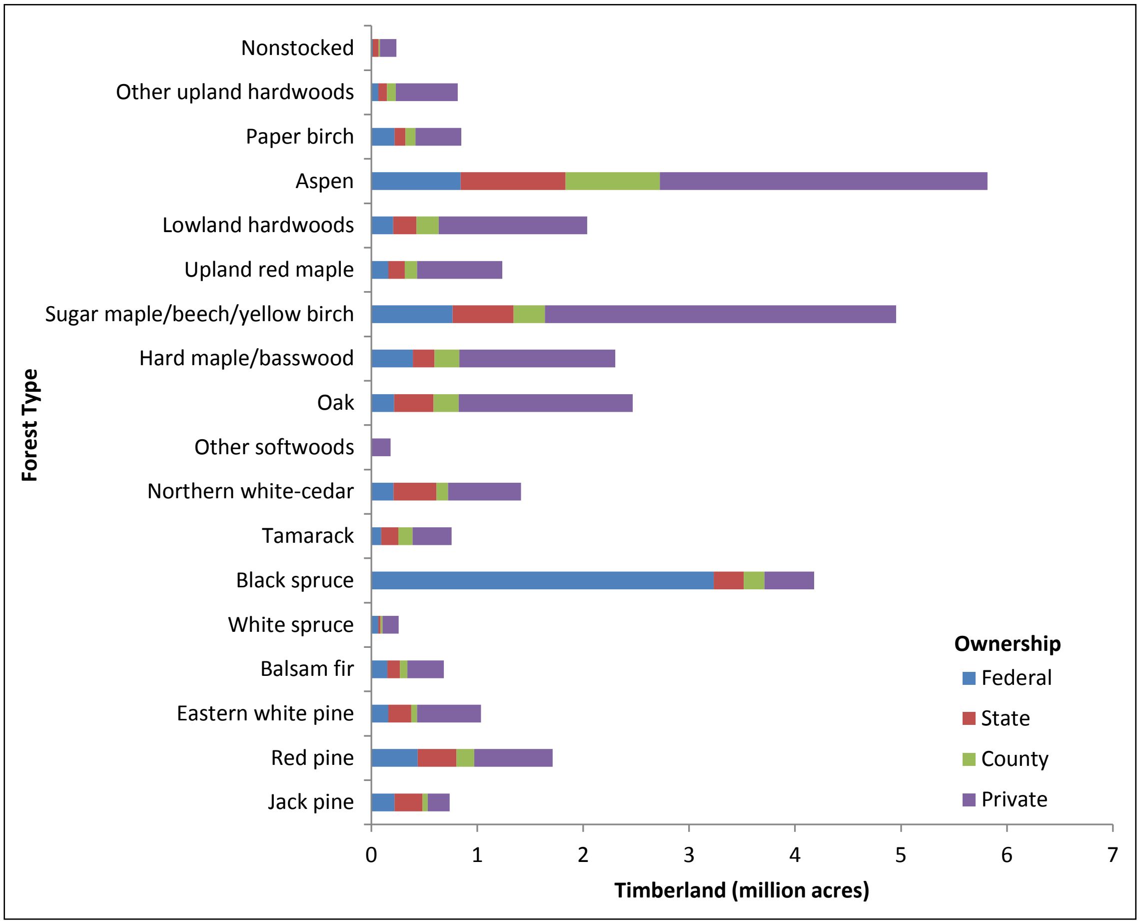

Figure 8.—Timberland area by forest type and ownership, Lake States ceded territories, 2013.

1837 Treaty area is dominated by aspen (1.5 million acres) and oak (1.1 million acres). In the 1842 Treaty area, sugar maple-beech-yellow birch and aspen are the dominant forest types, each occupying over 1 million acres of timberland (2.3 million and 1.6 million acres, respectively). The 1854 Treaty area is dominated by aspen, with over 1 million acres in this forest type, more than double the acreage of the next most common forest type (black spruce; 0.5 million acres).

Analyzing the timberland data by ownership category shows interesting differences (Fig. 8). In the Federal, State, and county ownership classes, aspen forest type covers the most area, followed by sugar maple-beech-yellow birch (Table 2). On Federal land there is slightly more timberland with aspen than sugar maple-beech-yellow birch, however on State land, the area covered by aspen forest type is nearly double that of sugar maple-beech-yellow birch. On county lands, aspen covers nearly three times the acreage of sugar maple-beech-yellow birch while in the private ownership category, sugar maple-beech-yellow birch covers the greatest amount of timberland area (followed by aspen). These two dominant forest types represent from 34 to 40 percent of the forested area in each of the ownership classes.

What this means

Site characteristics, past management, and adaptive abilities of species within forest types influence the forest type distribution of the LSCT. The climate, soil, and physiography affect

Table 2.—Timberland area by forest type and ownership, Lake States ceded territories, 2013

Forest type	Ownership									
	Federal		State		County		Private		All Owners	
	Acres	*%*	*Acres*	*%*	*Acres*	*%*	*Acres*	*%*	*Acres*	*%*
Jack pine	215,185	4.7	269,750	5.9	50,638	1.7	204,756	1.2	740,329	2.6
Red pine	430,333	9.4	361,385	7.9	167,984	5.7	723,751	4.4	1,683,452	5.9
Eastern white pine	161,432	3.5	210,122	4.6	54,304	1.8	593,991	3.6	1,019,849	3.6
Balsam fir	153,183	3.3	114,503	2.5	68,096	2.3	345,620	2.1	681,402	2.4
White spruce	63,030	1.4	24,589	0.5	15,554	0.5	161,602	1	264,775	0.9
Black spruce	319,914	7	274,301	6	190,720	6.4	473,483	2.9	1,258,418	4.4
Tamarack	90,418	2	157,707	3.4	130,681	4.4	363,478	2.2	742,283	2.6
Northern white-cedar	213,325	4.7	395,254	8.6	110,799	3.7	704,418	4.3	1,423,796	5
Other softwoods	--	0	--	0	--	0	173,500	1.1	173,500	0.6
Oak	226,538	4.9	371,759	8.1	237,254	8	1,527,738	9.3	2,363,289	8.3
Hard maple/basswood	406,242	8.9	218,051	4.8	236,102	8	1,438,798	8.8	2,299,194	8.1
Sugar maple/beech/yellow birch	791,885	17.3	572,960	12.5	304,104	10.3	3,315,746	20.2	4,984,695	17.5
Upland red maple	159,373	3.5	156,349	3.4	116,346	3.9	792,993	4.8	1,225,061	4.3
Lowland hardwoods	199,250	4.3	219,955	4.8	212,225	7.2	1,346,772	8.2	1,978,202	6.9
Aspen	846,291	18.5	998,294	21.8	884,970	29.9	3,073,466	18.7	5,803,022	20.3
Paper birch	227,181	5	102,946	2.2	93,352	3.2	433,830	2.6	857,309	3
Nonstocked	14,492	0.3	53,233	1.2	10,563	0.4	149,583	0.9	227,871	0.8
Other upland hardwoods	64,629	1.4	83,662	1.8	78,640	2.7	578,834	3.5	805,766	2.8
Total all forest types	4,582,700	100	4,584,821	100	2,962,331	100	16,402,360	100	28,532,212	100

not only the forest type, but also the tree quality and health. Logging, fire, storms, insects, and disease also have a large role in altering the forest types. Yet another factor influencing the forest is management objectives of the ownership classes. In the late 1800s and early 1900s major logging changed the once primarily late successional species forests to early successional forests. As land is intensively harvested or reverts from nonforest to forest, early successional species such as aspen, birch, and red maple become established. If these forests are not harvested or disturbed, they become mid- to late-successional forests over time and the presence of species like red oak, white pine, beech, and sugar maple increases. As these forests change, they offer different habitat and serve various aesthetic and cultural purposes.

TREE SPECIES COMPOSITION

Background

The species composition of a forest drives the dynamics of its growth, development, and ecosystem function. Some forests are composed of a diverse set of tree species while others are composed of very few species or dominated by a single species. Both types of forests provide valuable ecological niches for flora and fauna. Diverse forests can have health problems but they are less likely to be severely impacted by insect or disease, which can reach epidemic levels in monocultures. Knowledge of the species composition reveals the different resources available for wildlife and cultural interest as well as information about the current and potential future forest ecosystems.

What we found

LSCT forest land contains nearly 5 billion trees at least 5 inches d.b.h. Including the trees at least 1 inch d.b.h., the number increases to about 23.8 billion trees and represents 16 species of softwood trees and 64 species of hardwood trees for a total of 80 species. Among softwoods, balsam fir is the most common of trees 1 inch d.b.h. or larger and the second most common in the 5 inch d.b.h. or larger class (northern white-cedar has the greatest number of trees 5 inches in d.b.h. or greater) (Fig. 9). Among the hardwoods, quaking aspen is the most common species. However, when only considering trees 5 inches in diameter or greater, sugar maple is the most common species, closely followed by red maple (Fig. 10).

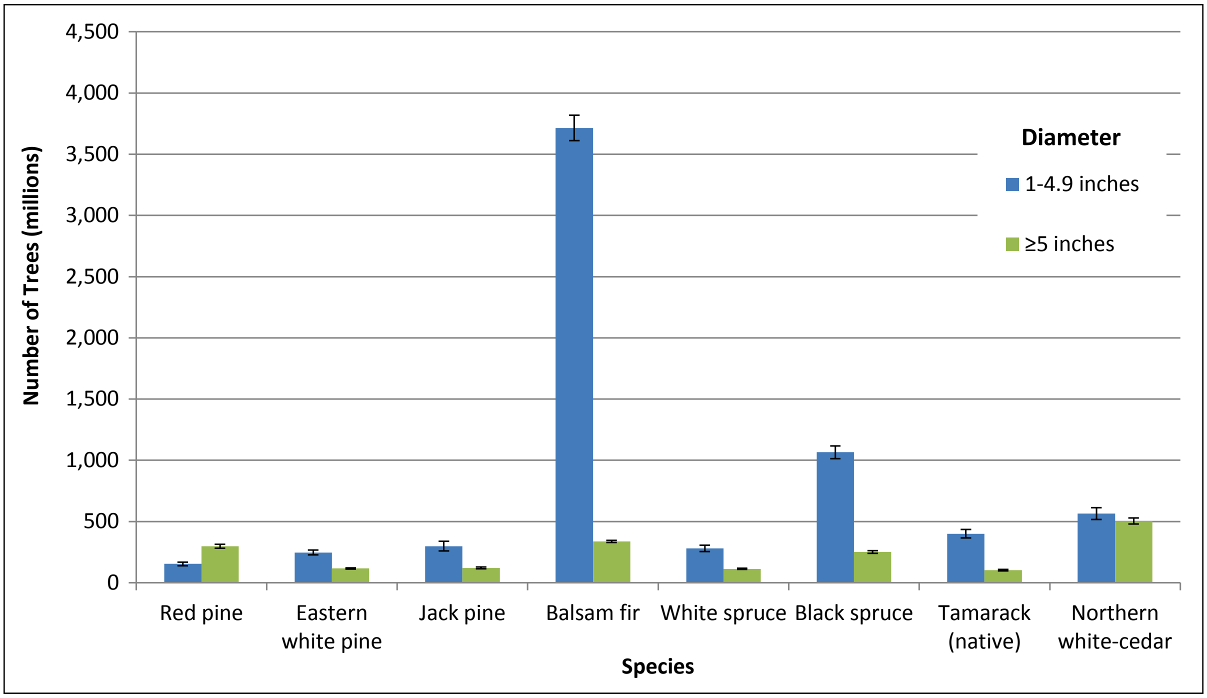

Figure 9. —Estimated number of trees for the eight most common softwood species on forest land by diameter class and species, Lake States ceded territories, 2013. Error bars represent a 68 percent confidence interval around the estimated mean.

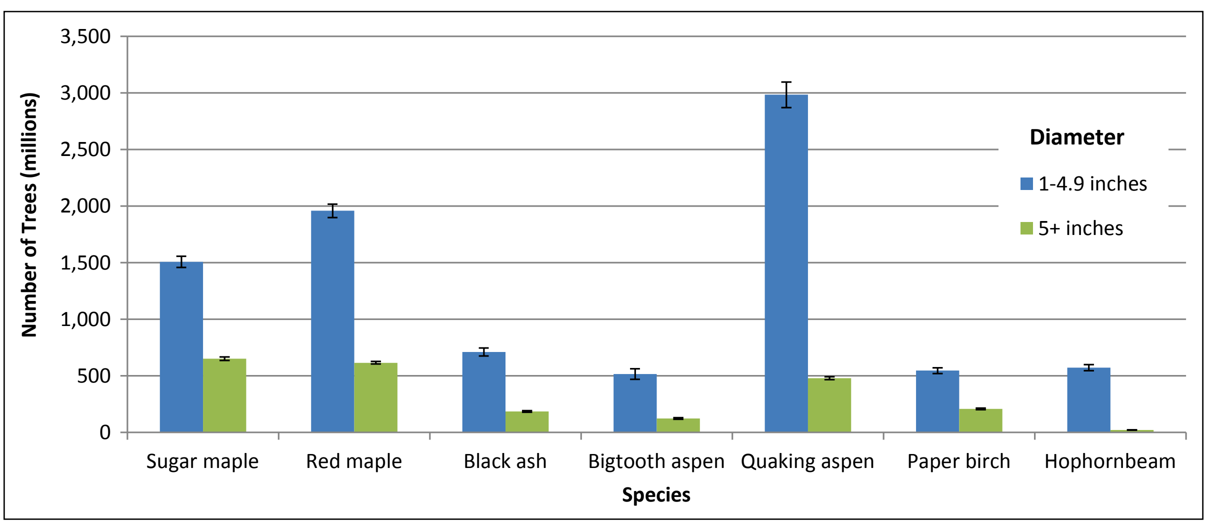

Figure 10.—Estimated number of trees for the seven most common hardwood species on forest land by diameter class and species, Lake States ceded territories, 2013. Error bars represent a 68 percent confidence interval around the estimated mean.

What this means

The LSCT supports a diverse mix of tree species. The diversity of species provides valuable cultural and wildlife benefits and also helps to reduce susceptibility to mortality from insects and disease. In the future, balsam fir will likely increase since this species currently dominates the sapling size class (1.0 to 4.9 inches d.b.h.). It will be important to monitor the change in abundance of tree species with climate change, deer browse, and insect and disease risks.

BIOMASS AND GROWING-STOCK VOLUME

Background

Measuring total live-tree biomass and growing-stock volume helps us understand the components of a forest stand and the resources available for different uses (e.g., wildlife habitat, carbon sequestration, or biofuels). Biomass estimates are measured as all live aboveground tree biomass on forest land including the stump, bole, bark, and limbs but excluding foliage and roots. Roughly half of the dry tree biomass is carbon. Global climate change concerns have focused attention on the capacity of forests to act as carbon sinks.

Growing-stock volume is the amount of sound wood in live, commercial tree species at least 5 inches d.b.h. and excludes rough, rotten, and dead trees as well as noncommercial species such as hophornbeam and apple. This measure has traditionally been used to ascertain wood volume potentially available for commercial use. Estimates of the volume of growing-stock are important considerations in economic planning and evaluations of forest sustainability.

What we found

Aboveground biomass of live trees at least 1 inch d.b.h. is estimated to be more than 1.1 billion dry short tons on forest land (averaging 36.7 tons per acre). About 55 percent of the forest land biomass and 58 percent of the timberland biomass is found on private land (Fig. 11). Hardwoods make up 73.4 percent of the total biomass on forest land, which accounts for 825.1 million dry short tons, with hard maple dominating the group (219.3 million dry short tons) (Table 3). The bole component of trees holds 67 percent of the total biomass, tops and limbs hold 17 percent, saplings hold 12 percent, and stumps hold 4 percent. The total growing-stock volume in the LSCT is estimated at 38.3 billion cubic feet, an average of 1,343.7 cubic feet per acre of timberland. Four species groups, eastern white and red pines, hard maple, cottonwood and aspen, and soft maple, make up over 50 percent of the total growing-stock volume (Fig. 12).

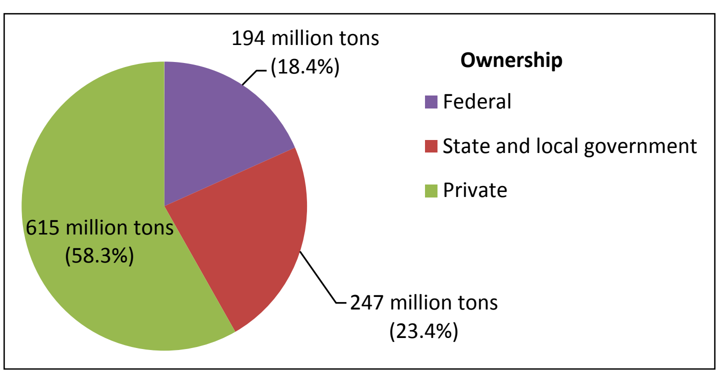

Figure 11.—Aboveground dry weight (million dry short tons) and proportion of live trees (at least 1.0 inch d.b.h.) on timberland, by ownership, Lake States ceded territories, 2013.

Table 3.—**Aboveground dry weight of live trees (at least 1 inch d.b.h./d.r.c.), in thousand dry short tons, on forest land by species group and diameter class, Lake States ceded territories, 2013**

	1.0-4.9 inches	≥ 5.0 inches	Total	Percentage of all species
Softwood species		*1,000 tons*		
Other yellow pines	493	2,187	2,680	0.2
Eastern white and red pines	3,197	95,360	98,557	8.8
Jack pine	1,986	13,195	15,181	1.3
Spruce and balsam fir	26,500	58,353	84,853	7.5
Eastern hemlock	808	27,368	28,176	2.5
Other eastern softwoods	7,194	63,111	70,305	6.2
Total for all softwoods	40,179	259,572	299,751	26.6
Hardwood species				
Select white oaks	1,299	26,903	28,202	2.5
Select red oaks	2,038	63,162	65,200	5.8
Other red oaks	1,533	23,565	25,098	2.2
Hickory	129	1,500	1,629	0.1
Yellow birch	2,157	26,923	29,080	2.6
Hard maple	17,998	201,331	219,329	19.5
Soft maple	17,995	136,936	154,931	13.8
Beech	1,297	12,338	13,635	1.2
Tupelo and blackgum	1	45	46	0
Ash	8,977	48,610	57,587	5.1
Cottonwood and aspen	23,156	104,363	127,519	11.3
Basswood	1,048	26,095	27,143	2.4
Black walnut	0	65	65	0
Other eastern soft hardwoods	9,805	55,949	65,754	5.8
Other eastern hard hardwoods	100	288	388	0
Eastern noncommercial hardwoods	6,491	3,034	9,525	0.8
Total for all hardwoods	94,023	731,108	825,131	73.4
Total for all species groups	134,202	990,680	1,124,882	100

Value of 0 indicates the aboveground tree biomass rounds to less than 1,000 dry tons.
Columns and rows may not add to their totals due to rounding.

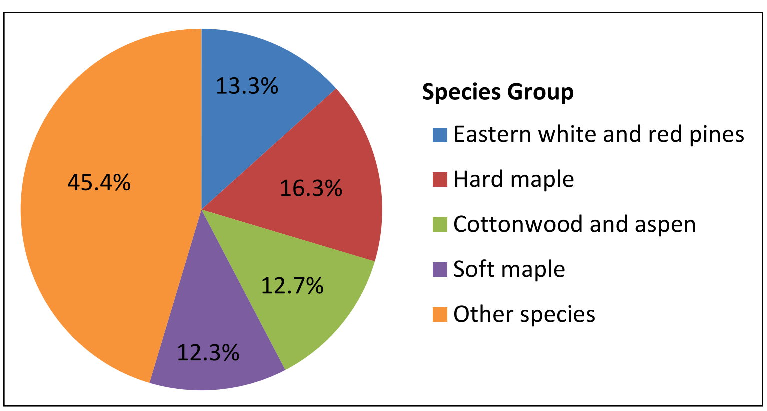

Figure 12.—Percentage net growing-stock volume of the four most common species groups on timberland, Lake States ceded territories, 2013.

What this means

The total live-tree biomass of the LSCT is a tremendous resource in terms of both economic and environmental importance. These stores of carbon for expanding woody biomass energy production make knowledge of the resource vital to additional demands on forest planning and management. Biomass is a renewable energy source and can help reduce fossil fuel use and offset carbon dioxide emissions.

FOREST GROWTH, REMOVALS, AND MORTALITY

Background

Forest health, vigor, and the rate of woody biomass growth (accretion) and depletion are all influenced by dynamic relationship between tree growth, mortality, and removals (i.e., harvests and land-use changes). A stand's capacity for growth is an indication of the overall condition of the forest and more specifically of tree vigor, forest health, and successional stage. Growth is reported as average annual net growth of growing-stock trees (at least 5 inches d.b.h.) on timberland and is equivalent to gross growth, including ingrowth, minus mortality. Mortality is a part of forest stand development that can be caused by insects, disease, adverse weather, succession, competition, fire, old age, or human or animal activity. Tree mortality due to harvesting or land clearing is considered removals and is not included in mortality. Mortality and removals become a particular concern if they surpass growth and regeneration of the forest. Removals are based on the trees that are lost due to harvest or diversion. Harvest removals include utilized trees and trees that are cut as a result of harvest operations (including land clearing) but are not utilized. Diversion removals occur when trees are removed from the timberland base due to land-use change. Analysis of each of these components (growth, mortality, and removals) can help us to better understand what is influencing the net change in volume.

What we found

The average annual net growth on LSCT timberland is 841.9 million cubic feet with softwoods at 344.5 million cubic feet and hardwoods accounting for 497.5 million cubic feet of growth. The species with the greatest net growth vary by ownership class (Fig. 13). Overall, sugar maple dominates the average annual net growth of growing stock, exceeding 125 million cubic feet per year. Red pine and red maple follow closely with net growth at 116.4 and 111.6 million cubic feet per year, respectively. Among the six species with the greatest net growth, two are softwoods.

Negative annual net growth indicates that mortality is exceeding growth. Black maple, paper birch, butternut, and black willow have negative growth. Some of these species are relatively rare in the region and sampling error or a minimal fluctuation can result in a negative net growth. These species have a negative growth of less than 1 million cubic feet, except for paper birch, with an average annual net growth of -8.9 million cubic feet.

Mortality, reported as average annual mortality of growing-stock trees (at least 5 inches d.b.h.) on timberland, varies across ownership categories (Fig. 14). There are six species with net mortality greater than 15 million cubic feet per year. Annual mortality is greatest for quaking aspen (108.7 million cubic feet per year). Quaking aspen has twice the mortality of balsam fir (54.7 million cubic feet per year), the species with the second highest amount of mortality. Despite having the highest mortality, quaking aspen is still among the six species with the greatest average annual net growth of growing-stock trees at least 5 inches d.b.h. (74.5 million cubic feet per year). Average annual mortality of growing-stock trees on timberland is 407.7 million cubic feet with 127.2 million cubic feet from softwoods and 280.5 million cubic feet from hardwoods.

The average annual growing-stock removals on timberland totals 482.5 million cubic feet, 145.7 million cubic feet from softwoods and 336.8 million cubic feet from hardwoods. Removals vary by ownership category (Fig. 15) and are dominated by quaking aspen, sugar maple, red pine, and red maple. Eight species have growing-stock removals greater than 20 million cubic feet per year.

Overall, gross growth is over 1.2 billion cubic feet with softwoods contributing 471.7 million cubic feet and hardwoods adding 778.0 million cubic feet. Annual mortality averages 407.7 million cubic feet of which 127.2 million cubic feet is from softwoods and 280.5 million cubic feet is from hardwoods. This results in a net growth of 841.9 million cubic feet per year where 344.5 million cubic feet is from softwood and 497.5 million cubic feet is from hardwoods. Removals of trees due to both harvesting and land-use change is 482.5 million cubic feet with 145.7 million cubic feet from softwood and 336.8 million cubic feet from hardwood. This leaves an annual surplus or net increase of 359.4 million cubic feet (198.8 million cubic feet from softwood and 160.7 million cubic feet from hardwood).

Another way to assess the forest sustainability is by looking at the ratio of net growth to removals. This answers the basic question: is the growth of trees less than, equal to, or greater than mortality/removals? A growth-to-removal ratio (G:R) of 1.0 means growth is equal to removals, a ratio less than 1.0 means that removals exceed growth, and a value greater than 1.0 means growth exceeds removals. For the LSCT, the overall ratio is 1.7; hardwoods have a lower ratio (1.5) than softwoods (2.4). By ownership class, the ratio for public land is 1.9 and for private land it is 1.7. On public land the G:R for softwoods is 2.2 while for hardwoods it is 1.6, and on private land the softwood G:R is 2.5 and the hardwood ratio is 1.4.

What this means

Overall, the growth to removal ratio is greater than 1.0 for the LSCT across all ownership categories. While this suggests sustainable forest management, other factors, such as the G:R ratio for each species, ownership class, and the quality of the trees left behind, need to be considered. Analyzing the growth, removal, and mortality data suggests some species have a negative net growth. Paper birch is the species with the greatest negative growth, which is a concern because of its vast cultural importance to the tribes. Further detailed analyses of the paper birch data are found on page 54 of this publication as well as in Moser et al. (2015).

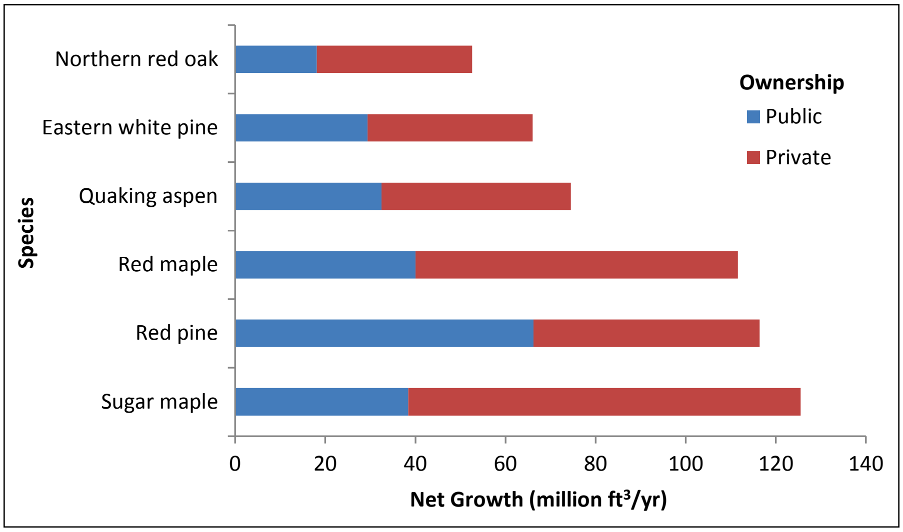

Figure 13.—Annual average net growth of growing-stock trees (≥5.0 inches d.b.h.) on timberland, in million cubic feet, by species and ownership, Lake States ceded territories, 2013. Species listed have the greatest annual net growth in the Lake States ceded territories.

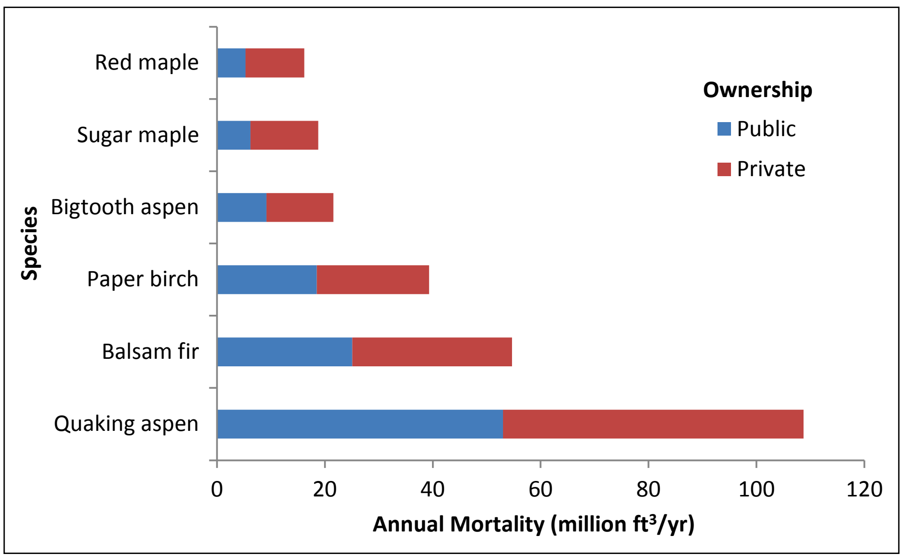

Figure 14.—Average annual mortality of growing-stock trees (≥ 5.0 inches d.b.h.) on timberland, in million cubic feet, by species and ownership, Lake States ceded territories, 2013. Species listed have the greatest annual mortality in the Lake States ceded territories.

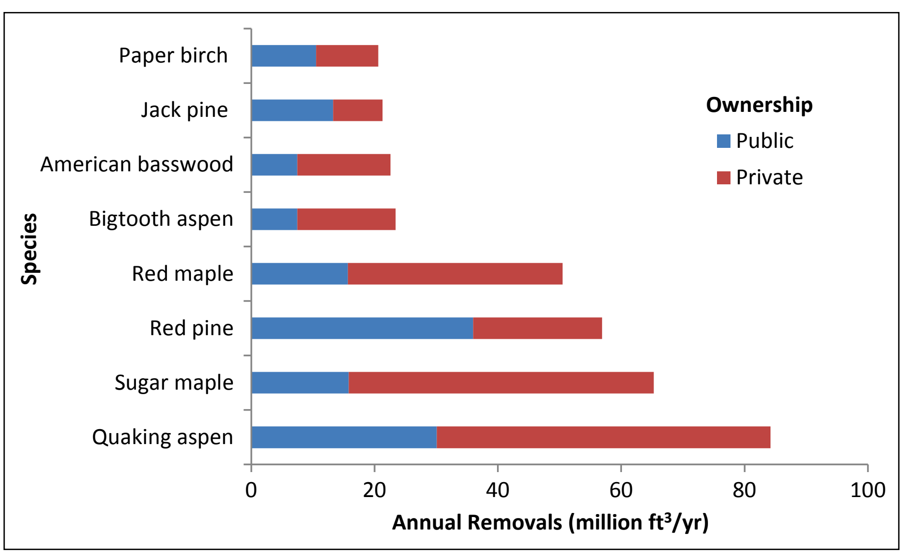

Figure 15.—Average annual removals of growing-stock trees (≥ 5.0 inches d.b.h.) on timberland, in million cubic feet, on timberland, by species and ownership, Lake States ceded territories, 2013. Species listed have the greatest annual removals in the Lake States ceded territories.

CARBON

Background

Collectively, forest ecosystems represent the largest terrestrial carbon sink on earth (Pan et al. 2011). The accumulation of carbon in forests through sequestration helps to mitigate emissions of carbon dioxide to the atmosphere from sources such as forest fires and burning of fossil fuels. FIA does not directly measure forest carbon stocks in the LSCT. Instead, a combination of field measurements and models are used to estimate carbon in tree and nontree pools. Descriptions of the measurements and models used in FIA forest carbon estimation procedures are described in Smith et al. (2006), Woodall et al. (2008, 2011), and Domke et al. (2011, 2013).

What we found

Total carbon density in LSCT forests increased by an average of 0.43 tons per acre (SD= 13.92) since the last inventory period (2004-2008) (Fig. 16). On average, forests in the LSCT gained an estimated 0.08 tons of carbon per acre per year over the last 5 years resulting in annual increases in carbon stocks of more than 16.6 million tons—the equivalent of offsetting the emissions of more than 6.2 billion gallons of gasoline each year (US EIA 2014). The rise in carbon density led to an estimated increase of more than 833 million tons of carbon over all forest land, bringing the total estimated carbon stocks in the LSCT to 3.2 billion tons. The 1842 Treaty area contains most of the forest carbon with an estimated 965 million tons, followed by the 1837 Treaty area with more than 704 million tons, the 1836 Lower Peninsula Treaty area with 550 million tons, the 1854 Treaty area with 535 million tons, and the 1936 Upper Peninsula Treaty area with 464 million tons. Soil organic matter (SOM) represents the largest forest ecosystem carbon pool in the LSCT at more than 2.1 billion tons, followed by live biomass (i.e., live trees and understory) at 702 million tons (Fig. 17).

There are substantial differences in the carbon stocks and stock changes between ceded territories in the region. These differences can be attributed to the size of each territory, the forest type conditions (e.g., stand structure and composition), forest management practices, and land-use changes, among other factors. Carbon stocks in the oak/hickory forest-type group, for example, increased substantially in the 1836 Lower Peninsula, 1837, and 1842 Treaty areas but decreased sharply in the 1836 Upper Peninsula and 1854 Treaty areas (Fig. 17). There are also differences in the distribution of forest carbon stocks by forest type, which are driven by many of the same factors. In the spruce/fir group, for example, about 11 percent (79 million tons) of the estimated forest carbon is in live biomass, whereas in the maple/beech/birch group, 29 percent (274 million tons) is in live biomass. Most of the forest carbon stocks in the LSCT are found in middle-aged stands, 40 to 100 years old (Fig. 18). Early in stand development most of the forest ecosystem carbon is in SOM and belowground tree components. As forest stands mature, the ratio of aboveground to belowground carbon begins to shift and the aboveground components play an increasingly important role in ecosystem carbon storage. This trend continues well into stand development as carbon accumulates in live and dead aboveground components.

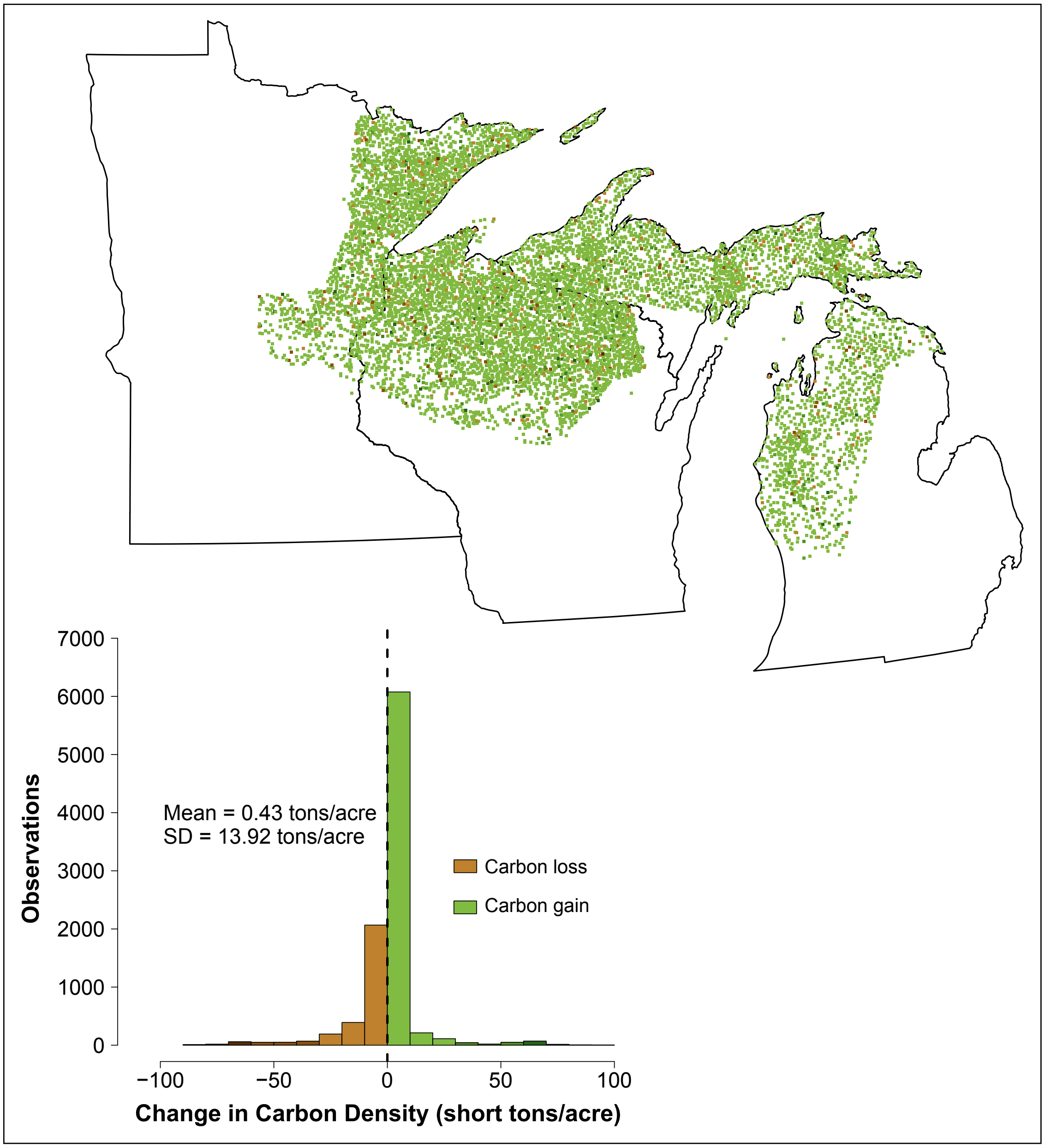

Figure 16.—Distribution of estimated changes in total carbon density (short tons per acre) on forest land in the Lake States ceded territories since the last inventory period, 2008 to 2013.

What this means

Carbon stocks in forests of the LSCT have increased substantially over the last decade, with the largest increases in the oak/hickory (12 percent), other (8 percent), and elm/ash/cottonwood (6 percent) forest-type groups (Fig. 17). Most of the forest carbon in the region is found in middle-aged stands dominated by relatively long-lived species. This suggests that forest carbon stocks will continue to increase in the region as stands mature and accumulate carbon in above and belowground components. Given the age class structure and species composition of LSCT forests there may be opportunities to increase forest carbon stocks. That said, managing for carbon sequestration and/or accumulation in combination with other land management objectives will require careful planning and creative silviculture.

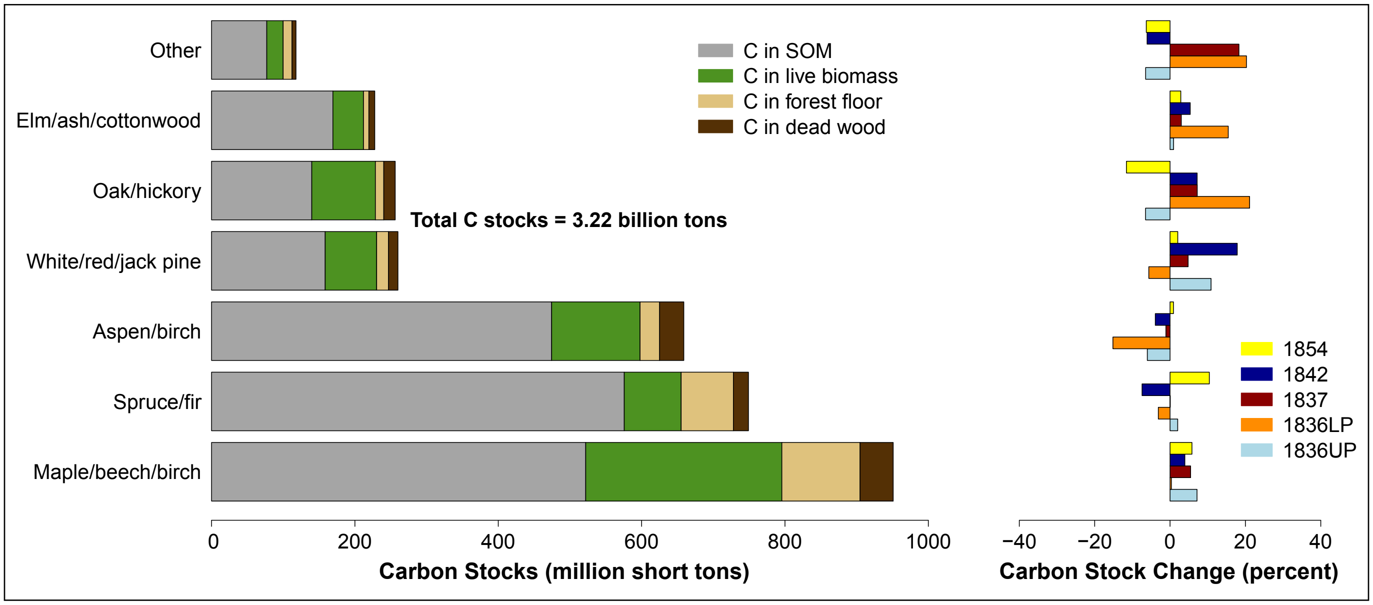

Figure 17.—Estimated carbon stocks on forest land by forest-type group and carbon pool for the 2013 inventory and 10-year percent change in carbon stocks, Lake States ceded territories.

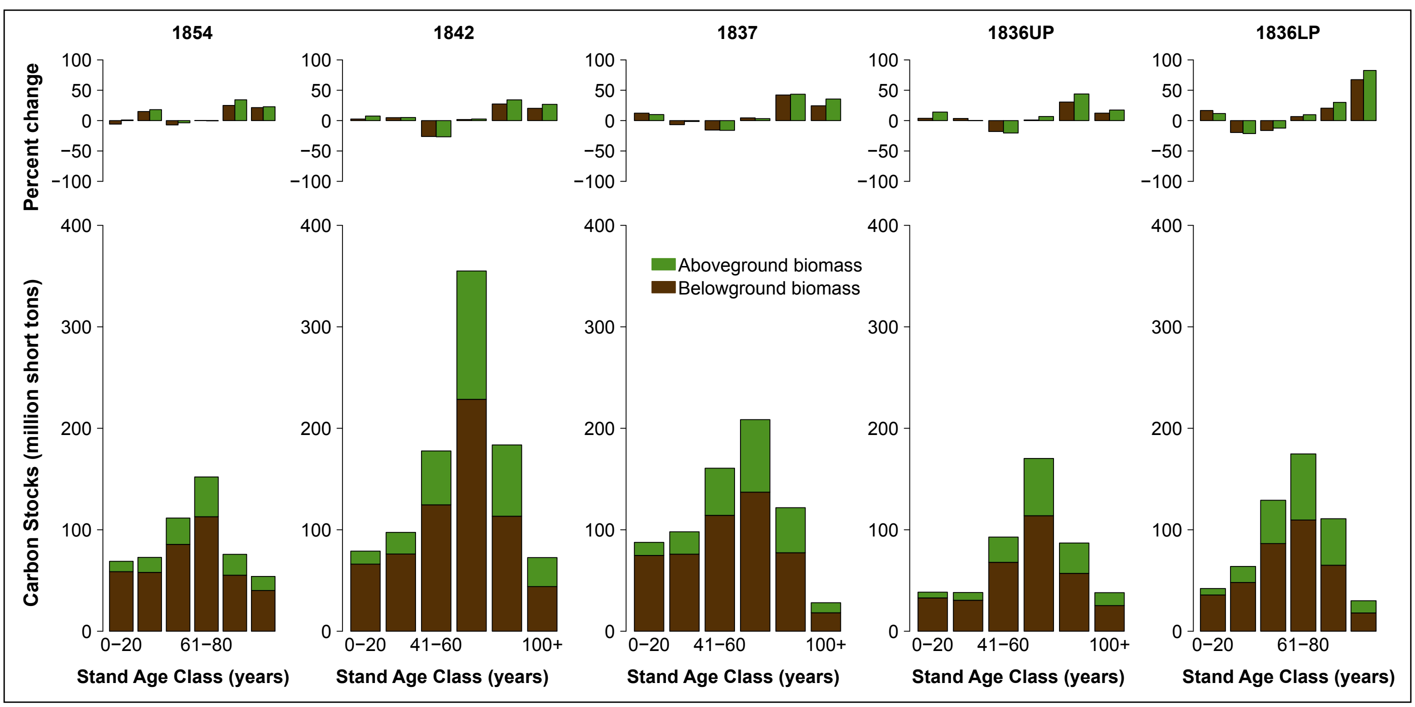

Figure 18.—Estimated aboveground and belowground carbon stocks on forest land by stand-age class for the 2013 inventory and 10-year percent change in carbon stock, Lake States ceded territories.

STANDING DEAD TREES

Background

Standing dead trees, also known as snags, are important indicators of wildlife habitat, structural diversity, past mortality events, stage of stand development, and carbon storage. The abundance of snags, together with decay classes, species, and sizes, define the snag resource across LSCT forests. Between 2005 and 2013, FIA collected data on snags of numerous species and sizes in varying stages of decay.

What we found

The greatest number of snags is found in the 1842 ceded territory, an estimated 148 million in 2005 and increasing to over 167 million snags in 2013 (Fig. 19). The 1854 Treaty area has the second highest abundance of snags with approximately 106 million snags in 2005 increasing to over 120 million in 2013. The other territories have had rather stable abundances of snags over the inventory period—all exceeded an estimated 80 million total snags. Quaking aspen (110 million), balsam fir (93 million), and paper birch (79 million) are the most common snag species in the LSCT (Fig. 20). In terms of decay distribution, nearly 64 percent of all snags in the LSCT are fresh to moderately decayed (decay classes 1, 2, and 3) (Fig. 21A). In terms of the diameter distribution, 77 percent of all snags are less than 10 inches (Fig. 21B). In contrast, there are only an estimated 1 million snags with a diameter greater than 25 inches out of an estimated 575 million snags across the LSCT. The most abundant tree species in terms of snags also had the highest percentages in terms of snags to live trees (Fig. 22). Paper birch has the highest percentage at approximately 38 percent (snag abundance compared to live tree abundance). Tree species with the lowest percentages are American basswood, bur oak, sugar maple, red pine, and boxelder.

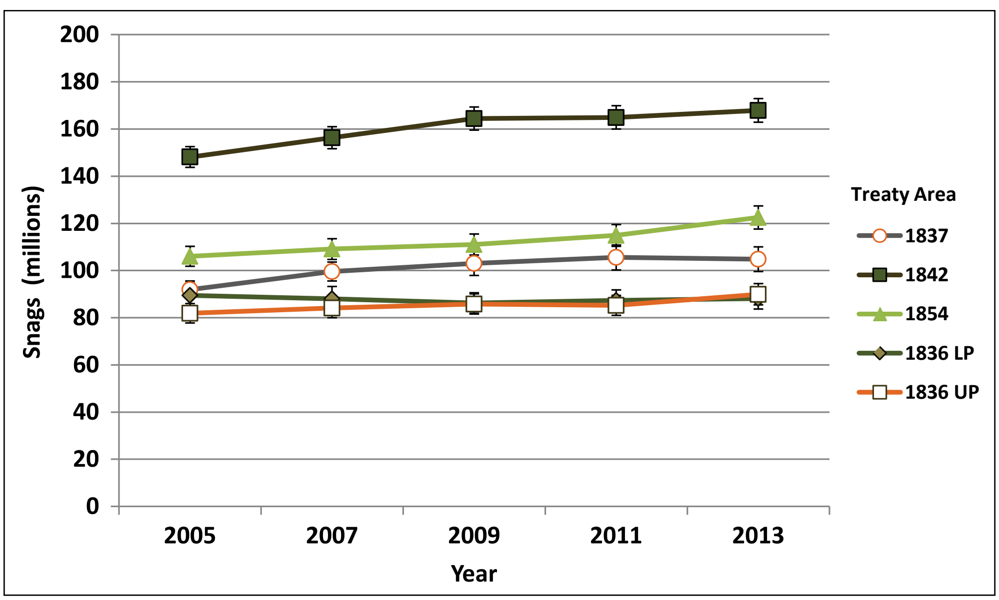

Figure 19.—Snags on forest land in the Lake States ceded territories, by treaty year, 2005-2013. Error bars represent a 68 percent confidence interval around the estimated mean.

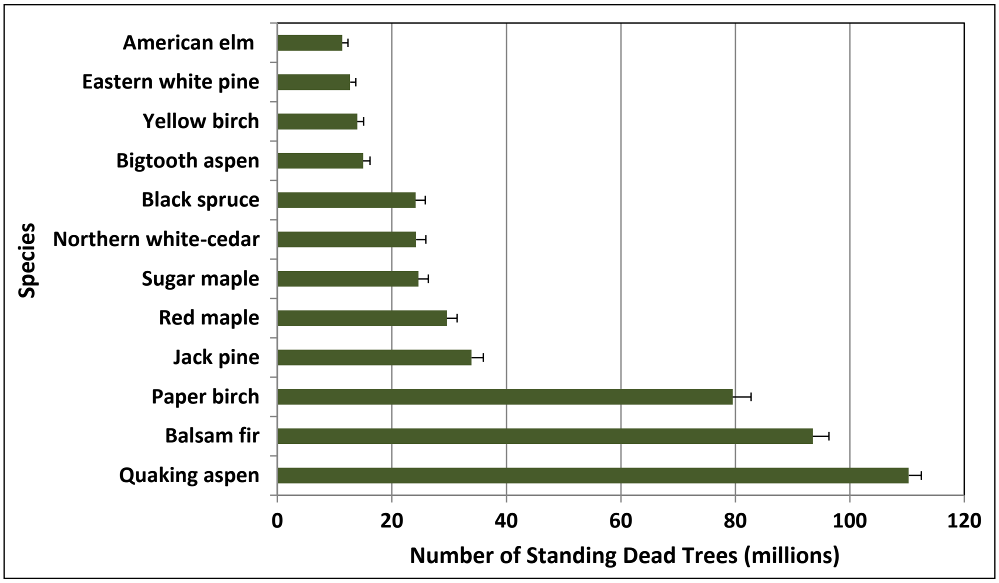

Figure 20.—Abundance of the 12 most common species of snags on forest land, Lake States ceded territories, 2013. Error bars represent a 68 percent confidence interval around the estimated mean.

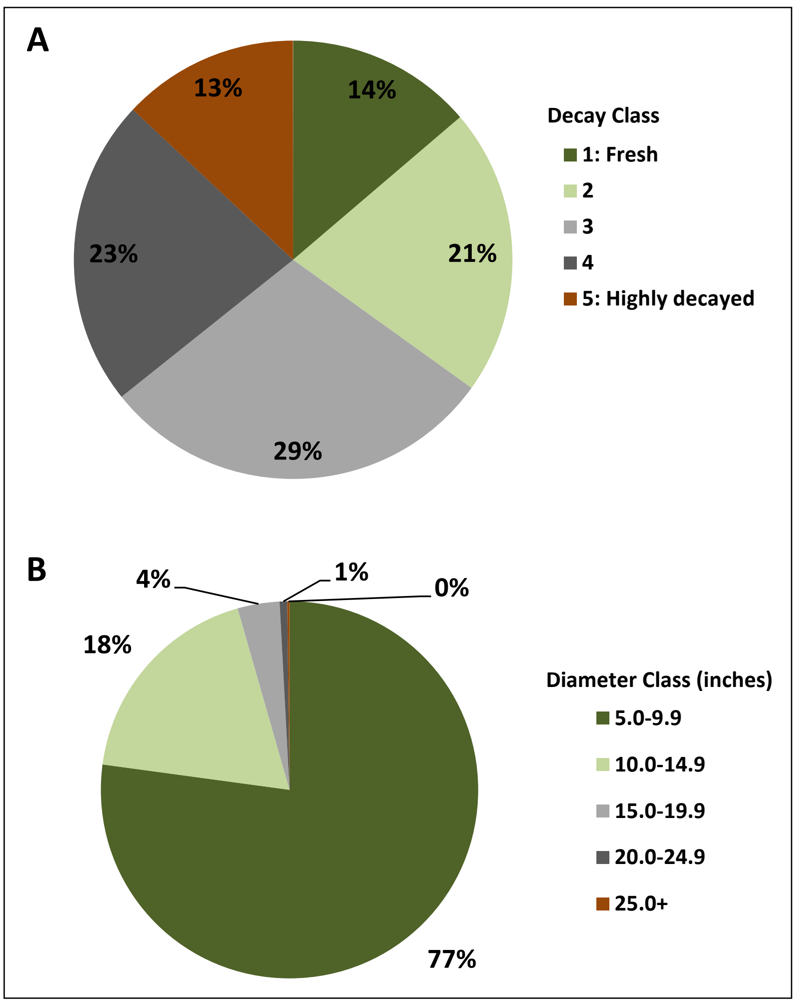

Figure 21.—Distribution of snags on forest land by decay class (A) and diameter class (B), Lake States ceded territories, 2013.

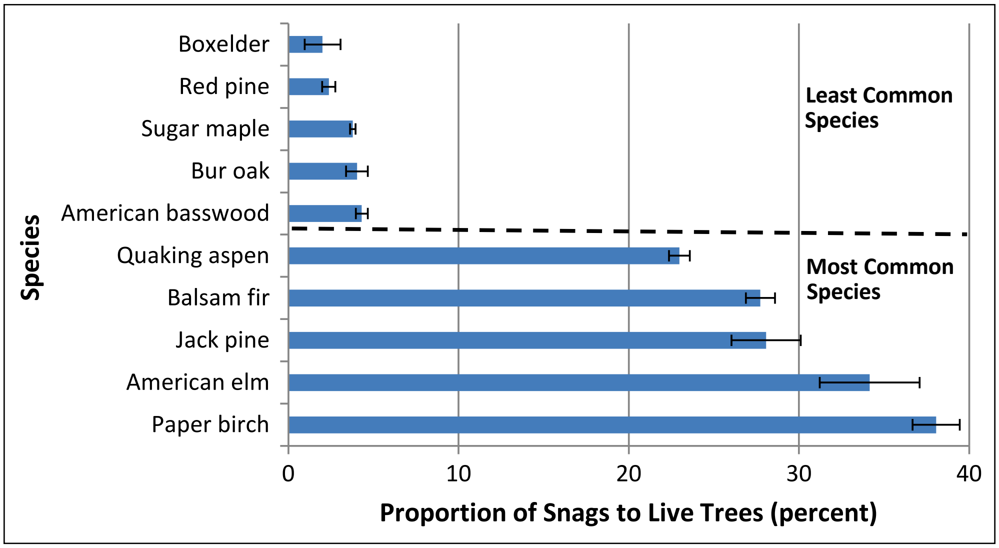

Figure 22.—Most common and least common tree species in terms of percentage of snags to standing live trees, Lake States ceded territories, 2013. Error bars represent a 68 percent confidence interval around the estimated mean. (Note: only tree species with at least 100 live trees sampled on forest land were included in this analysis)

What this means

The abundance and associated attributes of snags across LSCT forest land is a result of the unique disturbance, management, and stand development processes that are occurring across the region. The slight upward trend in snag abundance over time suggests a maturing forest resource, especially with the prominence of small sized snags. An increase in snags can also suggest a health issue, so it is important to continue monitoring the forest. As LSCT forests recover from widespread logging over a century ago, the self-thinning of forests results in the prevalence of mortality of small trees and/or early successional stage species (paper birch and quaking aspen). These normal forest maturation dynamics ensure gap succession (creation of small openings through tree mortality) which facilitates the critical recruitment of tree regeneration in the understory. Given that a preponderance of snags is slightly to moderately decayed, one can assume that this mortality process is still occurring and should expect a greater abundance of snags in the near future. As an indicator of potential sources of snags in the future, the abundance of snags was compared to the associated live tree abundance by species. Both paper birch and American elm have high percentages of snags compared to other tree species. This suggests that these species are still experiencing a long-term mortality event such as Dutch elm disease (*Ophiostoma novo-ulmi*) in the case of American elm. In contrast, tree species that have a very low ratio of snags to live trees suggests that some species, such as basswood, may be expanding their range/prevalence. Overall, results suggest that the abundance of snags may continue to increase across LSCT forests. Additionally, snag abundance of some species (e.g., paper birch) suggest that the composition and structure of LSCT forests will continue to evolve, potentially benefiting wildlife and stand structural diversity at the expense of stand volume production.

FOREST ECONOMICS

Firewood in Bigfork, Minnesota. Photo by Christie L. Kurtz, used with permission.

SAWTIMBER VOLUME AND QUALITY

Background

Sawtimber trees are live trees of commercial species that contain at least one 12-foot or two noncontiguous 8-foot logs that are free of defect. Hardwoods must be at least 11 inches d.b.h. and softwoods must be at least 9 inches d.b.h. to qualify as a sawtimber-sized tree. Sawtimber volume is defined as the net volume of the saw log portion of a tree, measured in board feet (International ¼-inch rule), from a 1 foot stump to the merchantable top (9 inches d.b.h. for hardwoods and 7 inches d.b.h. for softwoods). Estimates of sawtimber volume are used to determine the potential commercial value of wood and to identify the quantity of merchantable wood available.

A system of standards, called tree grades, are used to rate the quality of a tree for producing forest products. While grading specifications vary by species group, tree grade is generally based on tree diameter, the presence or absence of knots, decay, or curvature of the bole, and the length of usable sections in the saw log portion of the tree. Grade 1 is given to the highest quality trees. Softwood sawtimber is valued primarily for dimensional lumber while hardwood sawtimber is valued for the production of other products, such as flooring or furniture stock.

What we found

The net sawtimber volume on all LSCT timberland in 2013 is estimated at more than 112.6 billion board feet, a roughly 9 percent increase over the 2008 estimate of 103 billion board feet. Hardwoods make up nearly 58 percent (65.1 billion board feet) of the total sawtimber volume. Softwood volume is 47.5 billion board feet. One-third of the total sawtimber volume is located in the 1842 Treaty area (Fig. 23). The 1842 Treaty area also contains the largest volume of both hardwood and softwood sawtimber volume. More than 50 percent of sawtimber volume is in trees with diameters between 9.0 and 14.9 inches (Fig. 24). The top five species in sawtimber volume, containing 52 percent of the total, are sugar maple, red pine, eastern white pine, red maple, and northern white-cedar. Thirty-nine percent of the sawtimber volume is in grade 3 trees, while 27 percent was in grade 1 trees (Fig. 25). Most of the grade 1 sawtimber comes from non-pine softwoods such as northern white-cedar, eastern hemlock, white spruce, balsam fir, and black spruce. Sugar maple has the most grade 1 sawtimber trees among hardwoods, with northern red oak, American basswood, and white ash also having substantial amounts.

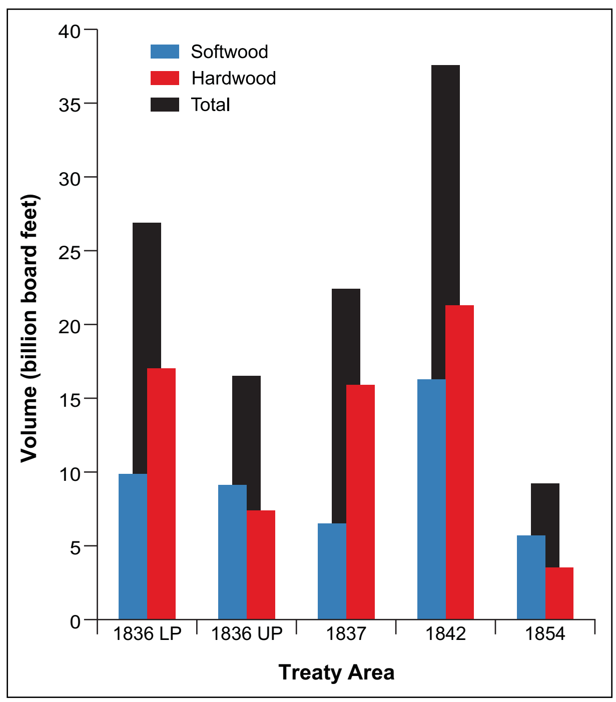

Figure 23.—Sawtimber volume on timberland by treaty area, Lake States ceded territories, 2013.

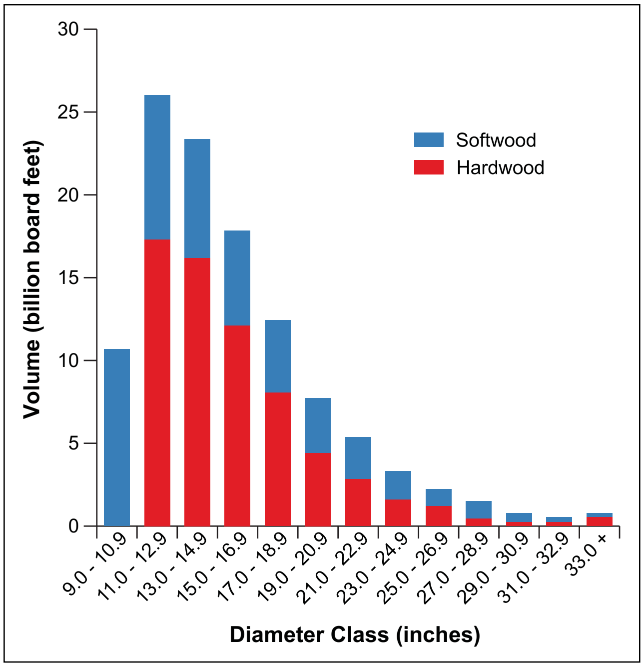

Figure 24.—Sawtimber volume on timberland by diameter class, Lake States ceded territories, 2013.

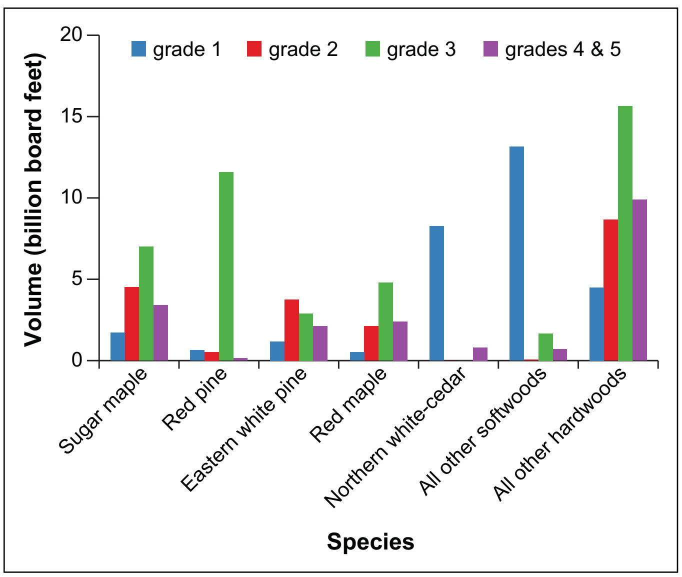

Figure 25.—Sawtimber volume on timberland by tree grade and species, Lake States ceded territories, 2013.

What this means

Total sawtimber volume has been increasing in the LSCT in recent years. Net growth of sawtimber averaged 3.33 billion board feet annually between 2004 and 2008, and averaged 3.31 billion board feet annually between 2009 and 2013. That average annual net growth outpaced the average annual removals for the same time periods (2.8 billion board feet removed per year in 2004-2008, 2.9 billion board feet in 2009-2013). This trend will ensure that the LSCT will provide quality sawtimber from a diverse range of softwood and hardwood species for years to come.

FOREST INDICATORS

Wetland. Photo by Christie L. Kurtz, used with permission.

GROUND FLORA

Background

Ground flora offers many benefits within the forest. It can filter pollutants, curtail erosion, regulate soil temperature, support various wildlife species, sequester carbon, improve air quality, and provide various cultural and spiritual values. Plants are ecological indicators and offer important information on soil fertility, pollution, and disturbance. Assessing plant cover is important to understand forest change and identify species of concern. From 2007 through 2010, forest vegetation data were collected on 239 Phase 3 plots across the LSCT. These plots are a subset of the inventory plots and have a more extensive set of forest health data collected on them during the summer measurement window.

What we found

On the Phase 3 plots, 951 species of plants are found on the LSCT. The 33 most commonly observed species are shown in Table 4. Canada mayflower, often called false (or wild) lily-of-the-valley, is the most frequently observed species, found on 203 plots (84.9 percent). It is a common woodland flower of the boreal forest that has shiny green foliage and often forms carpet-like masses in the understory. Canada mayflower blooms in the spring and yields small red berries. This herbaceous plant has several traditional medicinal uses (Meeker et al. 1993).

Red maple is the second most frequently recorded species and was found on 183 Phase 3 plots (76.6 percent). This species is found throughout the LSCT. It is the most commonly observed tree species on Phase 3 plots where all tree observances (seedling, sapling, pole, and saw log), regardless of height or diameter, are recorded. Red maple has the widest climatic tolerance of all the maples and is thought to thrive on a wider range of soils with varying texture, moisture, pH, and elevation than any other North America forest species. At maturity, red maple grows an average of 60 to 90 feet and 18 to 30 inches in diameter. It seldom lives more than 150 years and is an important food source for white-tailed deer (*Odocoileus virginianus*) in the winter (Walters and Yawny 1990). The extent of red maple has increased throughout eastern North America in the past century. Early land records for the northern hardwood/white pine/hemlock forests of Michigan and Wisconsin indicate that less than 5 percent of surveyed trees were red maple. Now this tree is one of the most abundant and widespread tree species in the eastern United States. Several characteristics have helped red maple spread, such as its ability to sprout vigorously, survive on a wide variety of sites with varying nutrient, light, and moisture availability, reach sexual maturity at a young age, produce a large number of seeds that readily disperse, and minimal germination requirements. It is believed that disturbances, such as logging and land clearing, and the suppression of fires also contributed to the increase in red maple (Abrams 1998). Red maple is also an important species for various cultural uses and the sap is gathered from this tree to make syrup, though the sweetness of sugar maple is the preferred choice (Meeker et al. 1993).

Table 4.—Plant species observed on Phase 3 plots in the Lake States ceded territories, 2007-2010

Common name	Scientific name	Number of plots observed
Canada mayflower	*Maianthemum canadense*	203
Red maple	*Acer rubrum*	183
Starflower	*Trientalis borealis*	182
Balsam fir	*Abies balsamea*	145
Black cherry	*Prunus serotina*	138
Wild sarsaparilla	*Aralia nudicaulis*	135
Pennsylvania sedge	*Carex pensylvanica*	135
Western brackenfern	*Pteridium aquilinum*	133
American red raspberry	*Rubus idaeus*	128
Quaking aspen	*Populus tremuloides*	119
Sugar maple	*Acer saccharum*	115
Paper birch	*Betula papyrifera*	115
Bigleaf aster	*Eurybia macrophylla*	115
Bunchberry dogwood	*Cornus canadensis*	113
Common ladyfern	*Athyrium filix-femina*	108
Common dandelion	*Taraxacum officinale*	107
American fly honeysuckle	*Lonicera canadensis*	99
Bluebead	*Clintonia borealis*	97
Spinulose woodfern	*Dryopteris carthusiana*	97
Chokecherry	*Prunus virginiana*	96
Wood anemone	*Anemone quinquefolia*	91
Beaked hazelnut	*Corylus cornuta*	90
Common serviceberry	*Amelanchier arborea*	90
Northern bush honeysuckle	*Diervilla lonicera*	88
Greater bladder sedge	*Carex intumescens*	83
Northern red oak	*Quercus rubra*	81
Dwarf red blackberry	*Rubus pubescens*	80
Threeleaf goldthread	*Coptis trifolia*	78
Lowbush blueberry	*Vaccinium angustifolium*	78
Sensitive fern	*Onoclea sensibilis*	76
Hophornbeam	*Ostrya virginiana*	73
White spruce	*Picea glauca*	71
Eastern white pine	*Pinus strobus*	71

Starflower is the third most commonly observed species and is found on 182 Phase 3 plots (76.2 percent). This dainty perennial plant is found throughout the boreal forest and can tolerate a wide range of environmental conditions. It is found throughout Wisconsin with highest presence north of the tension zone (Anderson and Loucks 1973), a zone highly fragmented by agriculture, urbanization, and roads. This plant has traditional importance; the roots of starflower are used to attract deer to hunters by mixing them with those of other plants and creating a smoking scent (Meeker et al. 1993).

What this means

The vast array of plants found within the LSCT is an important resource not only for wildlife but also for cultural purposes. It is estimated that there are between 900 and 1,500 vascular plant species in the ceded territories with specific uses recorded for 25 to 40 percent of the flora. This represents the considerable plant knowledge of the Ojibwa. As a sustainable practice, it is important that the abundance of the species of interest is considered and that forest management, land use, and plant harvesting are done in a manner that ensures their survival (Meeker et al. 1993).

INVASIVE PLANT SPECIES

Background

Invasive plant species (IPS) can supplant native species and change plant communities. They are often aggressive colonizers that readily establish from vegetative propagules (e.g., multiflora rose) and/or produce copious amounts of seed (e.g., purple loosestrife). After establishment in an area, some IPS can change the soil chemistry by altering nutrient availability (e.g., black locust, common buckthorn), which can displace native species and support their spread. IPS have spread throughout the United States, costing billions of dollars for inspection, monitoring, and eradication (Pimentel et al. 2005). Gathering IPS data helps individuals and land managers understand the distribution and abundance of these species. In the future, data from remeasured plots will enhance our understanding of how these species have spread, their impact to the forest community, and factors that influence their presence.

FIA has monitored the distribution, spread, and abundance of invasive species on Phase 2 (P2) invasive plots in the LSCT since 2005. The invasive plots are a subsample of the total P2 plots. In 2005 and 2006, the invasive data were collected on all plots year round, whereas from 2007 through 2011, only a 20 percent subsample was collected and only during the summer window. Data from 2007 through 2011 are summarized here and are presented to provide an overview of the IPS found on forested P2 invasive plots.

What we found

FIA monitors 43 invasive plant species and one undifferentiated genus (*Lonicera* spp.)[1] on P2 invasive plots (Table 5). On the 1,502 P2 invasive plots measured in the LSCT, 28 IPS are found. Invasive plants occur fairly homogeneously throughout the region with the exception of the southern part of the region, which has slightly higher presence. Figure 26 shows the number of IPS per plot in the LSCT. There are 396 plots (26.4 percent) with one or more invasive plants present, with most invaded plots having one invasive species present. The highest number of IPS found on a plot is six. Two plots have six IPS, one near the Minnesota/Wisconsin border and a second in the Lower Peninsula of Michigan. One thousand one hundred and six plots (73.6 percent) have no monitored IPS present.

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[1] Hereafter the 43 species and one genus are collectively referred to as “invasive species” or “IPS”. The results reported refer to these 44 selected species.

Table 5.—The 43 invasive plant species and one undifferentiated genus monitored on Phase 2 Invasive plots, 2007 to present

Tree species	**Vine species**
Black locust (*Robinia pseudoacacia*)	English ivy (*Hedera helix*)
Chinaberry (*Melia azedarach*)	Japanese honeysuckle (*Lonicera japonica*)
Norway maple (*Acer platanoides*)	Oriental bittersweet (*Celastrus orbiculatus*)
Russian olive (*Elaeagnus angustifolia*)	
Princesstree (*Paulownia tomentosa*)	**Herbaceous species**
Punktree (*Melaleuca quinquenervia*)	Black swallow-wort (*Cynanchum louiseae*)
Saltcedar (*Tamarix ramosissima*)	Bull thistle (*Cirsium vulgare*)
Siberian elm (*Ulmus pumila*)	Canada thistle (*Cirsium arvense*)
Silktree (*Albizia julibrissin*)	Creeping jenny (*Lysimachia nummularia*)
Tallow tree (*Triadica sebifera*)	Dames rocket (*Hesperis matronalis*)
Tree of heaven (*Ailanthus altissima*)	European swallow-wort (*Cynanchum rossicum*)
	Garlic mustard (*Alliaria petiolata*)
Shrub species	Giant knotweed (*Polygonum sachalinense*)
Amur honeysuckle (*Lonicera maackii*)	Japanese knotweed (*Polygonum cuspidatum*)
Autumn olive (*Elaeagnus umbellata*)	Leafy spurge (*Euphorbia esula*)
Common barberry (*Berberis vulgaris*)	Bohemian knotweed (*Polygonum xbohemicum*)
Common buckthorn (*Rhamnus cathartica*)	Purple loosestrife (*Lythrum salicaria*)
European cranberrybush (*Viburnum opulus*)	Spotted knapweed (*Centaurea stoebe* ssp. *micranthos*)
European privet (*Ligustrum vulgare*)	
Glossy buckthorn (*Frangula alnus*)	**Grass species**
Japanese barberry (*Berberis thunbergii*)	Common reed (*Phragmites australis*)
Japanese meadowsweet (*Spiraea japonica*)	Nepalese browntop (*Microstegium vimineum*)
Morrow’s honeysuckle (*Lonicera morrowii*)	Reed canarygrass (*Phalaris arundinacea*)
Multiflora rose (*Rosa multiflora*)	
Nonnative bush honeysuckles (*Lonicera* spp.)	
Showy fly honeysuckle (*Lonicera xbella*)	
Tatarian honeysuckle (*Lonicera tatarica*)	

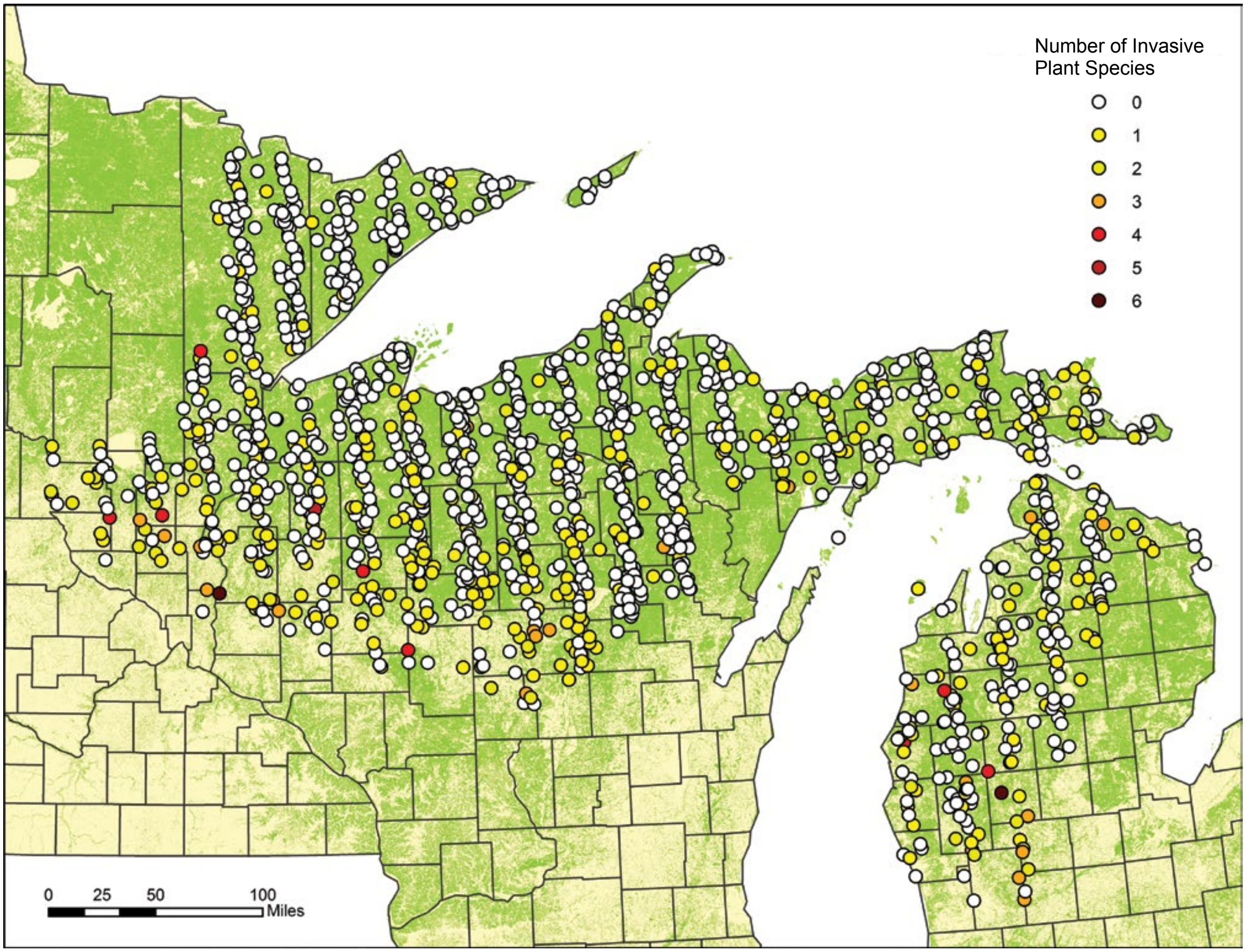

Figure 26.—Number of invasive plant species (IPS) per Phase 2 invasive plot, Lake States ceded territories, 2007-2011. Plot locations are approximate.

Reed canarygrass is the most commonly observed invasive plant (of those monitored), occurring on 175 (11.7 percent) of the P2 invasive plots (Table 6). It is found fairly homogeneously across the LSCT with the exception of very low occurrence in northeastern Minnesota (Fig. 27). Where this invader is observed, it occurs with high average cover[2], 11.4 percent. This problematic species can form dense monocultures that shade out other plant species, reducing species diversity and changing wildlife habitat. Agronomists have bred cultivars of reed canarygrass that adapt to a range of environmental conditions which has increased the use of this noxious graminoid for agriculture and restoration (Kurtz 2013). Even though reed canarygrass is native to the United States, many nonnative cultivars exist, making it difficult to distinguish native plants.

[2] Average cover is based on subplot data and is calculated for only the subplots where the species is present.

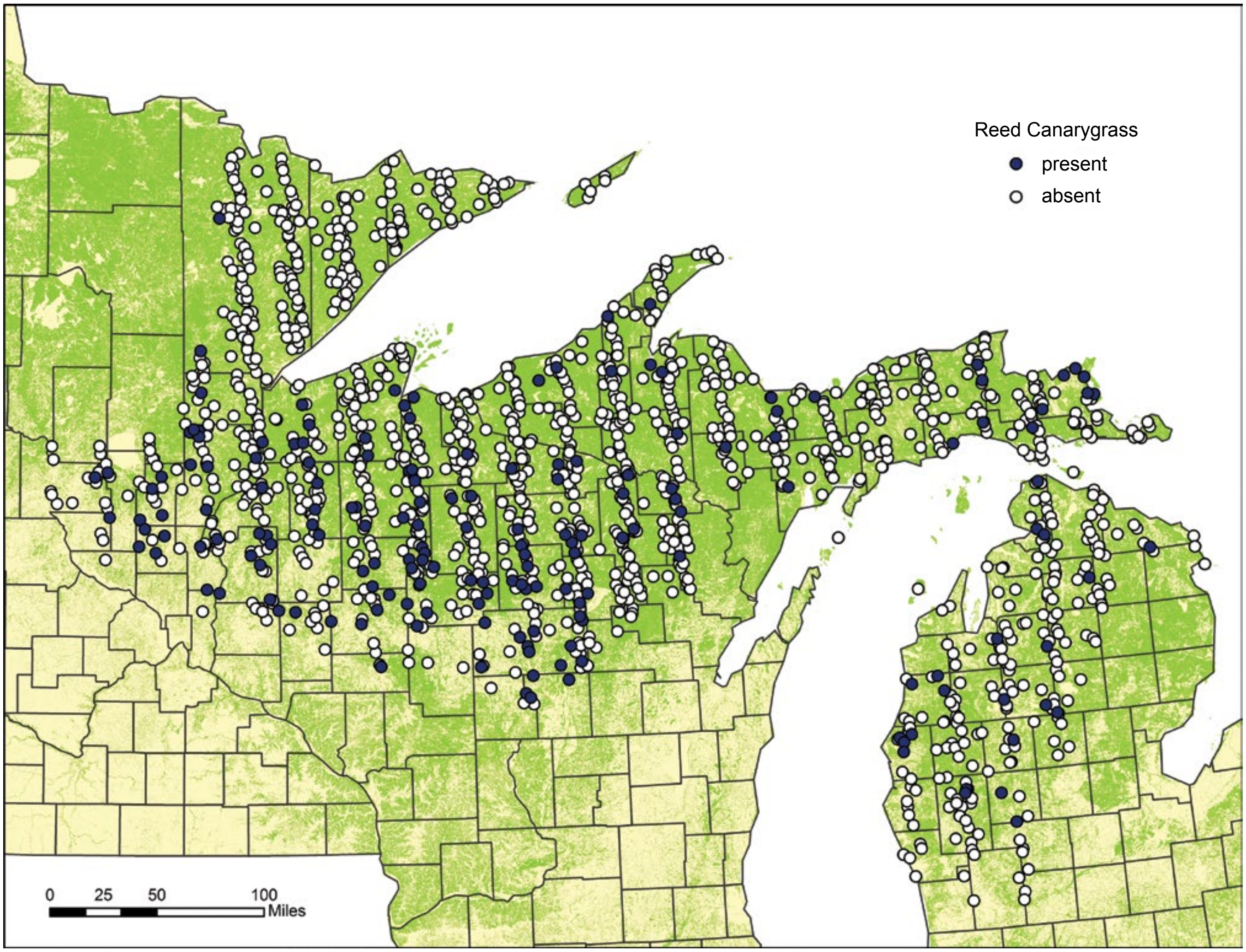

Figure 27.—Reed canarygrass presence on Phase 2 invasive plots, Lake States ceded territories, 2007-2011. Plot locations are approximate.

Canada thistle is the second most commonly observed invasive plant, occurring on 72 P2 invasive plots (4.8 percent) with an average cover of 2.5 percent. It is most frequently observed in an area from central Wisconsin into the Upper Peninsula of Michigan (Fig. 28). This herbaceous perennial forms a vast network of roots that can create extensive colonies (Kaufman and Kaufman 2007). Within these colonies, each Canada thistle plant is capable of producing 5,000 seeds that remain viable for up to 20 years, making restoration difficult and costly (Kurtz 2013). Canada thistle plants have been attributed to millions of dollars in annual crop loss in agricultural areas (Czarapata 2005).

Common buckthorn is the third most commonly observed IPS, occurring on 62 P2 invasive plots (4.1 percent) with an average cover of 6.2 percent. Interest in this shrub dates back to the 1800s when it was introduced from Europe as an ornamental. Its use in urban plantings

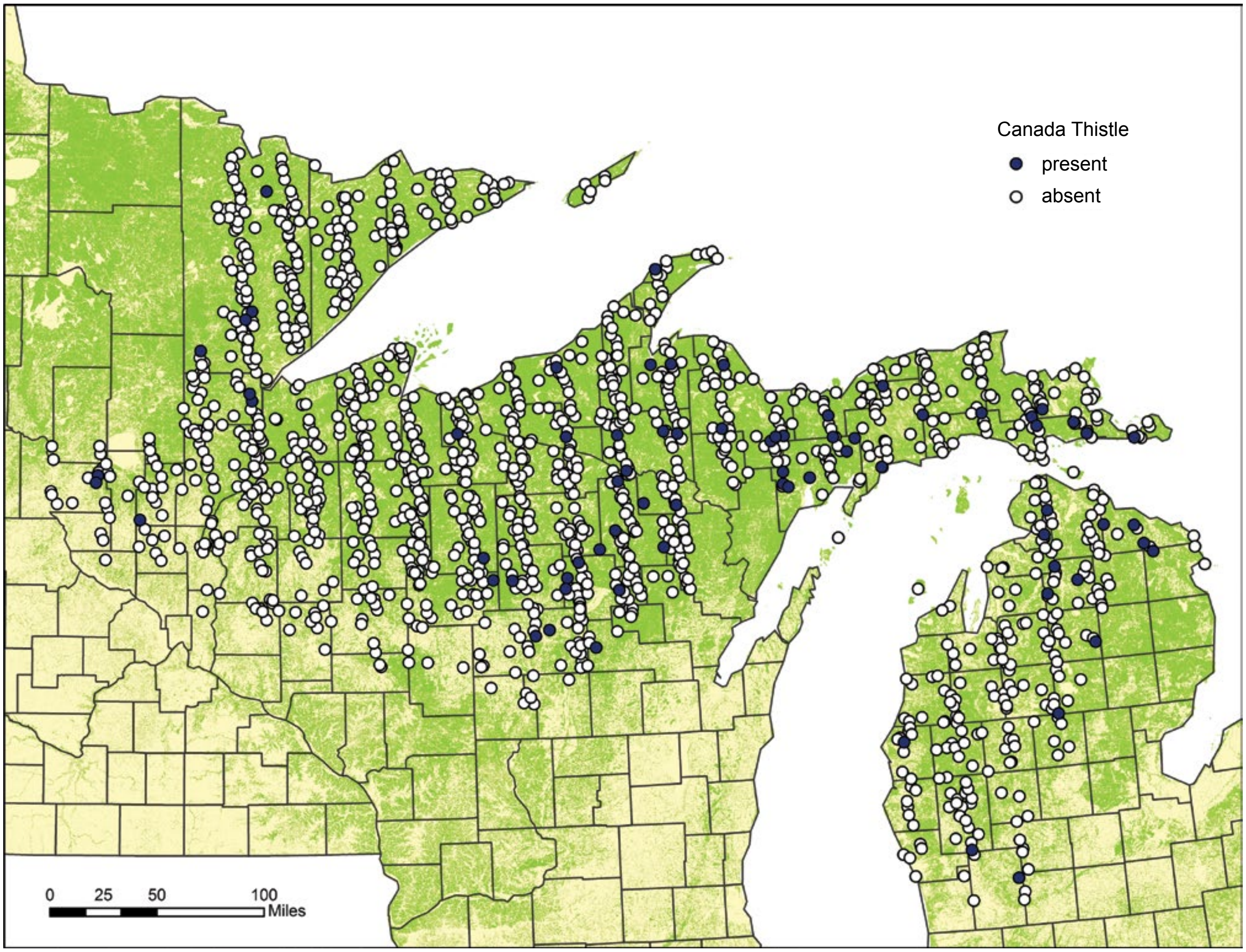

Figure 28.—Canada thistle presence on Phase 2 invasive plots, Lake States ceded territories, 2007-2011. Plot locations are approximate.

and as a windbreak has resulted in its widespread occurrence along the prairie tension zone, an area heavily fragmented by agriculture, roads, and cities. Its high presence in this zone is shown in Figure 29 (see also Kurtz 2013 and Moser et al. 2009). Within the forest, common buckthorn is able to survive under dense canopies, however in deep shade it is less vigorous (Knight et al. 2007). Since this IPS leafs out early, it has a competitive advantage over native plants, quickly shading the forest floor. In Wisconsin, Delanoy and Archibold (2007) found up to 35 percent of its annual carbon is gained before native species leaf out and common buckthorn holds its leaves approximately 58 days longer than similar native shrubs. Once this shrub matures and produces fruit, birds and mammals readily disperse the seeds, facilitating spread.

Data indicate that the presence of invasive plants reduces the numbers of seedlings and saplings, and basal area (Table 6) compared to plots without IPS. Looking at IPS that occurred on 30 or more plots, the data also suggest that invasive plants tend to occur on plots with less forest land (i.e., partially forested plots).

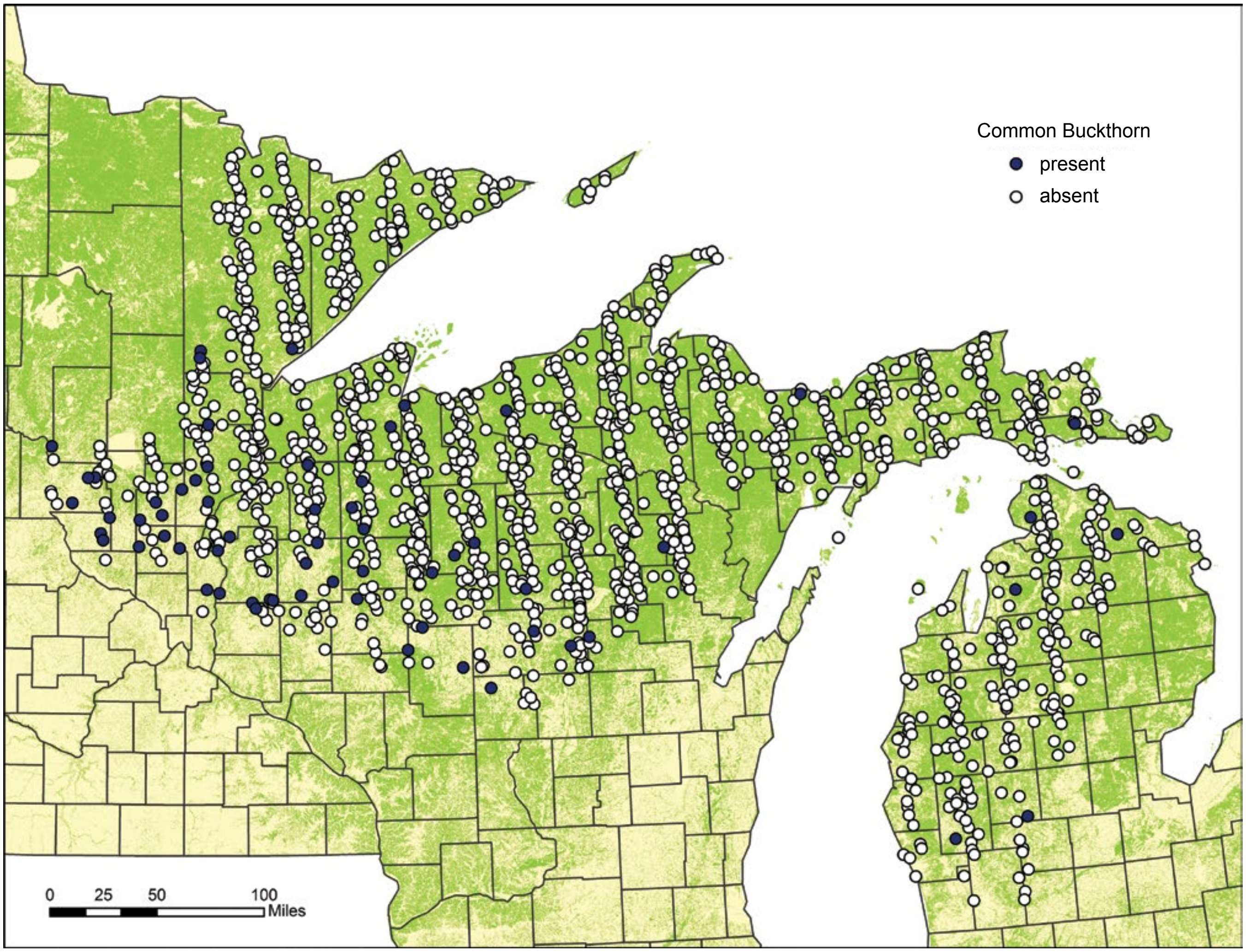

Figure 29.—Common buckthorn presence on Phase 2 invasive plots, Lake States ceded territories, 2007-2011. Plot locations are approximate.

Plot data reveal some key factors that are associated with the presence of these IPS. For example, Table 7 suggests the closer a plot is to a road, the greater the number of invasive plants observed. Table 8 reports the average distance to the nearest road by species and suggests that roads may act as a conduit for spread. This offers valuable information for managers trying to reduce the number of IPS present.

What this means

IPS are capable of forming dense colonies which are detrimental to the diversity of the forest and can cause vast economic and environmental consequences by altering aesthetics, habitat quality, sustainability, and nutrient availability (Kurtz 2013). It is important to monitor the presence and abundance of these species in the region to determine spread. Continued monitoring will offer valuable information for management and help determine risk as well as indicate trends such as the impact of IPS on regeneration and the role of forest characteristics (e.g., soil, precipitation, temperature, site quality) on their presence.

Table 6.—Attributes for plots with and without invasive plant species, Lake States ceded territories, 2007-2011

Invasive species	Number of plots observed	Average proportion forested	Average seedlings per acre	Average saplings per acre	Average basal area ≥1 inch d.b.h. (ft^2/ac)	Average basal area ≥5 inches d.b.h. (ft^2/ac)
Amur honeysuckle	2	100	1,949	412	102	91
Autumn olive	12	80.3	3,126	126	160	155
Black locust	3	100	6,522	150	130	120
Bull thistle	48	94.7	3,037	517	79	61
Canada thistle	72	94.6	3,371	669	87	67
Common barberry	1	72.3	0	0	59	59
Common buckthorn	62	81.4	1,942	376	92	79
Common reed	7	88.9	1,725	563	75	58
Creeping jenny	5	98.5	945	361	75	61
Dames rocket	1	75	1,999	408	112	94
European privet	1	72.3	0	0	59	59
Garlic mustard	3	71.5	3,608	371	96	79
Giant knotweed	1	100	4,048	156	42	40
Glossy buckthorn	32	83.6	2,141	388	96	80
Japanese barberry	7	100	3,780	542	87	66
Japanese honeysuckle	2	93.5	4,535	1,244	70	42
Leafy spurge	2	100	3,711	0	75	75
Morrow's honeysuckle	5	65	3,089	815	84	69
Multiflora rose	8	96.1	2,027	313	83	74
Nonnative bush honeysuckles	34	75.4	2,660	427	94	80
Norway maple	1	72	0	108	49	46
Purple loosestrife	1	100	750	600	29	19
Reed canarygrass	175	90.8	3,129	504	76	61
Russian olive	4	100	2,211	513	80	64
Showy fly honeysuckle	13	80.4	2,744	311	91	79
Siberian elm	3	91.7	1,641	285	66	54
Spotted knapweed	36	86	2,930	371	79	67
Tatarian honeysuckle	11	97.3	2,031	484	92	73
No invasive species present	1,106	93.4	3,582	610	99	79

Table 7.—Average distance to the nearest road for Phase 2 Invasive plots with or without observed invasive plant species in the Lake States ceded territories, 2007-2011

Number of invasive plant species	Number of plots	Average road distance (ft)
0	1,106	3,785
1	292	2,185
2	68	1,992
3	25	1,401
4	8	1,042
5	1	201
6	2	125

Table 8.—Average distance to the nearest road for invasive plant species observed on Phase 2 Invasive plots in the Lake States ceded territories, 2007-2011

Invasive plant species (number of plots observed)	Average road distance (ft)	Standard error
Reed canarygrass (175)	1,828	117
Canada thistle (72)	2,600	380
Common buckthorn (62)	1,571	136
Bull thistle (48)	3,379	374
Spotted knapweed (36)	1,378	292
Nonnative bush honeysuckles (34)	974	139
Glossy buckthorn (32)	1,667	243
Showy fly honeysuckle (13)	631	130
Autumn olive (12)	1,004	243
Tatarian honeysuckle (11)	1,218	273
Multiflora rose (8)	1,473	331
Japanese barberry (7)	982	192
Common reed (7)	1,515	848
Creeping jenny (5)	1,998	569
Morrow’s honeysuckle (5)	6,146	4,815
Russian olive (4)	1,011	362
Garlic mustard (3)	5,568	2,883
Siberian elm (3)	758	434
Black locust (3)	1,607	214
Japanese honeysuckle (2)	7,933	2,628
Leafy spurge (2)	3,960	0
Amur honeysuckle (2)	1,392	642
Purple loosestrife (1)	1,821	0
Norway maple (1)	751	0
Common barberry (1)	50	0
Dames rocket (1)	50	0
European privet (1)	50	0
Giant knotweed (1)	3,960	0

TREE SPECIES OF CULTURAL SIGNIFICANCE

Harvesting birch bark. Photo by Great Lakes Indian Fish and Wildlife Commission staff, used with permission.

INTRODUCTION

LSCT tribes care about the plants of the region and recognize that each is a being and has a spirit. The tribes respect and honor the plant life on this planet, Aki, our Mother the Earth, and express their thankfulness through ceremony, prayer, and offerings (Meeker et al. 1993). It is important that the ecosystems are protected and harvested in a sustainable manner as everything has a role in the web of life.

LSCT tribes have great interest and understanding of the species found in the region. While the focus of this report is to provide information on the forest resources of the region, we provide further information on six tree species of high cultural significance. For each of the six species, the Anishinabe name is provided along with the common and Latin names for these species. The collection of nontimber forest products (NTFPs)[3] from these six species for traditional and other uses is an important part of life to many residents of this region. This collection of products can range from low intensity levels that have no impact on the resource (e.g., collecting a few leaves, needles, or twigs for medicinal use) to large scale personal use or commercial levels (e.g., tapping large numbers of sugar maples for syrup production or clipping balsam boughs for wreath production) that can have significant impacts on current and future resources in a stand. The six species are found in a diverse range of forest sites across the region. The current status of these species and changes in this resource serve as indicators of the overall trends in the forest resources of the region.

The six species of high cultural interest are highlighted in Table 9, which shows the 28 most common tree species (in terms of number of live trees on forest land) with five measures of their relative abundance in the region. The six species of cultural significance (highlighted) are among the 10 most common species in terms of total number of trees 5 inches d.b.h. or larger across the region. At least one of the six species was found growing on nearly 80 percent of all forest stands in the region (see Table 9, last row), an indication of how widespread and important these trees are to the forest ecosystems of this region. Two species (northern white-cedar and black ash) are typically found growing in lowland forests, sugar maple and hophornbeam inhabit mostly upland sites, and the others can be found on a wide range of physiographic sites. Soil nutrient requirements for these species range from relatively low for paper birch and balsam fir to much higher for sugar maple and hophornbeam. There is also a broad range in shade tolerance levels among these species with sugar maple, hophornbeam, and northern white-cedar among the most tolerant species in there region and paper birch and black ash among the least tolerant species.

[3] Nontimber forest products (NTFPs) are useful substances, materials, and/or commodities obtained from forests which do not require harvesting (logging) trees. Some traditional uses of forest trees that require the cutting of a few select trees, such as hophornbeam for lodge poles and black ash for basket making, are also included.

Table 9.—Relative abundance of tree species in the Lake States ceded territories, 2013

Species	Abundance Relative to Total (percent)				
	Seedlings [a]	Saplings [b]	Small trees [c]	Large trees [d]	Forest area [e]
Balsam fir	11.1	19.8	8.1	0.9	47.5
Quaking aspen	7.6	15.9	9.8	8.6	43.2
Red maple	11.1	10.4	12.5	11.6	61.1
Sugar maple	18.7	8.0	12.2	16.4	37.3
Black spruce	3.6	5.7	6.1	0.6	18.6
Northern white-cedar	2.2	3.1	10.1	9.1	15.4
Black ash	4.6	3.8	4.2	1.8	21.7
Paper birch	1.2	2.9	4.5	2.8	31.9
Bigtooth aspen	0.9	2.7	2.4	2.8	13.8
Hophornbeam	3.4	3.0	0.5	0.0	19.8
Tamarack	0.8	2.1	2.4	0.7	9.6
Red pine	0.3	0.8	5.5	7.7	11.5
Jack pine	0.5	1.6	2.7	1.4	8.0
Black cherry	3.5	1.8	1.2	1.0	29.6
White spruce	1.0	1.5	2.3	2.1	21.6
Eastern white pine	1.2	1.3	1.8	4.5	18.5
Northern red oak	1.7	1.0	1.5	6.0	20.9
American basswood	0.4	0.8	1.9	4.6	16.1
Yellow birch	0.6	0.9	1.6	2.6	17.6
American beech	2.7	1.1	0.6	1.2	8.9
Eastern hemlock	0.6	0.7	1.4	4.5	10.6
Mountain maple	3.1	1.2	0.0	0.0	10.6
American hornbeam	1.9	1.2	0.0	0.0	5.6
White ash	4.0	1.0	0.6	1.4	15.1
Balsam poplar	0.6	0.9	0.8	0.5	6.1
Green ash	1.7	0.8	0.8	0.7	9.4
Northern pin oak	0.8	0.8	0.7	1.5	6.1
American elm	0.5	0.8	0.8	0.3	12.7
All others	9.7	4.4	3.0	4.7	51.4
Six species of interest	41.3	40.6	39.7	31.0	79.1

[a] Seedlings – trees less than 1 inch d.b.h. and at least 1 foot tall (hardwood species) or 6 inches tall (softwood species)

[b] Saplings – trees 1.0 to 4.9 inches d.b.h.

[c] Small trees – trees 5.0 to 10.9 inches d.b.h.

[d] Large trees – trees 11 inches d.b.h. or larger

[e] Forest area – Values in this column indicate the percent of the total forest land area where the species indicated was found to occur as live seedlings, saplings, or trees of any size.

The percentage of trees in a size class (the first four columns) all sum to 100 percent as they are expressed as the percent of the total number of trees in that size class. The last column indicates the percentage of the total forest land area where trees of any size were observed in the stand. Since most forest stands have many tree species present, this column sums to a value much greater than 100 percent.

SUGAR MAPLE (ININAATIG)

Acer saccharum

Background

Sugar maple wood is used for flooring, cabinetry, furniture, and other purposes. Sugar maple also has traditional medicinal uses (Meeker et al. 1993). But it is best known for the sweet syrup and sugar made by boiling down its sap. Maple syrup (zhiiwaagamizigan*)*, sugar (ziinzibaakwad), and the activity known as sugaring are so important to the Anishinabe people that one of the 13 moons of the year is named the maple sugar moon (iskigamiige-giizis) (Erickson 2006). Syrup can be produced from many species (e.g., sugar maple, red maple, boxelder, paper birch, and fireweed), but sugar maple has high sugar content and is often preferred to other sources. In addition to its cultural importance, maple syrup production is a significant industry in the ceded territories. In 2013, over 400,000 gallons of maple syrup were produced in the Lake States for sale in the commercial market (National Agricultural Statistics Service 2014). Recent research estimates this is only a portion of the potential commercially viable syrup production from the region (Farrell 2013). Within the LSCT, sugar maple grows on a wide variety of soil, ranging from sands to silty loams, but it does best on well-drained loams. Sugar maple does not grow well on dry, shallow soils and is rarely, if ever, found in swamps (Godman et al. 1990).

What we found

In 2013, 630 million sugar maple trees (5 inches and larger in diameter) were found on timberland in the LSCT. This represents a 10.6 percent increase from 1980 (Table 10). Since 1980, the number of trees increased in all size classes except the smallest (5.0 to 6.9 inches d.b.h.). Sugar maple is distributed unevenly throughout the ceded territories with the greatest abundance located in lands ceded in 1842 and the least in those ceded in 1854 (Fig. 30). Just over one-third of the sugar maple resource is on public forest lands. On both public and private lands, the number of large diameter (≥11 inches) sugar maple has increased (Fig. 31). The number of sugar maple trees 11 inches diameter and greater increased 75.9 percent on private land and by 163.8 percent on public land since 1980.

Table 10.—Number of live sugar maple trees on timberland by diameter class and inventory year, Lake States ceded territories

Diameter class (inches)	1980	1990	2008	2013	Percent change 1980 - 2013
	millions				
5.0-6.9	279.9	317.0	219.9	208.1	-25.6
7.0-8.9	143.6	179.6	164.4	156.2	8.8
9.0-10.9	68.9	105.6	113.3	111.4	61.8
11.0-12.9	33.7	54.7	67.5	71.8	112.8
13.0-14.9	19.3	28.4	34.8	41.4	115.1
15.0-16.9	11.7	16.0	17.2	20.6	75.2
17.0-18.9	6.4	9.0	9.2	11.0	71.5
19.0-20.9	3.2	4.9	4.1	4.8	50.2
21.0-28.9	2.7	4.6	4.2	4.4	60.9
29.0+	0.1	0.2	0.2	0.2	42.9
All sizes	569.6	720.1	634.8	629.9	10.6

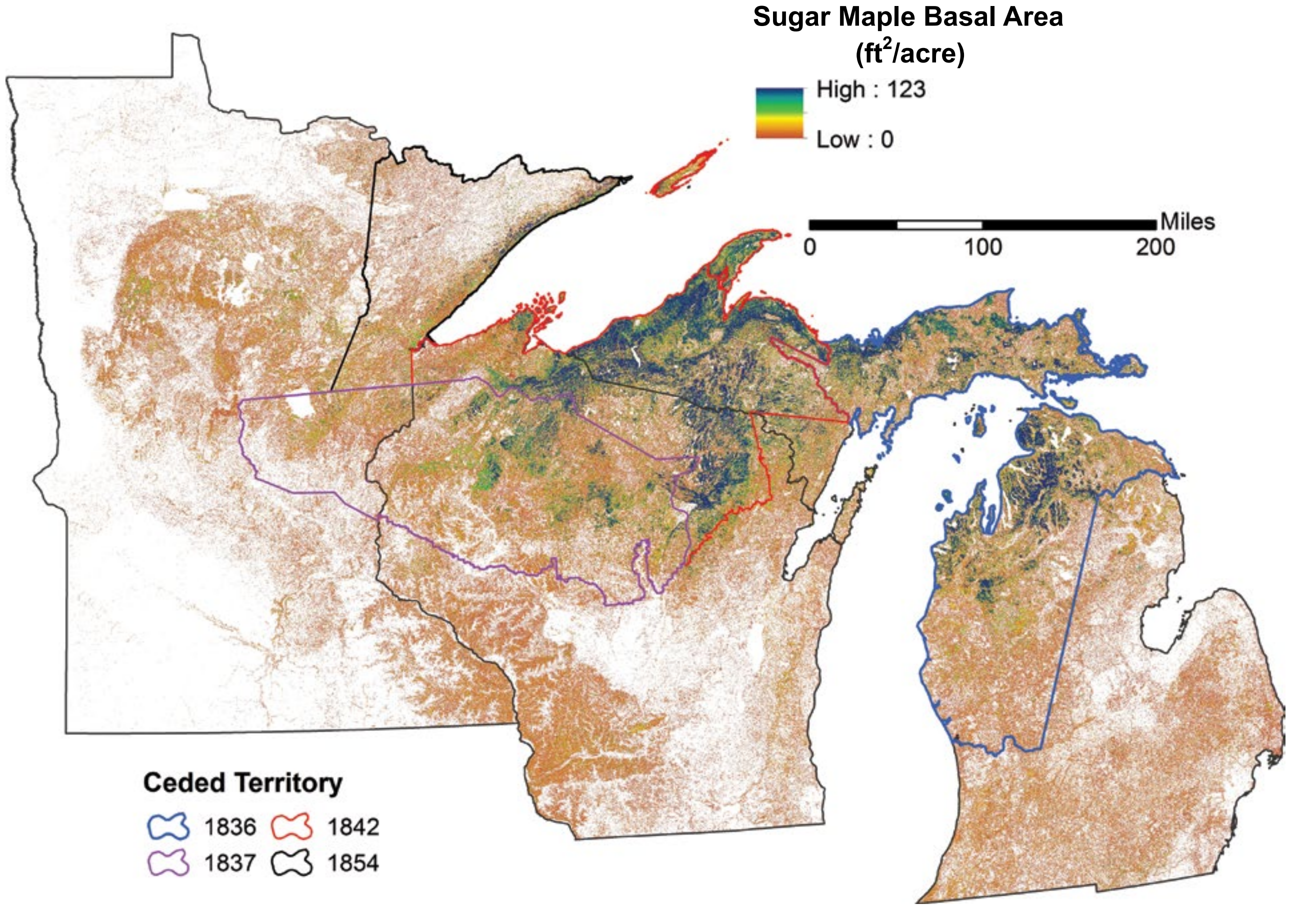

Figure 30.—Sugar maple basal area by treaty area, Lake States ceded territories, 2013 (Wilson et al. 2012, 2013).

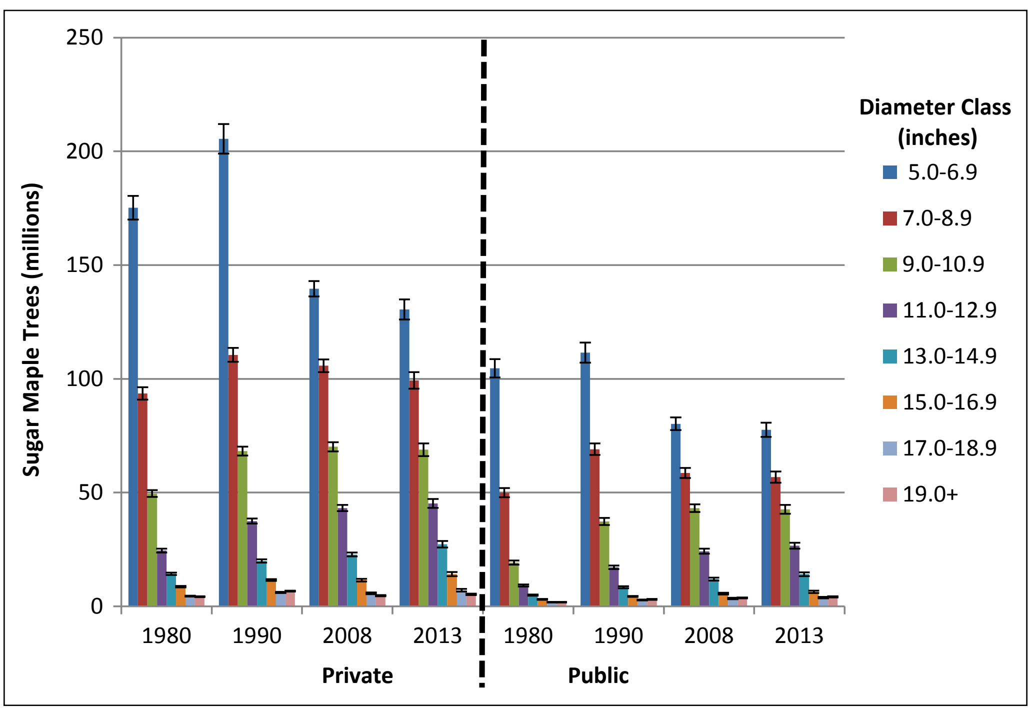

Figure 31.—Number of sugar maple trees on timberland by ownership, diameter class, and inventory year, Lake States ceded territories. Error bars represent a 68 percent confidence interval around the estimated mean.

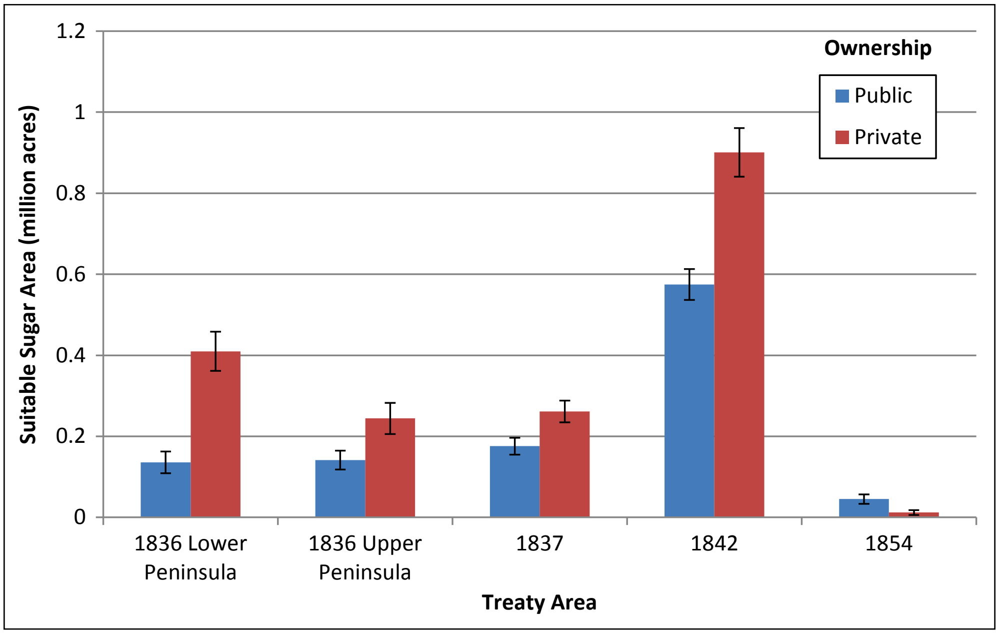

Figure 32.—Area of timberland suitable for maple syrup production by treaty area and ownership, 2013. Error bars represent a 68 percent confidence interval around the estimated mean.

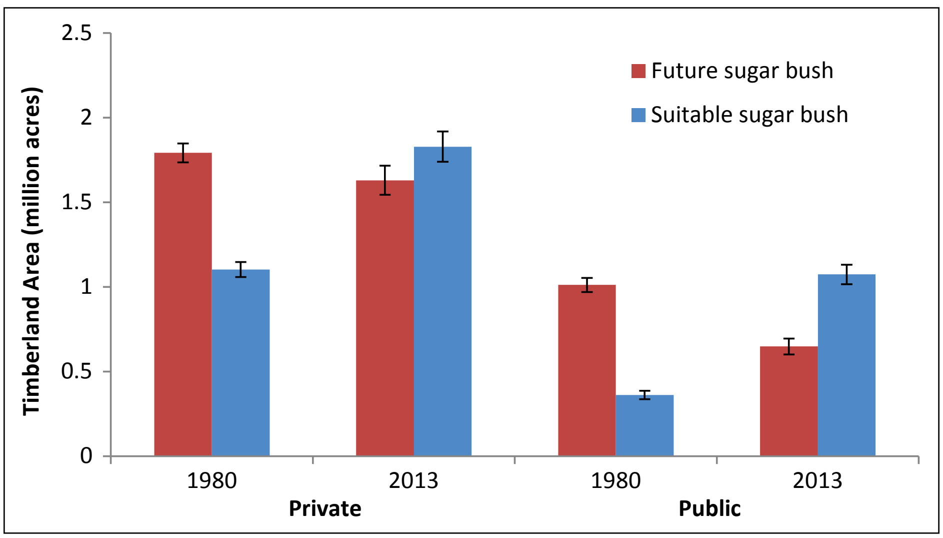

Figure 33.—Area of timberland currently suitable, and potentially suitable in the future, for maple syrup production, by ownership, Lake States ceded territories, 1980 and 2013. Error bars represent a 68 percent confidence interval around the estimated mean.

The highest concentration of forest stands currently suitable for maple syrup production are located in the 1836 Lower Peninsula and 1842 Treaty areas (Fig. 32). The potential for a forest stand to be utilized as a sugar bush for the production of syrup is based on the size and number of sugar maple trees in the stand. Suitable sugar bushes are those that currently meet criteria[4] and potential stands are those that with growth and management will meet these criteria in ten years or less. Suitable sugarbush area has increased between 1980 and 2013 on both public and private lands with nearly three times the area of public timberlands meeting the requirements of suitable and a 66 percent increase on private timberlands (Fig. 33).

[4] Suitable stands are those with a minimum of 25 square feet per acre in sugar maple trees that are 10 inches in diameter or larger and where sugar maple makes up at least one quarter of the total basal area of all species of trees. Future stands are those that do not meet the standard for suitable but have at least 10 square feet per acre in sugar maple trees that are 5 inches in diameter or larger and sugar maple makes up at least one quarter of the total basal area of all species of trees.

Future sugarbush area decreased on both public and private land but this category decreased by much less than the increase in suitable sugarbush, as some areas matured from future stands to suitable. These future stands have the potential to become good sugarbush stands as they mature.

Sugar maple is a primary component of two major forest types, the sugar maple-beech-yellow birch forest type and the hard maple-basswood forest type. In the LSCT, 89 percent of sugar maple trees (5 inches diameter and larger) grow in these two forest types. However sugar maple only comprises 45 percent of the trees in these two forest types, with a number of other species (e.g., red maple, American basswood, yellow birch, balsam fir, eastern hemlock, white ash, green ash, American beech, black cherry, and hophornbeam) making up the rest of the forest. The management of these two forest types, primarily through timber harvesting practices, has a major impact on the sugar maple resource. Over the 15 year period (1999-2013), harvesting rates (frequency of timber harvesting) in these two forest types differed substantially between public and private timberlands. In this period, harvesting on private timberlands occurred at an annual rate of 4.6 percent of the total area. Public timberlands were harvested at an annual rate of 2.3 percent, half the rate seen on private lands. The intensity of the harvest was nearly identical for both ownerships—an average of 33 percent of the total standing volume of all trees was cut. And likewise, the harvesting intensity of sugar maple on both ownerships was 29 percent. The intensity of harvesting other species is not statistically different (36 percent on public lands versus 38 percent on private lands), suggesting that both owner types may be electing to harvest other species and to leave more sugar maple for future growth.

On sugar maple-beech-yellow birch and hard maple-basswood forest types, where harvesting of any species took place, public timberlands have an average standing volume of 2,100 cubic feet per acre, about 12 percent greater than the 1,900 cubic feet per acre observed on private timberlands that were harvested. For these two forest types, the ratio of net growth to removals of live trees is 1.02 for private lands and 1.65 for public lands across all timberlands in the LSCT. This indicates an overall balance between growth and harvesting is occurring on private lands and an increasing resource on public lands.

What this means

Our analysis suggests good potential for future maple sugaring on LSCT lands and an increase in the sugar maple resource on public lands. In 2002 GLIFWC staff, working with elders from member tribes, identified a number of potential sugarbushes on national forest lands in the ceded territories in addition to stands on tribal lands (Danielsen 2002a). This extends opportunities for sugaring off reservation lands.

Optimal forest lands for sugaring are considerably less common in the lands ceded in 1837 and 1854, as well as the eastern half of the Upper Peninsula lands covered by the 1836 Treaty. Sugarers in these territories may have to travel further to gain access to a sugarbush if their goal is to produce syrup at volumes considered suitable for commercial sale. When looking for sugar camp sites, the potential forest types will vary between treaty areas.

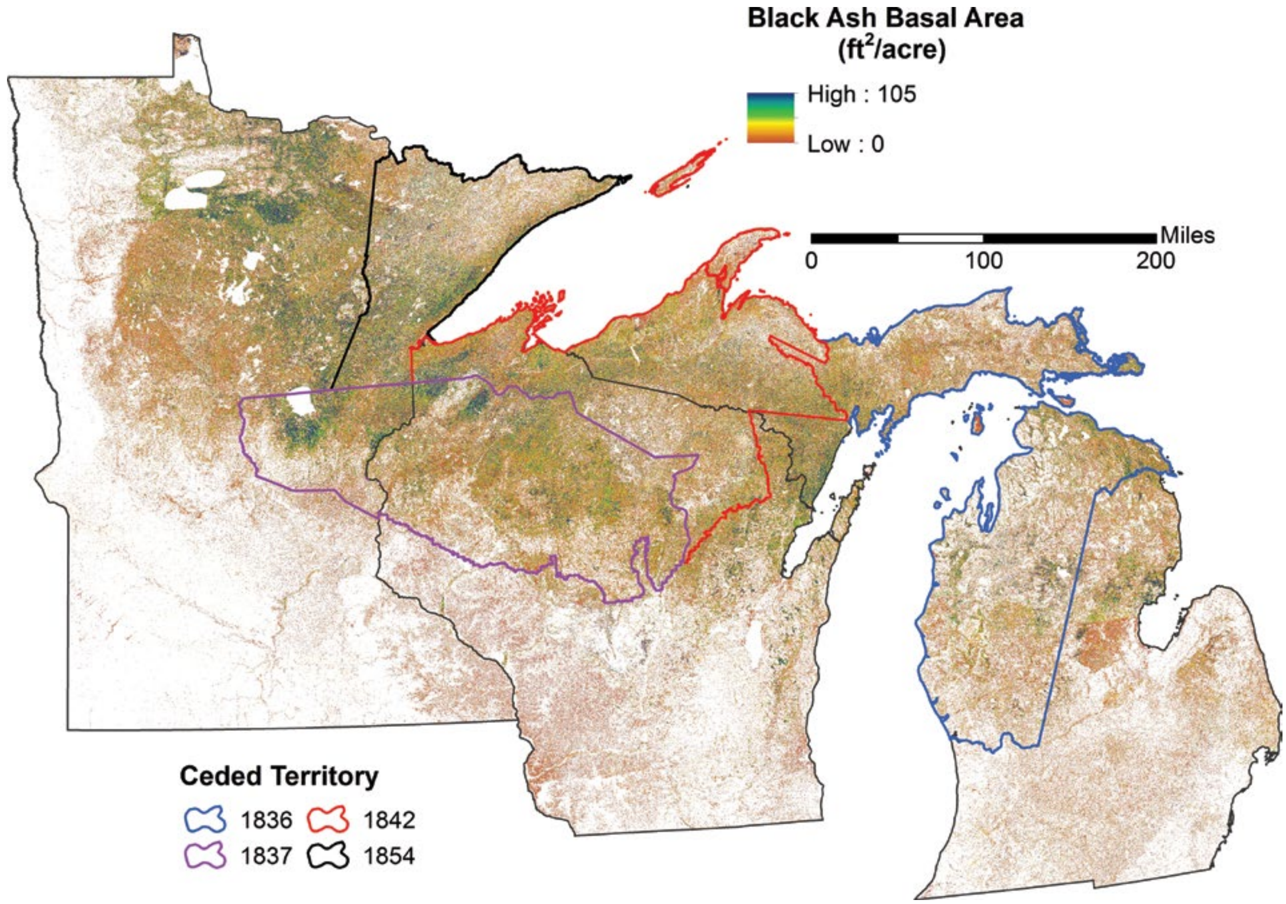

Figure 34.—Black ash basal area by treaty area, Lake States ceded territories, 2013 (Wilson et al. 2012, 2013).

BLACK ASH (WIISAGAAK)

Fraxinus nigra

Background

Black ash is found throughout the northern portion of eastern North America in areas with high water tables such as wetlands, bogs, along streams, and poorly drained soils (Wright and Rauscher 1990). It is a slow growing and relatively shade-intolerant species. Black ash is an important species of the black ash-American elm-red maple forest type and is commonly found in association with the northern white-cedar forest type, as well as with speckled alder, red osier dogwood, bog laurel, Labrador tea, willow, small cranberry, and common winterberry (Wright and Rauscher 1990). Black ash is used for many purposes including basket making. It also provides food for wildlife and browse for deer and moose. All ash species throughout the region, including black ash, are threatened by the emerald ash borer (EAB) (Garske 2013).

What we found

Black ash is found throughout the LSCT (Fig. 34). The forest type where black ash is most prevalent is in the elm-ash-cottonwood type followed by the maple-beech-birch type (Fig. 35). Black ash is also found frequently in the spruce-fir forest types in all treaty areas. In the 1837 treaty area, some black ash is found in the oak-hickory forest type. It is also found in the aspen-birch forest types throughout the LSCT.

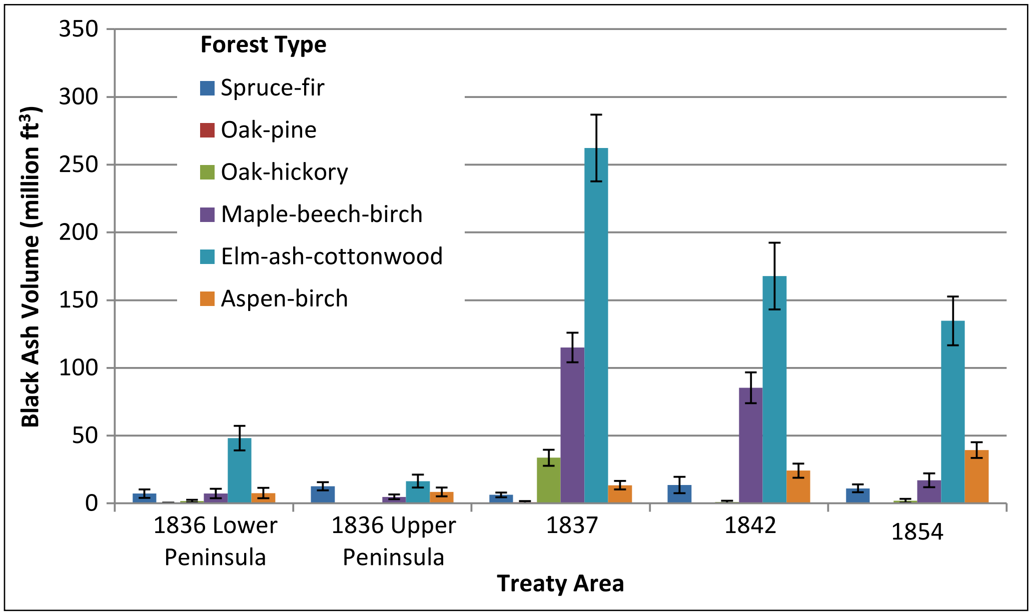

Figure 35.—Volume of live black ash trees on timberland by forest type and treaty area, 2013. Error bars represent a 68 percent confidence interval around the estimated mean.

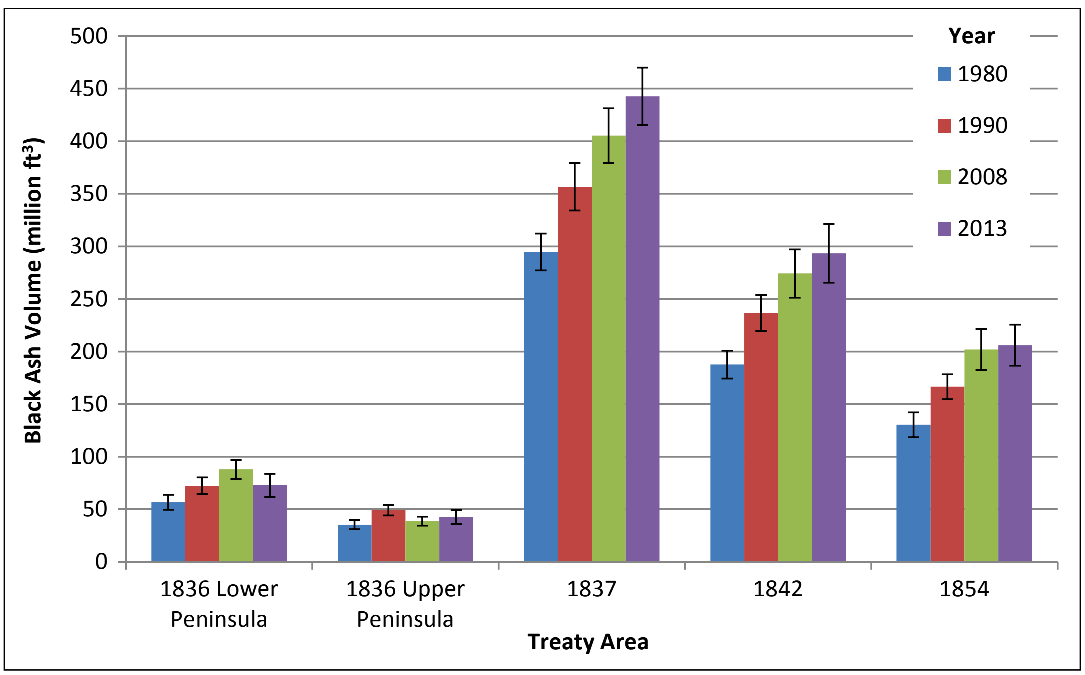

Figure 36.—Volume of live black ash trees on timberland by inventory year and treaty area, 2013. Error bars represent a 68 percent confidence interval around the estimated mean.

The 1837 Treaty area contains the largest volume of black ash trees followed by the 1842 and 1854 Treaty areas (Fig. 36). The 1836 Treaty areas has the least amount of ash volume. Most of the volume occurs in trees that are in the 5.0 to 10.9 inch categories in each treaty area. From 1980 to 2013, volume has generally increased for each diameter class. In other words, there has been growth within or recruitment into each diameter class.

Black ash resources appear to be stable and even increasing in volume over the measurement periods within the ceded territories, however EAB is expected to increase mortality within the LSCT. Ash mortality in the 11 counties in southeast Michigan, where

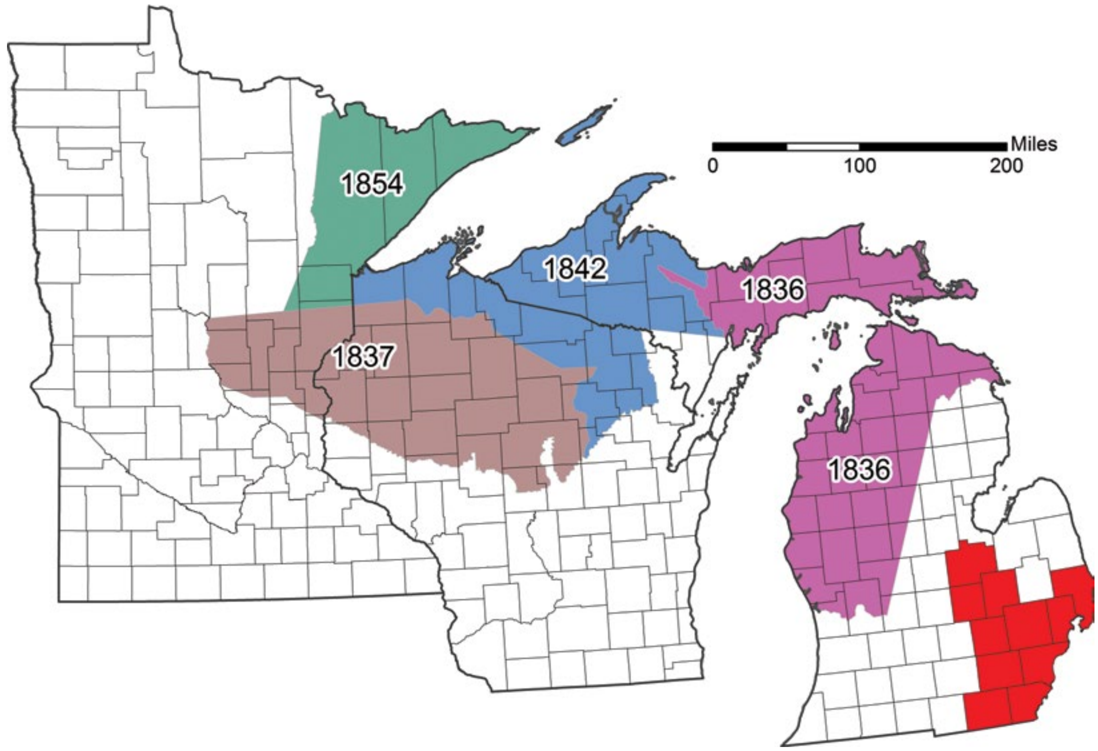

Figure 37.—Eleven southeast Michigan counties (in red) where emerald ash borer was first detected and where mortality rates of over 14 percent per year were observed in 2013.

EAB was first discovered, may serve as an indication of what may happen to ash resources in the ceded territories (Fig. 37). The 11 county area has more urban, agricultural, and other nonforest lands, but the mortality that has been observed in this area is expected in the forests of the LSCT as the EAB becomes established in these forests. Between 2005 and 2007 ash mortality rates in the 11 county area were already around 4 percent per year. Black ash shows a dramatic increase in mortality starting in the 2009 sampling year when mortality was just under 6 percent per year. As the EAB infestation became acute in the 11 county area, the mortality rates increased dramatically to around 8.5 and 14.6 percent per year in 2011 and 2013, respectively (Fig. 38). To put these figures into perspective, a forest stand with mortality rates of 10 percent per year would lose about 40 percent of the trees in around 5 years and 70 percent in 10 years. Lands outside of the ceded territories in Michigan's Lower Peninsula show increasing ash mortality in 2013. Only in the 1836 Lower Peninsula Treaty area—the closest LSCT area to the initial EAB outbreak—did ash mortality increase in 2013; no increase in ash mortality was observed in the other ceded territories.

What this means

Trends suggest that black ash is stable and growing in terms of volume throughout the ceded territories. These trends, however, are not expected to continue due to increased ash mortality associated with the emerald ash borer. EAB infects and kills all species of ash found in the ceded territories. It is expected that as EAB moves into the unaffected areas of the ceded territories, ash mortality will increase following mortality trends similar to the 11 county area where EAB was first discovered. These trends will have a negative impact on

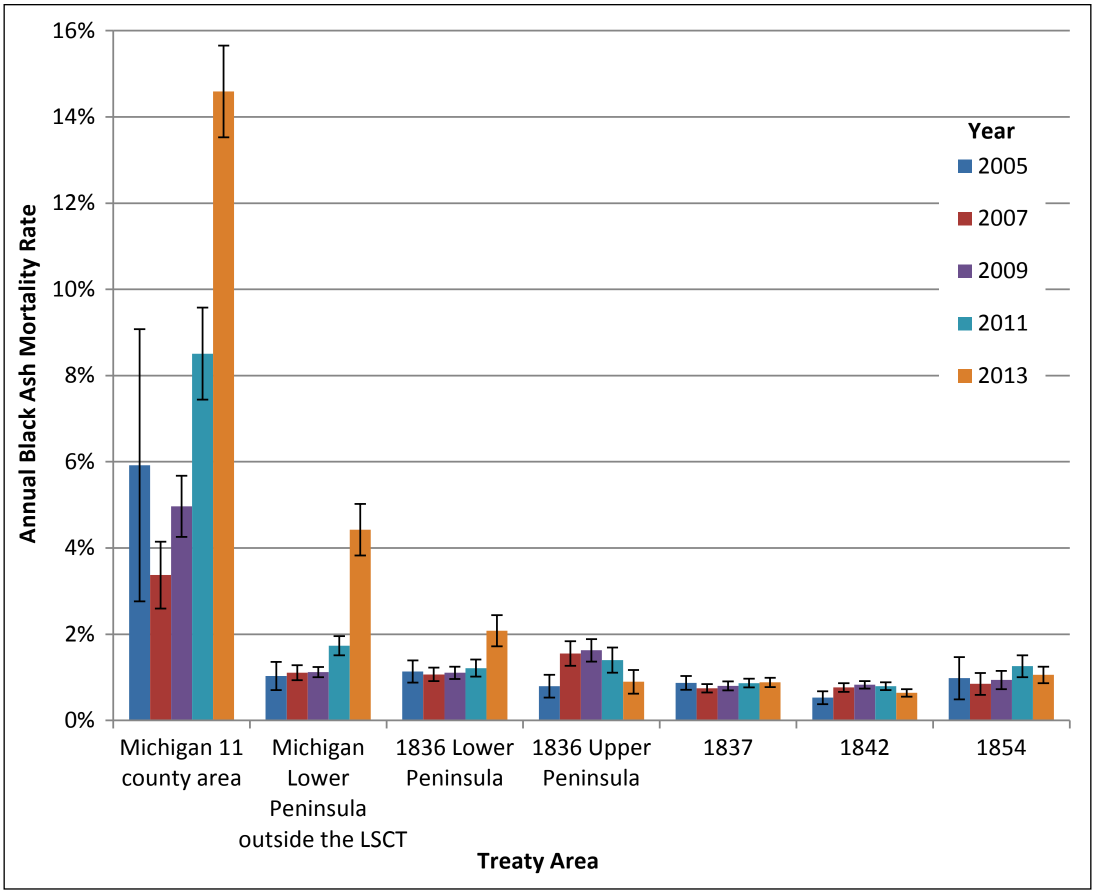

Figure 38.—Average annual mortality rates (percent mortality per year) of black ash, 2005-2013, for the five ceded territories and rest of Michigan's Lower Peninsula (LP). The 11-county area of southeast Michigan is the location where emerald ash borer was first detected (see Fig. 36). Michigan LP outside the Lake States ceded territories refers to the portion of the LP that is not part of the 11-county area or the 1836 treaty area. Error bars represent a 68 percent confidence interval around the estimated mean.

black ash availability. While mortality increases greatly once EAB is established in an area, research conducted with American Indian basket makers indicates it is possible to submerge infected ash logs for future use (Poland et al. 2005, 2011). It also suggests that ash mortality could be less severe in northern Minnesota and a small portion of northwestern Wisconsin due to colder winter temperatures limiting EAB survival (DeSantis et al. 2013). However winter low temperature trends have been increasing in the same region and projections forecast continued higher winter temperatures (Hayhoe et al. 2010). The interaction among EAB, ash mortality, and climate change are unknown at this time.

PAPER BIRCH (WHITE BIRCH; WIIGWAAS)

Betula papyrifera

Background

Paper birch grows throughout the ceded territories and can be found on any soil and topographic situation ranging from rocky outcrops of the Canadian Shield to flat poorly drained swamps. It grows best, as measured by volume over time, on deeper well-drained to moderately well-drained Spodosol, Inceptisols, and Entisols that are common to the glacial deposits of the region (Safford et al. 1990). It is a relatively short-lived species that matures in 60 to 70 years and seldom lives beyond 140 years. In this region it often forms nearly pure stands following major stand disturbances such as fire or logging, usually only lasts for one generation, and is replaced by more shade tolerant trees as stands mature in the absence of a major disturbance.

Paper birch is an important species for the timber industry and is harvested for both the pulpwood and sawtimber markets. In addition, the white bark of the paper birch is gathered for a variety of uses and is an important material in water transportation, shelter, and food storage for the Ojibwe. Canoes (jiiman), baskets (makak), winnowing trays (nooshkaachinaagan), and buckets (negwaakwaanan) are among the many items that are made from the bark that is harvested from live standing trees typically in late June and early July. When gathered using proper techniques, the bark can be harvested from a live tree with little or no harm to the tree, but improper methods can result in damage or mortality. Birch bark has many characteristics that vary substantially from tree to tree and determine its suitability for various uses. A tree that has bark suitable for canoe building may not be suitable for baskets. It is important to gatherers that large numbers of birch are available for consideration when searching for bark to harvest. In recent years, harvesters have reported shortages of birch with many dead or dying trees in areas where they have traditionally gathered bark.

What we found

Paper birch is found across the entire region (Fig. 39), although it is most abundant in the "Arrowhead" region of northeastern Minnesota, the location of lands ceded as a result of the 1854 Treaty (Fig. 40). Across the entire region, paper birch has decreased dramatically in both total numbers and as a percentage of the total population of trees. Paper birch is now about one half of what it was in 1980 for all treaty areas (Fig. 41). In 1980 paper birch accounted for 13.9 percent of all live trees on timberlands in the 1854 Treaty area, but only 6.7 percent of the trees in 2013. Considering the number of trees 9 inches d.b.h. and larger, the decrease is less drastic. Figure 41 shows the trend in total number of paper birch trees 9 inches diameter and larger (those typically used for bark harvesters) and all of the treaty areas have a 10 percent (1836 Upper Peninsula Treaty area) to 38 percent reduction (1842 Treaty area) between 1980 and 2013.

What this means

Paper birch is decreasing in abundance across the region, a trend that will likely continue in the near future. FIA plot data was used to classify stands as large diameter stands (at least 10 paper birch trees per acre, 10 inches d.b.h or larger) and small diameter stands (at least 50 paper birch trees per acre, 5 inches d.b.h. or larger). The area covered by stands with large diameter birch, where bark and timber products are harvested, has decreased by 18 percent between 1980 and 2013 (Fig. 42). The area covered by small diameter stands, which can be expected to grow into large diameter stands and provide a future resource, has decreased by 75 percent over the same period.

The reduction in birch reflects changes in land management and forest succession over the past 50-plus years. Increased wild fire suppression, fewer and smaller clear cuts, and increases in management for multi-aged stands all contribute to less regeneration of this pioneer species. The presence and vigor of paper birch should be closely monitored.

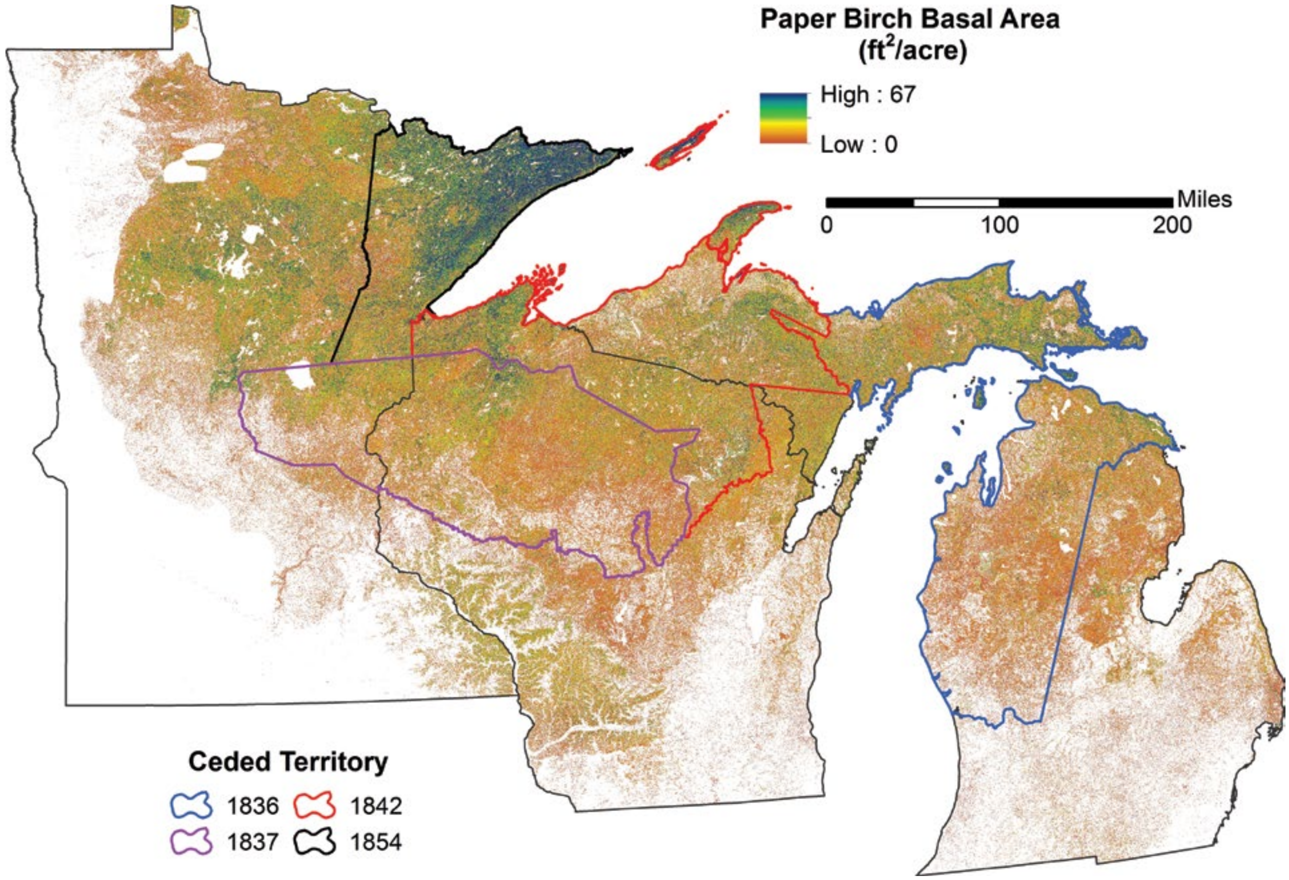

Figure 39.—Paper birch basal area by treaty area, Lake States ceded territories, 2013 (Wilson et al. 2012, 2013).

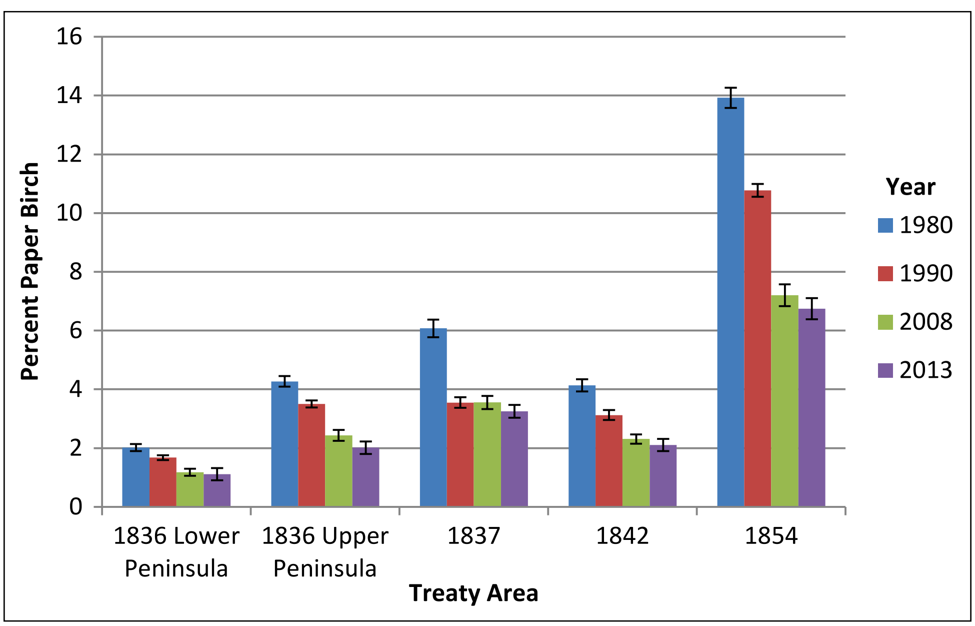

Figure 40.—Paper birch abundance as a percent of all live trees 5 inches d.b.h. and larger on timberland, by inventory year and Lake States ceded territories treaty area. Error bars represent a 68 percent confidence interval around the estimated mean.

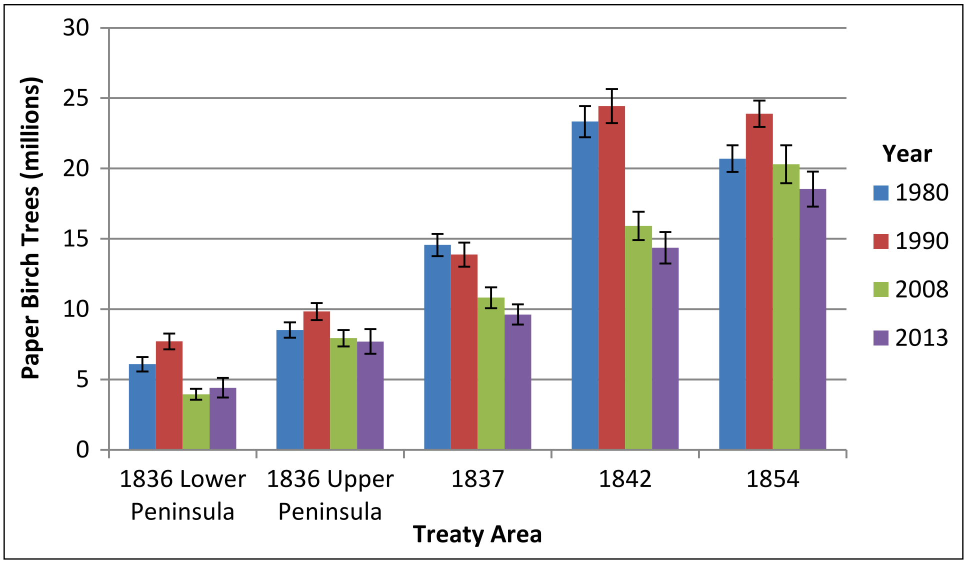

Figure 41.—Number of live paper birch 9 inches diameter and larger on timberland, by Lake States ceded territories treaty area and inventory year. Error bars represent a 68 percent confidence interval around the estimated mean.

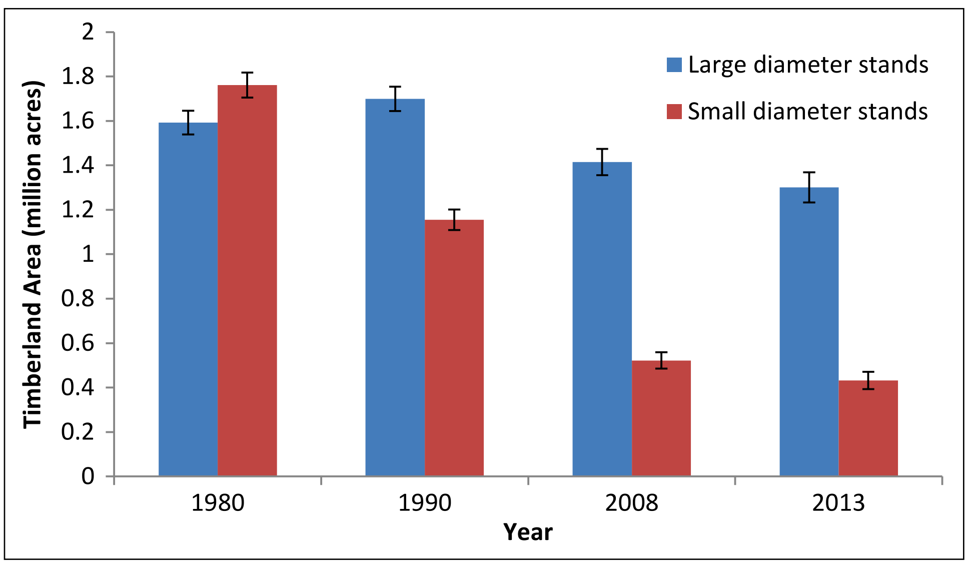

Figure 42.—Area of large and small diameter paper birch stands by inventory year, in Lake States ceded territories. Large diameter stands are those with at least 10 paper birch trees per acre 10 inches d.b.h. or larger. Small diameter stands are stands with at least 50 paper birch per acre 5 inches d.b.h. or larger. Error bars represent a 68 percent confidence interval around the estimated mean.

NORTHERN WHITE-CEDAR (GIIZHIK)

Thuja occidentalis

Background

Every part of the northern white-cedar tree has important uses for the tribes of the ceded territories. Its spiritual and material meaning is illustrated by the fact that a cedar tree plays an important role in one of the stories about Nenabozho, the Ojibwe cultural hero and trickster (Densmore 1974). Recently documented uses of the wood include (wild) ricing knockers and push poles, spigots for tapping and paddles for stirring maple sap, frames for birch bark canoes, and cradle boards. Bark is used for lodge coverings and insect repellant bedding. Leaves and boughs also have many uses, including tea, incense, wreaths, and other decorations, and prevention of maple sap boil-over (Danielsen 2002b). Historically, peeled and split roots were used to make baskets and mats. The northern white-cedar trees were also used for flooring, bedding, partitions, and sheathing for lodges (Lyford 1953). Northern white-cedar also has (proprietary) medicinal uses (Densmore 1974, Meeker et al. 1993). In addition to the many subsistence uses of northern white-cedar, harvest and sale of its boughs are also important commercial activities (Danielsen 2002b). Native peoples of the LSCT gather northern white-cedar on and off reservation lands. As early as the 1990s, representatives of the Great Lakes Indian Fish & Wildlife Commission member tribes became concerned about future availability of northern white-cedar. Factors affecting its supply include changes in hydrology due to road networks (Danielsen 2002b), and forest and wildlife management practices (Callan et al. 2013, Cornett et al. 2000, Davis et al. 1998, Forester et al. 2008, Heitzman et al. 1999, Hofmeyer et al. 2009, Rooney et al. 2002, White 2012).

What we found

There are 460.5 million live northern white-cedar trees 5 inches d.b.h. and larger on LSCT timberland as of 2013, a 24.1 percent increase since 1980. Between 1980 and 2013, the number of trees increased in all size classes except the smallest (5.0 to 6.9 inches d.b.h.), which decreased by 5.6 percent (Table 11). Northern white-cedar is distributed unevenly throughout the ceded territories (Fig. 43), with the greatest number of trees on lands ceded

Table 11.—Number of live northern white-cedar trees on timberland by diameter class and inventory year, Lake States ceded territories

Diameter class (inches)	1980	1990	2008	2013	Percent change 1980 - 2013
	millions				
5.0-6.9	189.7	201.5	179.8	179.2	-5.6
7.0-8.9	97.8	120.3	121.5	125.4	28.3
9.0-10.9	46.7	62.9	70.6	77.0	65.0
11.0-12.9	21.8	30.6	36.7	41.5	90.8
13.0-14.9	8.8	13.7	17.9	20.3	131.4
15.0-16.9	3.7	5.5	8.3	9.5	160.4
17.0-18.9	1.4	2.5	3.3	4.1	185.9
19.0-20.9	0.6	1.0	1.6	1.7	178.9
21.0+	0.5	0.6	1.0	1.6	208.2
All sizes	371.0	438.7	440.8	460.5	24.1

in the Upper Peninsula portion of the 1836 Treaty (40 percent of the total) and the fewest on lands ceded in 1837 (5 percent of the total). Northern white-cedar is found on Federal, State, county, and private lands. Across the ceded territories, just over half are growing on private lands; however the proportion varies by treaty area (Fig. 44).

What this means

The population of northern white-cedar is currently robust. However, the population is aging and the (modest) decrease in the smallest diameter trees may signal a long-term downward trend in numbers. Deer browse may represent a particular concern. Recruitment and survival of seedlings is adversely affected by high white-tailed deer populations in the region. However, hunting management practices on tribal lands, which significantly reduce deer numbers over those on adjacent state-managed lands, have been shown to result in improved regeneration of northern red oak (Reo and Karl 2010), offering one potential model for addressing this issue. In addition to the biological availability of northern white-cedar, access to lands with rights to harvest also affects the supply for commercial and cultural uses. It is noteworthy that the 1836 upper peninsula ceded territory has the greatest proportion of northern white-cedar trees (25 percent of all live trees 5 inches diameter and larger are northern white-cedar) with nearly equal numbers on public and private lands. In the 1842 ceded territories, northern white-cedar is also a large component of the forest

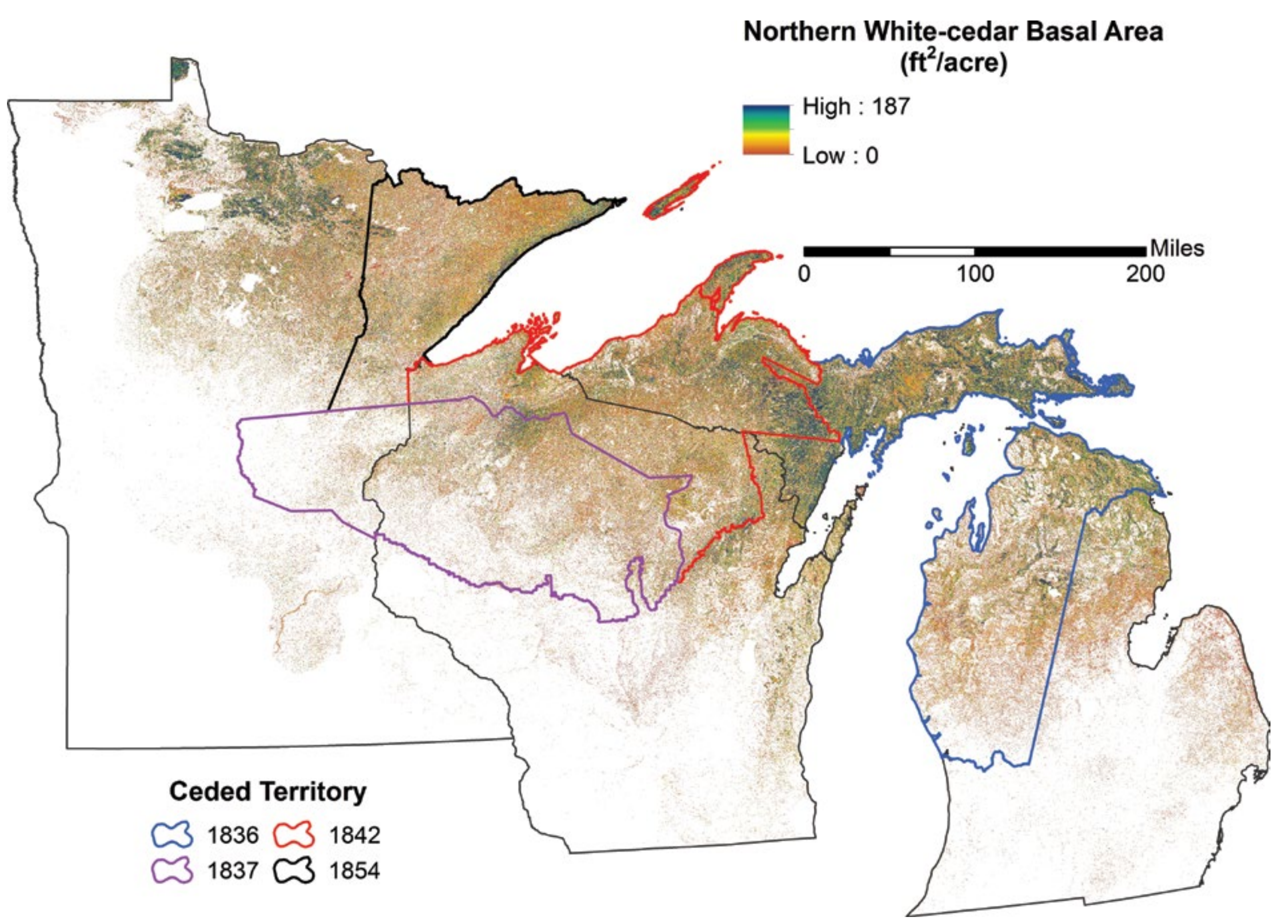

Figure 43.—Northern white-cedar basal area, Lake States ceded territories, 2013 (Wilson et al. 2012, 2013).

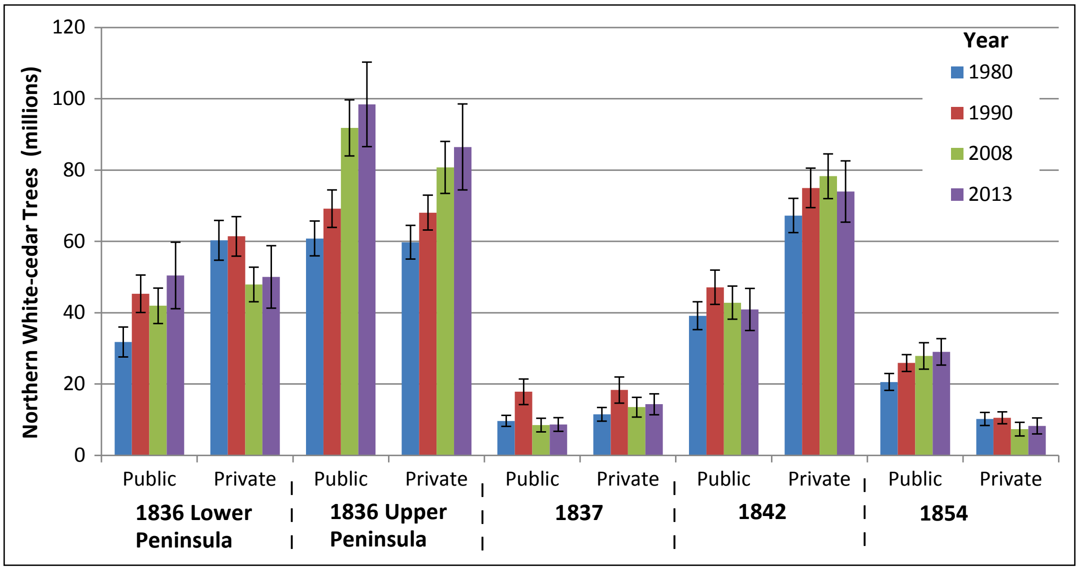

Figure 44.—Number of northern white-cedar trees 5 inches d.b.h. and larger on timberland by Lake States ceded territories treaty area and ownership. Error bars represent a 68 percent confidence interval around the estimated mean.

(8 percent of the live trees 5 inches diameter or larger) with the largest portion on private lands. State lands are home to a substantial portion of the northern white-cedar population of these areas. As a consequence, access to northern white-cedar in much of the ceded territories depends largely on State regulations and the capacity to negotiate harvesting rights on private, nontribal lands.

HOPHORNBEAM (EASTERN HOPHORNBEAM, IRONWOOD; MAANANOONS)

Ostrya virginiana

Background

Hophornbeam is a small short-lived understory tree species found throughout eastern North America (Metzger 1990). Throughout its range, hophornbeam grows on a wide variety of soils and can be found on xeric soils and rock outcroppings as well as mesic soils within the ceded territories. It is found in low abundance in most forest types throughout its range and often produces stump sprouts after fire. Typical silvicultural treatments select against hophornbeam in favor of more commercially valuable timber species (e.g., it is often removed during forest management operations). Hophornbeam grows slowly and produces very hard wood, which can be used for many purposes. In addition, the buds and catkins are eaten by many species of wildlife, especially wild turkey and sharp-tailed grouse.

What we found

Hophornbeam is found throughout the four ceded territories (Fig. 45), but it is most abundant within the 1837, 1842, and 1836 Lower Peninsula Treaty areas (Fig. 46). While most of these trees can be found on private land (this category includes tribal lands), there are substantial amounts occurring on public land in these three treaty areas as well. Few hophornbeams are found in the 1836 Upper Peninsula or 1854 Treaty areas.

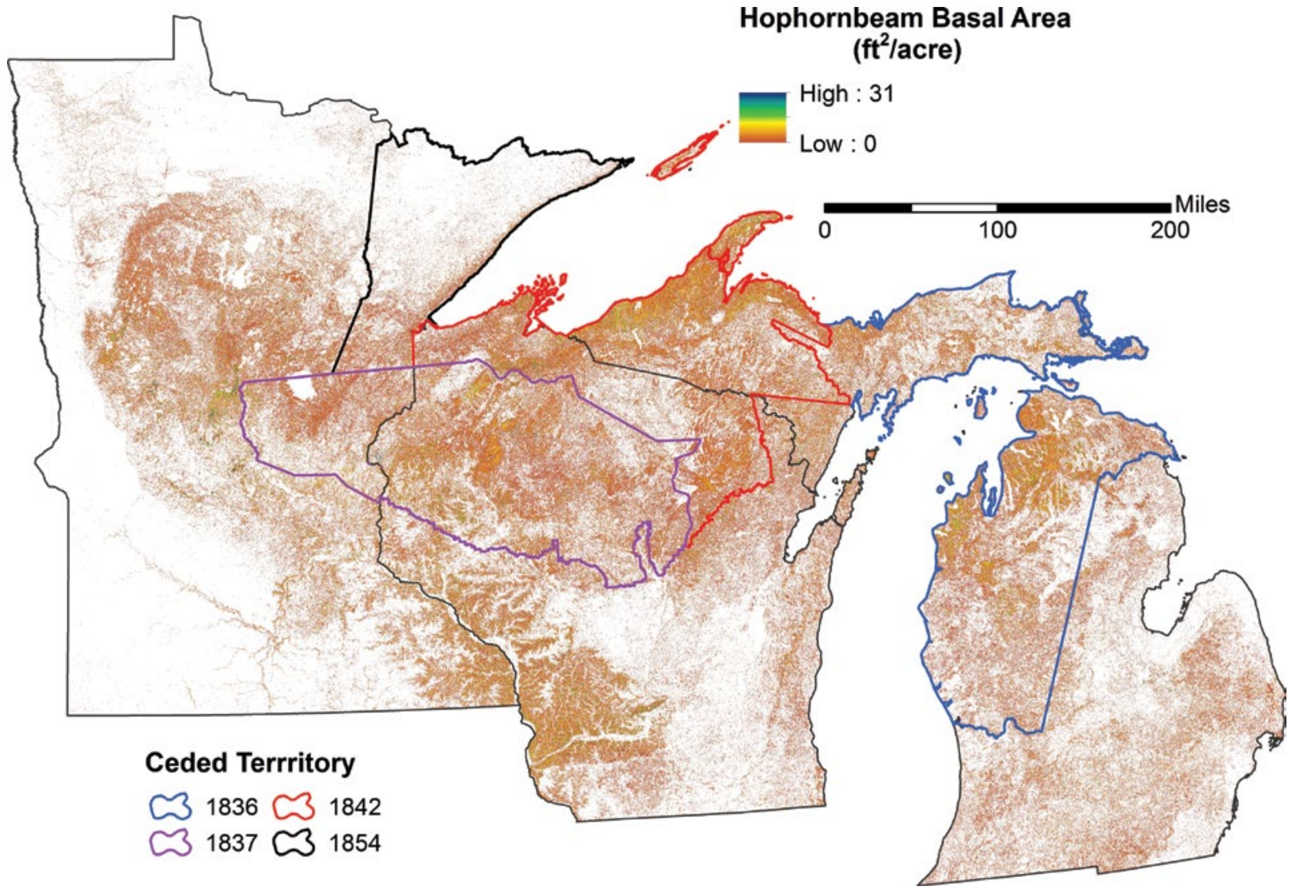

Figure 45.—Hophornbeam basal area, Lake States ceded territories, 2013 (Wilson et al. 2012, 2013).

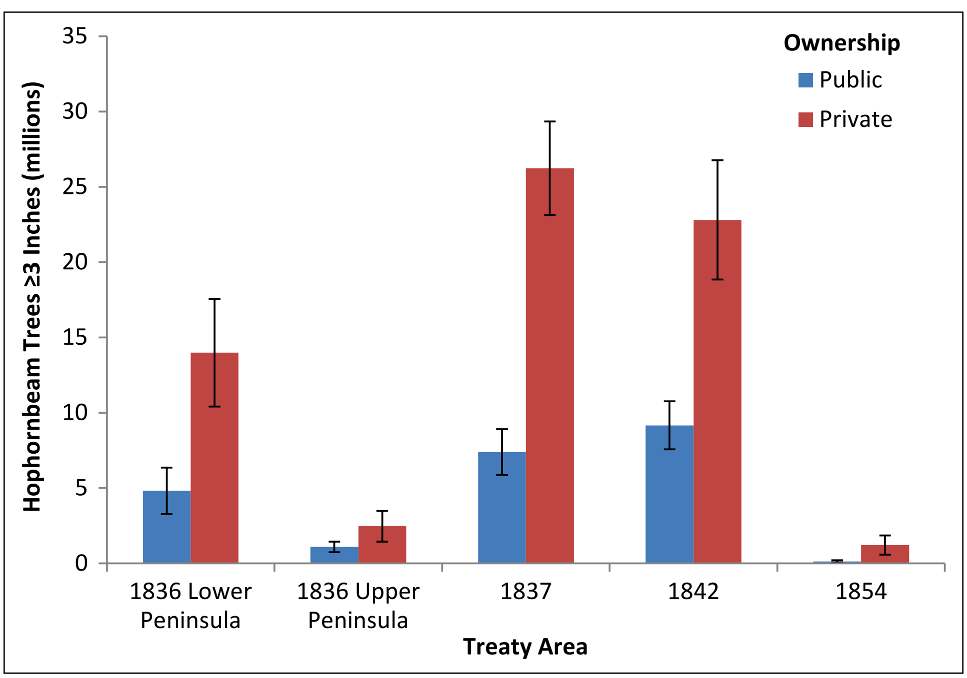

Figure 46.—Number of hophornbeam trees (≥3.0 inches d.b.h.) on timberland by Lake States ceded territories treaty area and ownership, 2013. Error bars represent a 68 percent confidence interval around the estimated mean.

The trends for hophornbeam from 3.0 to 6.9 inches in diameter between 1980 and 2013 show increases or stability in numbers over the sampling periods. The 1837 area shows a large increase from 1980 through 2008 and then a slight decrease from 2008 to 2013 (Fig. 47). Trends for large diameter trees (greater than 7 inches d.b.h.) are similar (Fig. 48) with the noticeable decrease in the number of large diameter trees found in the 1842 Treaty area. Finally, the number of small diameter hophornbeam is increasing in all treaty areas (Fig. 49).

What this means

Trends for recruitment from small to large diameter hophornbeam suggest that there will continue to be hophornbeam throughout the treaty areas in the future. These trends are supported by looking at potential future recruitment of medium sized pole trees[5] (referred to as poles) (Fig. 50). One area of concern is the dramatic decreases of large diameter trees in the 1842 Treaty area. This could indicate a lower potential to find large diameter hophornbeam in the near future. This may be due to forest management activities that removed larger diameter trees within the area or it could indicate that these trees were mature and are coming to the end of their life spans. In either case, forest management activities could be adapted to maintain a steady recruitment into larger diameter classes from the pool of smaller individuals. A noteworthy trend in the LSCT is that there appears to be a lot of recruitment from the small and medium sized trees which could eventually add to the number of large diameter trees in this treaty area.

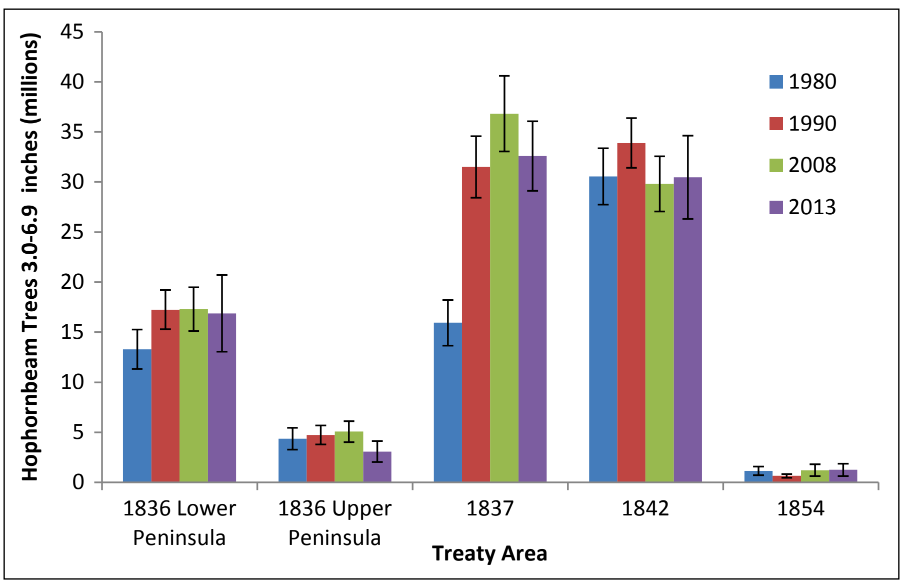

Figure 47.—Number of medium-sized hophornbeam trees (3.0 to 6.9 inches d.b.h.) on timberland by Lake States ceded territories treaty area and inventory year. Error bars represent a 68 percent confidence interval around the estimated mean.

[5] 1=possible future stands, those where hophornbeam was found but did not rank good or future

2=future stands for collecting poles, with at least 50 hophornbeam trees per acre that are 1 inch d.b.h. or larger

3=good stands for collecting poles, with at least 25 hophornbeam trees per acre that are 3 inches d.b.h. or larger

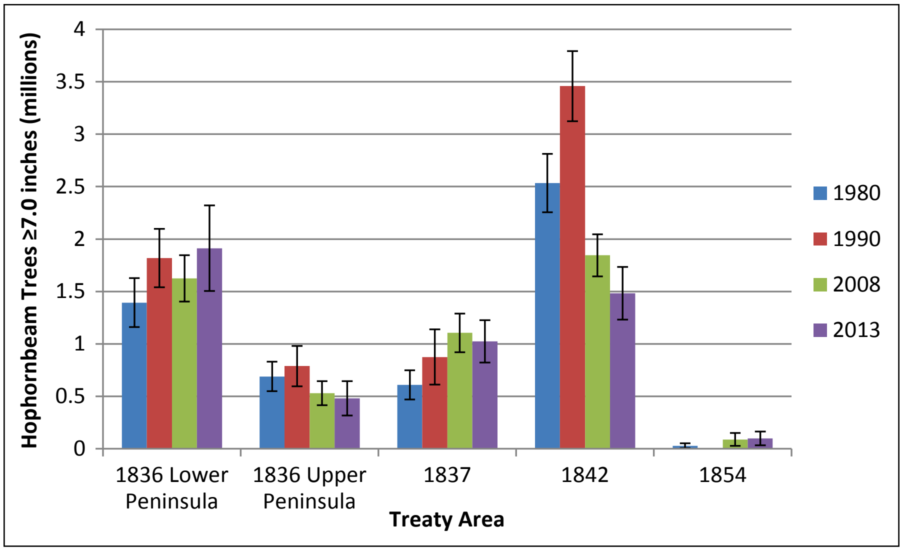

Figure 48.—Number of large hophornbeam trees (≥7.0 inches d.b.h.) on timberland by Lake States ceded territories treaty area and inventory year. Error bars represent a 68 percent confidence interval around the estimated mean.

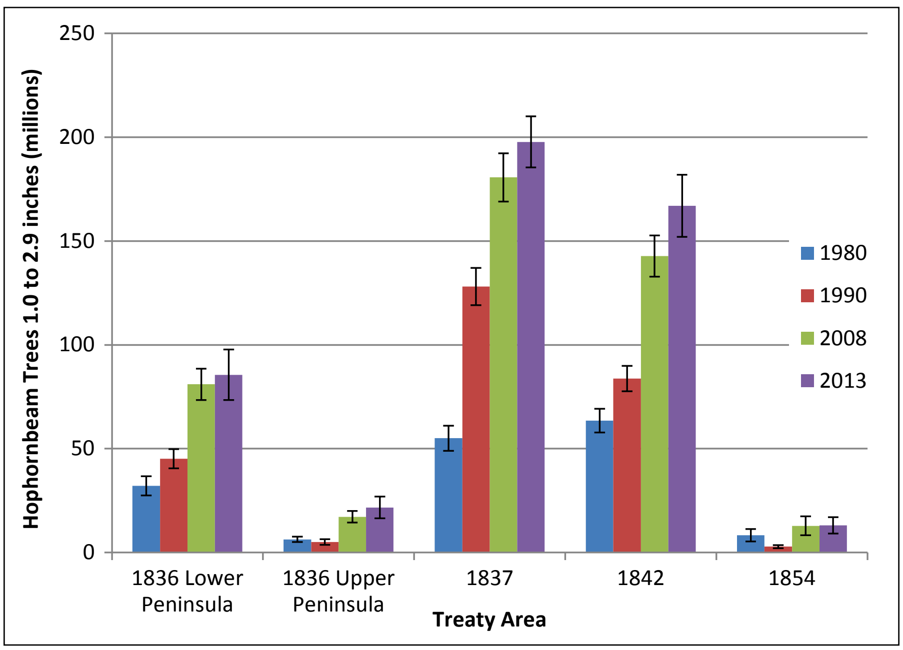

Figure 49.—Number of small hophornbeam trees (1.0 to 2.9 inches d.b.h.) on timberland by Lake States ceded territories treaty area and ownership. Error bars represent a 68 percent confidence interval around the estimated mean.

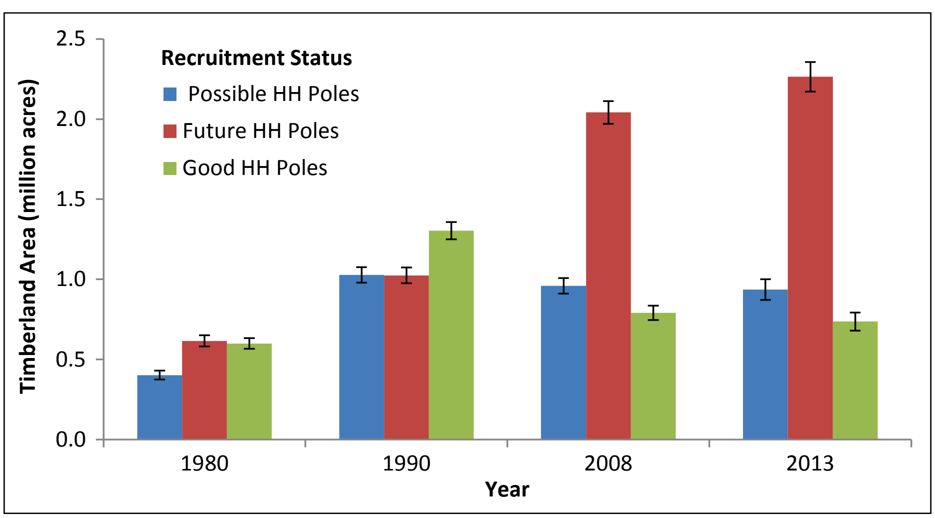

Figure 50.—Area of timberland by hophornbeam recruitment status in the Lake States ceded territories by inventory year. See footnote 5 for status definitions. Error bars represent a 68 percent confidence interval around the estimated mean.

BALSAM FIR (ZHINGOB)

Abies balsamea

Background

Balsam fir is a shade tolerant conifer that can establish in the dense shade of other species. It is an important conifer in this region. Commercial harvesting is primarily for pulp and light frame construction lumber. The harvesting of balsam fir boughs and Christmas trees is one of the NTFP collections that supports a commercial industry in the Lake States and provides seasonal income and enjoyment to many residents of this area. Traditional uses of balsam fir by the Ojibwe include medicinal uses of the needles, sap, and bark in various ways. Balsam fir resin blisters provide an easily harvestable source of sap that is used in canoe and boat caulk. Historic uses of balsam resin for mounting microscopic specimens and for optical glass cement have been replaced by synthetic substitutes. Wildlife relies extensively on this tree for food and shelter (Frank 1990).

One of largest threats to balsam fir populations is the spruce budworm, a native insect which, despite its name, prefers fir over spruce. This pest causes heavy damage and mortality, especially in stands that contain mature fir, are densely stocked with balsam fir, or have a high proportion of fir in relation to other species. Periodic outbreaks of spruce budworm have caused extensive mortality across large areas when the balsam fir population reaches high levels (Bakuzis and Hansen 1965).

What we found

Of the six species of cultural significance, balsam fir is the most abundant on the landscape and was found in 47.5 percent of all forest stands in the region (Table 9). The range of balsam fir extends across all of the northern parts of the region but is not found in the very southern portions of the of 1836 and 1837 Treaty areas (Fig. 51). Balsam fir's presence in the LSCT forests is increasing and was found to occur on 140,000 more acres in 2013 than in the 2008 inventory, an increase of almost 1 percent. In relation to other tree species in the LSCT, balsam fir is generally a smaller than average tree; balsam fir makes up nearly 20 percent of saplings (trees 1.0 to 4.9 inches d.b.h.) but slightly less than 1 percent of the large trees (trees 11 inches d.b.h. and larger) (Table 9). The increase in balsam fir has been primarily in small diameter trees. The total number of 5.0 to 6.9 inch diameter trees increased by 10.5 percent between 2008 and 2013, however the number of trees 7 inches in diameter and over increased by only 0.5 percent over the same period.

Balsam boughs are clipped primarily from smaller diameter trees in stands that are not dominated by an overstory of large diameter trees. These conditions allow enough light to reach the lower branches of the trees and lead to growth of healthy needles. There is standard criteria for ranking stands for suitability of harvesting boughs: good, medium, poor, or balsam fir not present.[6] Area of timberland ranked as "good" or "medium" showed

[6] To be classed as "good" for harvesting balsam fir boughs a stand must have at least 250 small diameter (1.0 to 4.9 inch) balsam fir trees per acre, less than 50 square feet per acre in trees 5 inches d.b.h. and greater (all species) and small diameter trees of other species are less than 50 percent of the small diameter trees are ranked as good. To be classed as "medium" for

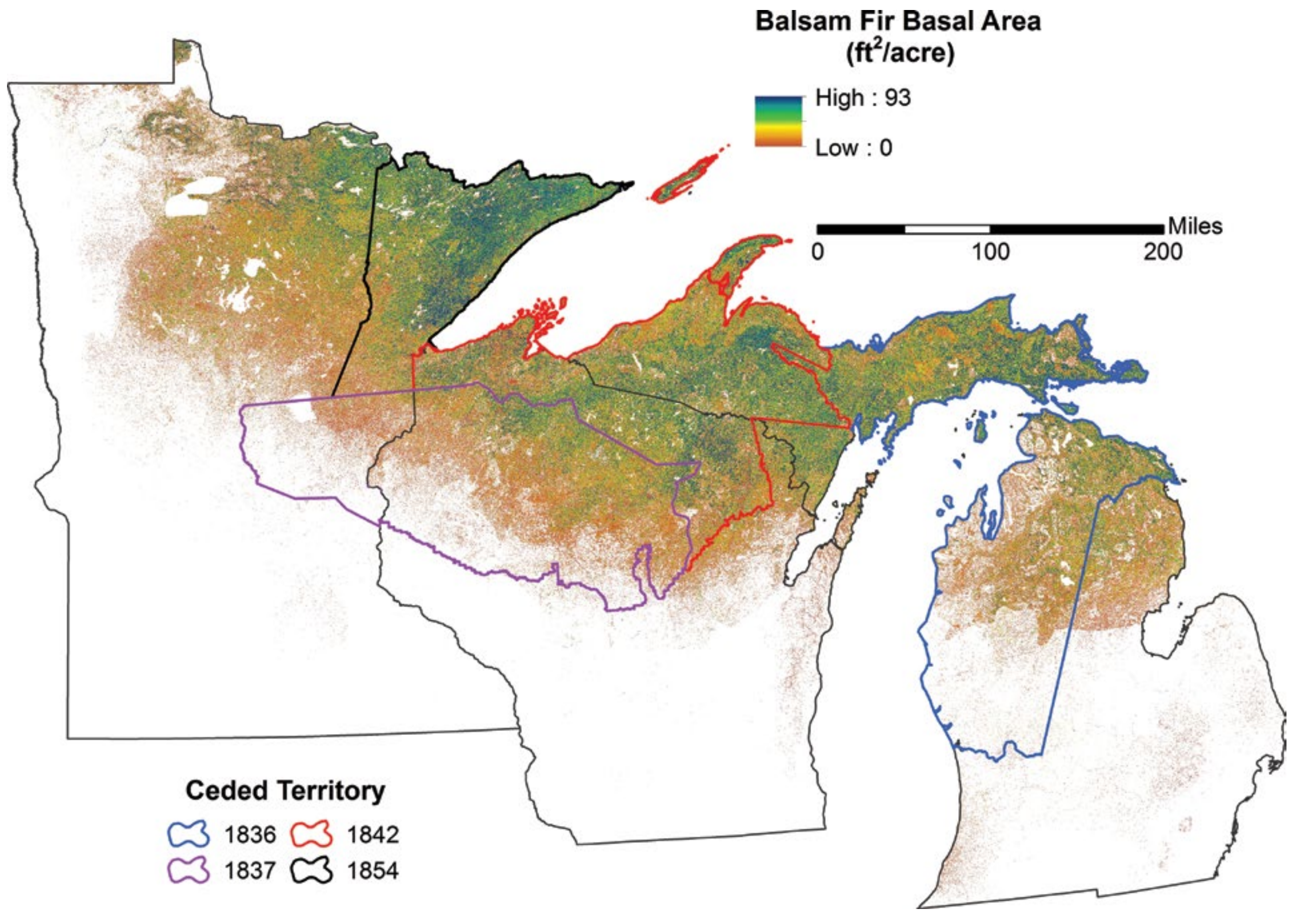

Figure 51.—Balsam fir basal area by treaty area, Lake States ceded territories, 2013 (Wilson et al. 2012, 2013).

a 1.1 percent decrease in area between 2008 and 2013. However, the overall decrease varies significantly (p=0.05) by ownership. There was a 4.6 percent decrease in timberland area ranked "good" or "medium" on privately owned forest lands and a 2.9 percent increase in similarly ranked timberland on public lands (Fig. 52).

Large areas of public timberland ranked as good balsam fir bough harvesting are present in all of the treaty areas except the Lower Peninsula portion of the 1836 Treaty area (Fig. 53). Most of the public (Federal, State, and county) agencies that manage these timberlands have programs that permit regulated harvesting of boughs for both personal and commercial use. Harvesting of boughs and other NTFPs on private lands occurs under arrangements with the owners. Tribes regulate gathering on reservation lands within their jurisdictions.

Changes in the total number of balsam fir versus all other species between the 2008 and 2013 inventories are shown in Table 12. For small trees (5.0 to 6.9 inches d.b.h.), the rate of increase in balsam fir is much greater than the rate for all other species combined (10.5 percent vs. 1.6 percent). However for large trees (13 inches or greater d.b.h.) the opposite

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harvesting balsam fir boughs a stand must not meet the criteria for good and have at least 10 small diameter (1.0 to 4.9 inch) balsam fir trees per acre and less than 80 square feet per acre in trees 5 inches and greater diameter (all species). Other stands where balsam fir is present are ranked "poor". Based on criteria in Smith et al. (2009).

is true, with balsam fir showing a decrease of 1.7 percent and all other species showing an increase of 11.7 percent over the same period. It appears that current harvesting and management practices on timberlands are tending to provide for the regeneration and development of smaller balsam fir while other species are developing into large trees more often than balsam fir.

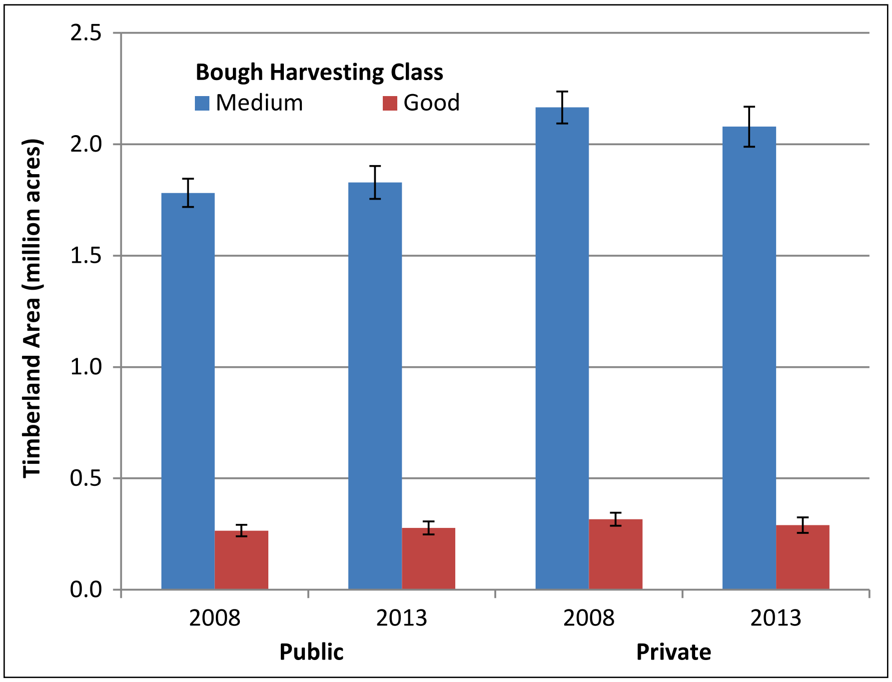

Figure 52.—Timberland area ranked as medium or good for harvesting of balsam fir boughs by ownership, Lake States ceded territories, 2008 and 2013. See footnote 6 for stand-ranking criteria. Error bars represent a 68 percent confidence interval around the estimated mean.

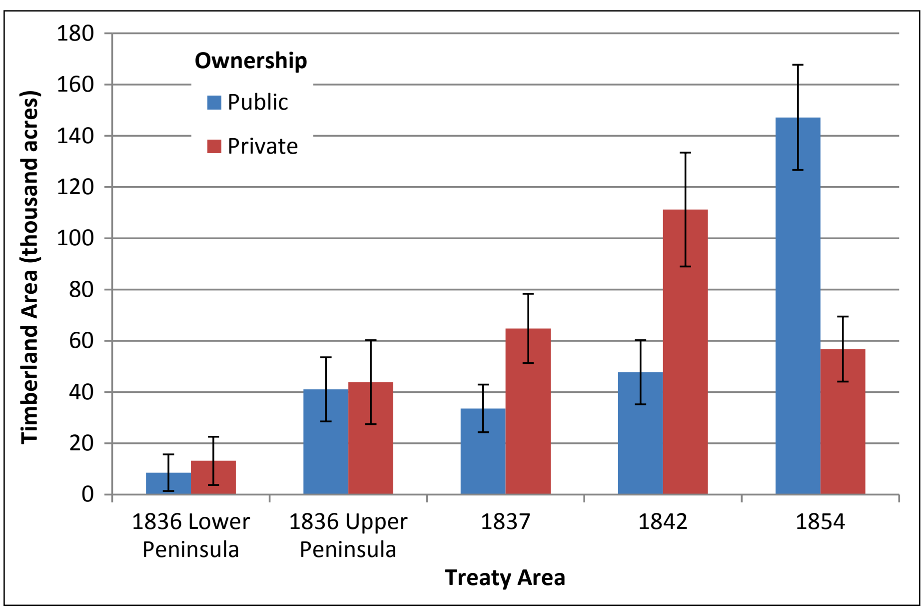

Figure 53.—Timberland area ranked good for harvesting of balsam fir boughs by ownership and Lake States ceded territories treaty area, 2013. See footnote 6 for stand-ranking criteria. Error bars represent a 68 percent confidence interval around the estimated mean.

Table 12.—Total number of live trees on timberland for balsam fir and all other species, Lake States ceded territories 2008 and 2013

Diameter class (inches)	2008	2013	Percent change 2008 to 2013
Balsam fir			
5.0-6.9	186.3	205.8	10.5%
7.0-8.9	72.4	72.8	0.5%
9.0-10.9	23.5	23.2	-1.1%
11.0-12.9	5.7	6.1	7.3%
13.0+	2.2	2.2	-1.7%
Total	290.1	310.1	6.9%
All other species			
5.0-6.9	1,695.3	1,721.9	1.6%
7.0-8.9	1,090.3	1,086.7	-0.3%
9.0-10.9	675.8	679.1	0.5%
11.0-12.9	391.0	403.1	3.1%
13.0+	441.0	492.6	11.7%
Total	4,293.5	4,383.4	2.1%

What this means

Balsam fir is a relatively short-lived species compared to others (e.g., sugar maple) and as stands are harvested at older ages and/or managed under multi-age management strategies, longer-lived species are favored. The maturing of forests, along with climate change, are concerns for this species as the LSCT are already at the southern edge of the region where balsam fir grows. The presence of balsam fir has remained relatively stable, but the trend should be watched as we are seeing a reduction in quality boughs on private lands.

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GLOSSARY

All live tree: All living trees. All size classes, all tree classes, and both saw log and non-saw log species are included.

Average annual mortality: The average annual change in mortality of trees during the period between inventories. This estimate can be provided in cubic feet for live and growing-stock trees that died or in board feet for sawtimber trees that died.

Average annual net growth: The average annual change in the volume of trees during the period between inventories. Components include the change in volume of trees that have met the minimum size requirements over the inventory period, plus the volume of trees reaching the minimum size during the period (ingrowth), minus the volume of trees that died during the period, minus the volume of cull during the period. Mortality removals (trees killed in the harvesting process and left on site) and diversion removals (trees removed from the forest-land base due to a change from forest to nonforest land) are not included. This estimate can be provided in cubic feet for live and growing-stock trees or in board feet for sawtimber trees.

Average annual removals: The average annual change in removals of trees during the period between inventories. The estimate includes harvest removals, mortality removals (trees killed in the harvesting process and left on site), and diversion removals (trees removed from the forest-land base due to a change from forest to nonforest land). This estimate can be provided in cubic feet for live and growing-stock trees or in board feet for sawtimber trees.

Biomass: The aboveground weight of live trees (including bark but excluding foliage) reported in dry tons (dry weight). Biomass has four components:

> ***Bole***: Biomass of a tree from 1 foot above the ground to a 4 inch top outside bark or to a point where the central stem breaks into limbs.
>
> ***Tops and limbs***: Total biomass of a tree from a 1 foot stump minus the bole.
>
> ***1-to 5-inch trees***: Total aboveground biomass of a tree from 1 to 5 inches in d.b.h.
>
> ***Stumps***: Biomass of a tree 5 inches d.b.h. and larger from the ground to a height of 1 foot.

Board foot: A unit of lumber measuring 1 foot long, 1 foot wide, and 1 inch thick, or its equivalent. International ¼-Inch Rule is used as the U.S. Forest Service standard log rule in the eastern United States; however, the Scribner rule is mainly used in the Black Hills area.

Coarse woody debris (CWD): Dead branches, twigs, and wood splinters 3 inches in diameter and larger measured at the smallest end.

Commercial species: Tree species suitable for industrial wood products.

Cull tree: A live tree, 5 inches in d.b.h. or larger, that is unmerchantable for saw logs now or prospectively because of rot, roughness, or species (see definitions for rotten and rough trees).

Decay class: Qualitative assessment of stage of decay (5 classes) of coarse woody debris based on visual assessments of color of wood, presence/absence of twigs and branches, texture of rotten portions, and structural integrity.

Diameter at breast height (d.b.h.): The diameter for tree stem, located at 4.5 feet above the ground (breast height) on the uphill side of a tree. The point of diameter measurement may vary on abnormally formed trees.

Diameter class: A classification of trees based on d.b.h. With 2 inch diameter classes, the 6 inch class, for example, includes trees 5.0 through 6.9 inches d.b.h.

Down woody material (DWM): Woody pieces of trees and shrubs that have been uprooted (no longer supporting growth) or severed from their root system, not self-supporting, and lying on the ground.

Dry Weight: The weight of wood and bark as it would be if it had been oven dried; usually expressed in pounds or short tons.

Duff: A soil layer dominated by organic material derived from the decomposition of plant and animal litter and deposited on either an organic or a mineral surface. This layer is distinguished from the litter layer in that the original organic material has undergone sufficient decomposition that the source of this material (e.g., individual plant parts) no longer can be identified.

Epidemic: (1) Entomology: pertaining to populations of plants, animals, and viruses that build up, often rapidly, to unusually and generally injuriously high levels. Synonym: outbreak. Many insect and other animal populations cycle periodically or irregularly between endemic and epidemic levels. (2) Pathology: a disease sporadically infecting a large number of hosts in an area and causing considerable loss (Helms 1998).

Fiber products: Products derived from wood and bark residues, such as pulp, composition board products, and wood chips.

Fine woody debris (FWD): Dead branches, twigs, and wood splinters 0.1 to 2.9 inches in diameter.

Forest land: Land at least 10 percent stocked by trees of any size, including land that formerly had such tree cover and that will be naturally or artificially regenerated. Forest land includes transition zones, such as areas between heavily forested and nonforested lands that are at least 10 percent stocked with trees and forest areas adjacent to urban and built-up lands. Also included are pinyon-juniper and chaparral areas and afforested areas. The minimum area for classification of forest land is 1 acre and 120 feet wide measured stem-to-stem from the outer-most edge. Unimproved roads and trails, streams, and clearings in forest areas are classified as forest if less than 120 feet wide.

Forest type: A classification of forest land based on the species presently forming a plurality of the live-tree stocking. If softwoods predominate (50 percent or more), then the forest type will be one of the softwood types and vice versa for hardwoods.

Forest-type group: Combinations of forest types that share closely associated species or site requirements and are generally combined for brevity of reporting.

Growing stock: A classification of timber inventory that includes live trees of commercial species meeting specified standards of quality or vigor. Rough and rotten cull trees are excluded. When associated with volume, this includes only trees 5 inches d.b.h. and larger.

Hardwood: A dicotyledonous tree, usually broad-leaved and deciduous.

> ***Soft hardwoods***: A category of hardwood species with wood generally of low specific gravity (less than 0.5). Notable examples include red maple, paper birch, quaking aspen, and American elm.
>
> ***Hard hardwoods***: A category of hardwood species with wood generally of high specific gravity (greater than 0.5). Notable examples include sugar maple, yellow birch, black walnut, and oaks.

Industrial wood: All commercial roundwood products except fuelwood.

Litter: Undecomposed or only partially decomposed organic material that can be readily identified (e.g., plant leaves, twigs).

Live cull: A classification that includes live, cull trees. When associated with volume, it is the net volume in live, cull trees that are 5 inches d.b.h. and larger.

Mean annual increment (MAI) at culmination: A measure of the productivity of forest land expressed as the average increase in cubic feet of wood volume per acre per year. For a given species and site index, the mean is based on the age at which the MAI culminates for fully stocked natural stands. The MAI is based on the site index of the plot (Azuma et al. 2004).

Merchantable: Refers to a pulpwood or saw log section that meets pulpwood or saw log specifications, respectively.

National Forest: An ownership class of Federal lands, designated by executive order or statute as National Forests or purchase units, and other lands under the administration of the U.S. Forest Service, including experimental areas.

Net volume in cubic feet: The gross volume in cubic feet less deductions for rot, roughness, and poor form. Volume is computed for the central stem from a 1 foot stump to a minimum 4 inch top diameter outside bark, or to the point where the central stem breaks into limbs.

Noncommercial species: Tree species of typically small size, poor form, or inferior quality, which normally do not develop into trees suitable for industrial roundwood products.

Nonforest land: Land that has never supported forests and lands formerly forested where use of timber management is precluded by development for other uses. (Note: Includes area used for crops, improved pasture, residential areas, city parks, improved roads of any width and adjoining clearings, powerline clearings of any width, and 1.0 to 4.5 acre areas of water classified by the Bureau of the Census as land. If intermingled in forest areas, unimproved roads and nonforest strips must be more than 120 feet wide, and clearings, etc., must be more than 1 acre in area to qualify as nonforest land.)

Nonstocked areas: Timberland less than 10 percent stocked with live trees.

Poletimber trees: Live trees at least 5 inches in d.b.h. but smaller than sawtimber trees.

Pulpwood: Roundwood, whole-tree chips, or wood residues used for the production of wood pulp.

Reserved forest land: Forest land withdrawn from timber utilization through statute, administrative regulation, or designation without regard to productive status.

Residues: Bark and woody materials that are generated in primary wood-using mills when roundwood products are converted to other products. Examples include slabs, edgings, trimmings, miscuts, sawdust, shavings, veneer cores and clippings, and pulp screenings. Includes bark residues and wood residues (both coarse and fine materials) but excludes logging residues.

Rotten tree: A live tree of commercial species that does not contain a saw log now or prospectively primarily because of rot (that is, when rot accounts for more than 50 percent of the total cull volume).

Rough tree: (a) A live tree of commercial species that does not contain a saw log now or prospectively primarily because of roughness (that is, when sound cull due to such factors as poor form, splits, or cracks accounts for more than 50 percent of the total cull volume); or (b) a live tree of noncommercial species.

Roundwood products: Logs, bolts, and other round timber generated from harvesting trees for industrial or consumer use.

Salvable dead tree: A downed or standing dead tree considered currently or potentially merchantable by regional standards.

Sampling Error: Difference between a population value and a sample estimate that is attributable to the sample, as distinct from errors due to bias in estimation, errors in observation, etc. Sampling error is measured as the standard error of the sample estimate (Helms 1998).

Saplings: Live trees 1.0 inch through 4.9 inches d.b.h.

Saw log: A log meeting minimum standards of diameter, length, and defect, including logs at least 8 feet long, sound and straight, and with a minimum diameter inside bark of 6 inches for softwoods and 8 inches for hardwoods, or meeting other combinations of size and defect specified by regional standards.

Sawtimber tree: A live tree of commercial species containing at least a 12 foot saw log or two noncontiguous saw logs 8 feet or longer, and meeting regional specifications for freedom from defect. Softwoods must be at least 9 inches d.b.h. Hardwoods must be at least 11 inches d.b.h.

Sawtimber volume: Net volume of the saw log portion of live sawtimber in board feet, International ¼-inch rule (unless specified otherwise), from stump to a minimum 7 inches top d.o.b. for softwoods and a minimum 9 inches top d.o.b. for hardwoods.

Seedlings: Live trees less than 1 inch d.b.h. and at least 1 foot in height.

Snag: A standing dead tree. In the current inventory, a snag must be 5 inches d.b.h. and 4.5 feet tall, and have a lean angle less than 45 degrees from vertical. A snag may be either self-supported by its roots, or supported by another tree or snag.

Softwood: A coniferous tree, usually evergreen, having needles or scale-like leaves.

Stand: A group of trees on a minimum of 1 acre of forest land that is stocked by forest trees of any size.

Stand age: A stand descriptor that indicates the average age of the live dominant and codominant trees in the predominant stand size-class of a condition.

Stand origin: A classification of forest stands describing their means of origin.

Planted: Planted or artificially seeded.

Natural: No evidence of artificial regeneration.

Stand-size class: A classification of forest land based on the size class of live trees in the area. The classes are as follows:

Sawtimber: Forest land stocked with at least 10 percent of full stocking with live trees with half or more of such stocking in poletimber or sawtimber trees or both, and in which the stocking of sawtimber is at least equal to that of poletimber.

Poletimber: Forest land stocked with at least 10 percent of full stocking with live trees with half or more of such stocking in poletimber or sawtimber trees or both, and in which the stocking of poletimber exceeds that of sawtimber.

Seedling-sapling: Forest land stocked with at least 10 percent of full stocking with live trees with half or more of such stocking in seedlings or saplings or both.

Nonstocked: Forest land stocked with less than 10 percent of full stocking with live trees. Examples are recently cutover areas or recently reverted agricultural fields.

Stocking: The degree of occupancy of land by trees, measured by basal area or number of trees by size and spacing, or both, compared to a stocking standard; that is, the basal area or number of trees, or both, required to fully utilize the growth potential of the land.

Timberland: Forest land that is producing or is capable of producing crops of industrial wood and not withdrawn from timber utilization by statute or administrative regulation. (Note: Areas qualifying as timberland are capable of producing in excess of 20 cubic feet per acre per year of industrial wood in natural stands. Currently inaccessible and inoperable areas are included.)

Timber products output: All timber products cut from roundwood and byproducts of wood manufacturing plants. Roundwood products include logs, bolts, or other round sections cut from growing-stock trees, cull trees, salvable dead trees, trees on nonforest land, noncommercial species, sapling-size trees, and limbwood. Byproducts from primary manufacturing plants include slabs, edging, trimmings, miscuts, sawdust, shavings, veneer cores and clippings, and screenings of pulpmills that are used as pulpwood chips or other products.

Tree: A woody plant usually having one or more erect perennial stems, a stem diameter at breast height of at least 3 inches, a more or less definitely formed crown of foliage, and a height of at least 15 feet at maturity.

Tree grade: A classification of the saw-log portion of sawtimber trees based on: (1) the grade of the butt log, or (2) the ability to produce at least one 12 foot or two 8 foot logs in the upper section of the saw-log portion. Tree grade is an indicator of quality; grade 1 is the best quality (see U.S. Forest Service 2013, Appendix E for grading specifications).

Tree-size class: A classification of trees based on diameter at breast height, including sawtimber trees, poletimber trees, saplings, and seedlings.

Sawtimber-sized trees: Softwood timber species ≥ 9 inches d.b.h., and hardwood timber species ≥ 11 inches d.b.h.

Poletimber-sized trees: Softwood timber species 5.0 to 8.9 inches d.b.h. and hardwood timber species 5.0 to 10.9 inches d.b.h.

Saplings: Live trees 1.0 to 4.9 inches d.b.h.

Seedlings: Live trees less than 1 inch d.b.h. and at least 1 foot in height.

Tops: The wood of a tree above the merchantable height (or above the point on the stem 4 inches diameter outside bark (d.o.b.) or to the point where the central stem breaks into limbs). It includes the usable material in the uppermost stem.

Upper stem portion: Portion of a sawtimber tree that is above the saw log portion. Begins at a top of 7 inches d.o.b. for softwoods and 9 inches d.o.b. for hardwoods, or where the central stem breaks into limbs.

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APPENDIX

Tree species observed on FIA plots in the Lake States ceded territories

Common name	Scientific name
balsam fir	*Abies balsamea*
boxelder	*Acer negundo*
black maple	*Acer nigrum*
striped maple	*Acer pensylvanicum*
Norway maple	*Acer platanoides*
red maple	*Acer rubrum*
silver maple	*Acer saccarinum*
sugar maple	*Acer saccharum*
mountain maple	*Acer spicatum*
Ohio buckeye	*Aesculus glabra*
common serviceberry	*Amelanchier arborea*
serviceberry spp.	*Amelanchier spp.*
yellow birch	*Betula alleghaniensis*
river birch	*Betula nigra*
paper birch	*betula papyrifera*
American hornbeam, musclewood	*Carpinus caroliniana*
bitternut hickory	*Carya cordiformis*
pignut hickory	*Carya glabra*
shagbark hickory	*Carya ovata*
hackberry	*Celtis occidentalis*
flowering dogwood	*Cornus florida*
hawthorn spp.	*Crataegus spp.*
cockspur hawthorn	*Crataegus crus-galli*
downy hawthorn	*Crataegus mollis*
Russian-olive	*Elaeagnus angustifolia*
American beech	*Fagus grandifolia*
white ash	*Fraxinus americana*
black ash	*Fraxinus nigra*
green ash	*Fraxinus pennsylvanica*
butternut	*Juglans cinerea*
walnut spp.	*Juglans spp.*
black walnut	*Juglans nigra*
eastern redcedar	*Juniperus virginiana*
tamarack (native)	*Larix laricina*
larch spp.	*Larix spp.*
apple spp.	*Malus spp.*
white mulberry	*Morus alba*
blackgum	*Nyssa sylvatica*
eastern hophornbeam	*Ostrya virginiana*
Norway spruce	*Picea abies*

APPENDIX—continued

Common name	Scientific name
jack pine	*Pinus banksiana*
white spruce	*Picea glauca*
black spruce	*Picea mariana*
Austrian pine	*Pinus nigra*
blue spruce	*Picea pungens*
red pine	*Pinus resinosa*
eastern white pine	*Pinus strobus*
Scotch pine	*Pinus sylvestris*
silver poplar	*Populus alba*
balsam poplar	*Populus balsamifera*
eastern cottonwood	*Populus deltoides*
bigtooth aspen	*Populus grandidentata*
quaking aspen	*Populus tremuloides*
American plum	*Prunus americana*
Canada plum	*Prunus nigra*
pin cherry	*Prunus pensylvanica*
black cherry	*Prunus serotina*
chokecherry	*Prunus virginiana*
Douglas-fir	*Pseudotsuga menziesii*
white oak	*Quercus alba*
swamp white oak	*Quercus bicolor*
northern pin oak	*Quercus ellipsoidalis*
bur oak	*Quercus macrocarpa*
pin oak	*Quercus palustris*
northern red oak	*Quercus rubra*
black oak	*Quercus velutina*
black locust	*Robinia pseudoacacia*
sassafras	*Sassafras albidum*
peachleaf willow	*Salix amygdaloides*
Bebb willow	*Salix bebbiana*
willow spp.	*Salix spp.*
black willow	*Salix nigra*
American mountain-ash	*Sorbus americana*
northern mountain-ash	*Sorbus decora*
mountain-ash spp.	*Sorbus spp.*
northern white-cedar	*Thuja occidentalis*
American basswood	*Tilia americana*
eastern hemlock	*Tsuga canadensis*
American elm	*Ulmus americana*
Siberian elm	*Ulmus pumila*
slippery elm	*Ulmus rubra*
rock elm	*Ulmus thomasii*

Included on the CD found in the back cover of this report are data tables providing summaries of the forest resource in the Lake States ceded territories. The tables are organized into two folders: "All Lands" and "Treaty Area". All table titles are listed below.

All Lands Table Titles

Table LSCT-17a.—Net volume of growing-stock trees (at least 5 inches d.b.h.), in million cubic feet, on timberland by species group, **species**, and diameter class, Lake States ceded territories, 2013

Table LSCT-18.—Net volume of growing-stock trees (at least 5 inches d.b.h.), in million cubic feet, on timberland by species group and ownership group, Lake States ceded territories, 2013

Table LSCT-18a.—Net volume of growing-stock trees (at least 5 inches d.b.h.), in million cubic feet, on timberland by species group, **species**, and ownership group, Lake States ceded territories, 2013

Table LSCT-19.—Net volume of sawtimber trees, in million board feet **(International 1/4-inch rule)**, on timberland by species group and diameter class, Lake States ceded territories, 2013

Table LSCT-19a.—Net volume of sawtimber trees, in million board feet **(Doyle rule)**, on timberland by species group and diameter class, Lake States ceded territories, 2013

Table LSCT-19b.—Net volume of sawtimber trees, in million board feet **(Doyle rule)**, on timberland by species group,

species, and diameter class, Lake States ceded territories, 2013

Table LSCT-19c.—Net volume of sawtimber trees, in million board feet **(International 1/4-inch rule)**, on timberland by species group, **species**, and diameter class, Lake States ceded territories, 2013

Table LSCT-20.—Net volume of saw-log portion of sawtimber trees, in million cubic feet, on timberland by species group and ownership group, Lake States ceded territories, 2013

Table LSCT-21.—Average annual net growth of live trees (at least 5 inches d.b.h./d.r.c.), in million cubic feet, by owner class and forest-land status, Lake States ceded territories, 2013

Table LSCT-21a.—Average annual net growth of live trees (at least 5 inches d.b.h./d.r.c.), in million cubic feet, by owner class and forest-land status **using accounting method** (U.S. Forest Service 2013), Lake States ceded territories, 2013

Table LSCT-22.—Average annual net growth of live trees (at least 5 inches d.b.h./d.r.c.), in million cubic feet, on forest land by forest-type group and stand-size class, Lake States ceded territories, 2013

Table LSCT-23.— Average annual net growth of live trees (at least 5 inches d.b.h./d.r.c.), in million cubic feet, on forest land by species group and ownership group, Lake States ceded territories, 2013

Table LSCT-23a.—Average annual net growth of live trees (at least 5 inches d.b.h./d.r.c.), in million cubic feet, on forest land by species group and ownership group **using accounting method** (U.S. Forest Service 2013), Lake States ceded territories, 2013

Table LSCT-23b.—Average annual net growth of live trees (at least 5 inches d.b.h./d.r.c.), in million cubic feet, on forest land by species group, **species**, and ownership group, Lake States ceded territories, 2013

Table LSCT-23c.—Average annual net growth of live trees (at least 5 inches d.b.h./d.r.c.), in million cubic feet, on forest land by species group, **species**, and ownership **group using accounting method** (U.S. Forest Service 2013), Lake States ceded territories, 2013

Table LSCT-24.—Average annual net growth of growing-stock trees (at least 5 inches d.b.h.), in million cubic feet, on timberland by species group and ownership group, Lake States ceded territories, 2013

Table LSCT-24a.—Average annual net growth of growing-stock trees (at least 5 inches d.b.h.), in million cubic feet, on timberland by species group and ownership group **using accounting method** (U.S. Forest Service 2013), Lake States ceded territories, 2013

Table LSCT-24b.—Average annual net growth of growing-stock trees (at least 5 inches d.b.h.), in million cubic feet, on timberland by species group, **species**, and ownership group, Lake States Ceded territories, 2013

Table LSCT-24c.—Average annual net growth of growing-stock trees (at least 5 inches d.b.h.), in million cubic feet, on timberland by species group, **species**, and ownership group **using accounting method** (U.S. Forest Service 2013), Lake States ceded territories, 2013

Table LSCT-25.—Average annual mortality of trees (at least 5 inches d.b.h./d.r.c.), in million cubic feet, by owner class and forest-land status, Lake States ceded territories, 2013

Table LSCT-26.—Average annual mortality of trees (at least 5 inches d.b.h./d.r.c.), in million cubic feet, on forest land by forest-type group and stand-size class, Lake States ceded territories, 2013

Table LSCT-27.—Average annual mortality of trees (at least 5 inches d.b.h./d.r.c.), in million cubic feet, on forest land by species group and ownership group, Lake States ceded territories, 2013

Table LSCT-27a.—Average annual mortality of trees (at least 5 inches d.b.h./d.r.c.), in million cubic feet, on forest land by species group, **species**, and ownership group, Lake States ceded territories, 2013

Table LSCT-28a.—Average annual mortality of growing-stock trees (at least 5 inches d.b.h.), in million cubic feet, on timberland by species group, **species**, and ownership group, Lake States ceded territories, 2013

Table LSCT-29.—Average annual removals of live trees (at least 5 inches d.b.h./d.r.c.), in million cubic feet, on forest land by species group and ownership group, Lake States ceded territories, 2013

Table LSCT-29a.—Average annual removals of live trees (at least 5 inches d.b.h./d.r.c.), in million cubic feet, on forest land by species group, **species**, and ownership group, Lake States ceded territories, 2013

Table LSCT-30.—Average annual removals of growing-stock trees (at least 5 inches d.b.h.), in million cubic feet, on timberland by species group and ownership group, Lake States ceded territories, 2013

Table LSCT-30a.—Average annual removals of growing-stock trees (at least 5 inches d.b.h.), in million cubic feet, on timberland by species group, **species**, and ownership group, Lake States ceded territories, 2013

Table LSCT-31.—Aboveground dry weight of live trees (at least 1 inch d.b.h./d.r.c.), in thousand dry short tons, by owner class and forest-land status, Lake States ceded territories, 2013

Table LSCT-32.—Aboveground dry weight of live trees (at least 1 inch d.b.h./d.r.c.), in thousand dry short tons, on forest land by species group and diameter class, Lake States ceded territories, 2013

Table LSCT-54.—Area of forest land, in thousand acres, by inventory unit, state, county, and forest-land status, Lake States ceded territories, 2013

Table LSCT-55.—Area of forest land, in thousand acres, by inventory unit, state, county, ownership group, and forest-land status, Lake States ceded territories, 2013

Table LSCT-56.—Area of forest land, in thousand acres, by inventory unit, state, county, and forest-type group, Lake States ceded territories, 2013

Table LSCT-57.—Area of timberland, in thousand acres, by inventory unit, state, county, and stand-size class, Lake States ceded territories, 2013

Table LSCT-58.—Area of timberland, in thousand acres, by inventory unit, state, county, and stocking class, Lake States ceded territories, 2013

Table LSCT-59.—Net volume of growing-stock trees (at least 5 inches d.b.h.), in million cubic feet, and sawtimber trees, in million board feet **(International 1/4-inch rule)**, on timberland by inventory unit, state, county, and major species group, Lake States ceded territories, 2013

Table LSCT-59a.—Net volume of growing-stock trees (at least 5 inches d.b.h.), in million cubic feet, and sawtimber trees, in million board feet **(Doyle rule)**, on timberland by inventory unit, state, county, and major species group, Lake States ceded territories, 2013

Table LSCT-59b.—Net volume of growing-stock trees (at least 5 inches d.b.h.), in million cubic feet, and sawtimber trees, in million board feet **(Scribner rule)**, on timberland by inventory unit, state, county, and major species group, Lake States ceded territories, 2013

Table LSCT-60.—Average annual net growth of growing-stock trees (at least 5 inches d.b.h.), in million cubic feet, and sawtimber trees, in million board feet **(International 1/4-inch rule)**, on timberland by inventory unit, state, county, and major species group, Lake States ceded territories, 2013

Table LSCT-60a.—Average annual net growth of growing-stock trees (at least 5 inches d.b.h.), in million cubic feet, and sawtimber trees, in million board feet **(Doyle rule)**, on timberland by inventory unit, state, county, and major species group, Lake States ceded territories, 2013

Table LSCT-60b.—Average annual net growth of growing-stock trees (at least 5 inches d.b.h.), in million cubic feet, and sawtimber trees, in million board feet **(Scribner rule)**, on timberland by inventory unit, state, county, and major species group, Lake States ceded territories, 2013

Table LSCT-61.—Average annual removals of growing-stock trees (at least 5 inches d.b.h.), in million cubic feet, and sawtimber trees, in million board feet **(International 1/4-inch rule)**, on timberland by inventory unit, state, county, and major species group, Lake States ceded territories, 2013

Table LSCT-61a.—Average annual removals of growing-stock trees (at least 5 inches d.b.h.), in million cubic feet, and sawtimber trees, in million board feet **(Doyle rule)**, on timberland by inventory unit, state, county, and major species group, Lake States ceded territories, 2013

Table LSCT-61b.—Average annual removals of growing-stock trees (at least 5 inches d.b.h.), in million cubic feet, and sawtimber trees, in million board feet **(Scribner rule)**, on timberland by inventory unit, state, county, and major species group, Lake States ceded territories, 2013

Treaty Area Table Titles

Table LSCT-62a.—Percentage of area by land status, **1836 Treaty area (Lower Peninsula)** of the Lake States ceded territories, 2013

Table LSCT-62b.—Percentage of area by land status**, 1836 Treaty area (Upper Peninsula)** of the Lake States ceded territories, 2013

Table LSCT-62c.—Percentage of area by land status, **1837 Treaty area** of the Lake States ceded territories, 2013

Table LSCT-62d.—Percentage of area by land status, **1842 Treaty area** of the Lake States ceded territories, 2013

Table LSCT-62e.—Percentage of area by land status, **1854 Treaty area** of the Lake States ceded territories, 2013

Table LSCT-63a.—Area of forest land, in thousand acres, by forest-type group, ownership group, and forest-land status, **1836 Treaty area (Lower Peninsula)** of the Lake States ceded territories, 2013

Table LSCT-63b.—Area of forest land, in thousand acres, by forest-type group, ownership group, and forest-land status, **1836 Treaty area (Upper Peninsula)** of the Lake States ceded territories, 2013

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The Lake States ceded territories are the portions of northern Michigan, northeastern Minnesota, and northern Wisconsin that were ceded by tribes of the Ojibwe to the government of the United States of America in the treaties of 1836, 1837, 1842, and 1854. The tribes retain rights to hunt, fish, and gather in the 1837, 1842, and 1854 treaty areas. This report summarizes the results of a series of forest inventories in the region between 1980 and 2013. Inventory results show the region has 30.7 million acres of forest land with forests covering 65.3 percent of the total land area. Forest features reported here focus on the status of six species of trees (sugar maple, black ash, paper birch, northern white-cedar, hophornbeam, and balsam fir) that have special historic and cultural value to the Ojibwe, in addition to the standard reporting of volume, biomass, growth, removals, and mortality of all trees that are typically included in the state-level reports produced by the Forest Inventory and Analysis program of the U.S. Forest Service. Sections of this report also focus on carbon, standing dead trees, invasive plant species, and ground flora.

KEY WORDS: Ojibwe, FIA, GLIFWC, nontimber forest products, tribal forest resources

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