Forestry and Tree Planting in Michigan

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Abstract

At the start of the 20th century, the pine forests of northern Michigan were largely depleted. In their place were large areas that had been devastated by years of forest fires and attempts to farm the poor soils. With the advent of the State Forestry Commission, the U.S. Department of Agriculture (USDA), Forest Service, and research at Michigan Agricultural College (now Michigan State University) planting on these cutover lands began in the early 1900s. At about the same time, the first forest tree seedling nurseries were established to provide seedlings for these planting projects. The planting of burned, cutover, and tax-reverted lands and the establishment of new seedling nurseries were accelerated by the work of the Civilian Conservation Corps in the 1930s. Today, the Forest Resources Division of the Michigan Department of Natural Resource and the USDA Forest Service, along with commercial and private forest landowners, continue the management and reforestation efforts of Michigan forests.

Introduction

Michigan is unique among all the States because it is composed of two peninsulas surrounded by four of the five Great Lakes. The State of Michigan covers 56,809 mi^2 (147,134 km^2) of land and 40,001 mi^2 (103,602 km^2) of water, of which 38,192 mi^2 (98,917 km^2) is part of the four Great Lakes that border Michigan. The geography of Michigan is quite varied. The eastern Upper Peninsula and the eastern Lower Peninsula are relatively flat, the western Lower Peninsula is somewhat rolling, and the northwestern Upper Peninsula is mountainous. The State elevations range from a low of 571 ft (174 m) at Lake Erie in the southeast Lower Peninsula to a high of 1,979 ft (174 m) at Mount Arvon in the western Upper Peninsula. The climate of Michigan is also quite varied. The southern one-third of the State has hot summers and cold winters and the northern two-thirds of the State have short, mild summers and cold to very cold winters. Some areas of northern Michigan average nearly 200 in (508 cm) of snow per year (State of Michigan 2013).

Most of the pre-European settlement land was forested, with portions of the southern Lower Peninsula in prairie and oak savanna. Today, about 50 percent of the State's land is covered with 19.3 million ac (7.8 million ha) of forest, of which 18.6 million ac (7.53 million ha) are considered capable of producing commercial timber (Pugh and others 2012). Most of the commercial timberland is in the northern two-thirds of the State, while agriculture and urban development dominate the southern one-third. Michigan's forest-related industries, recreation, and tourism supports 200,000 jobs statewide and annually contributes $121 billion to the State's economy (Michigan State University Extension 2013).

Recreation and tourism in particular are a vital part of the economy of Michigan. Michigan is a national leader in the number of licensed deer hunters and registered snowmobiles and boats. The Michigan Department of Natural Resources and the U.S. Department of Agriculture (USDA), Forest Service maintains an extensive system of hiking, skiing, snowmobile, and off-road vehicle trails. Both agencies also provide rustic and modern campgrounds throughout the State. In addition, two national lakeshores, six national wildlife refuges, and three national parks are in Michigan.

Michigan's Forests

Michigan's forests, as well as the ownership of the forest lands, are quite diverse. The forests range from those species normally associated with the central hardwoods: oak (*Quercus* spp.), elm (*Ulmus* spp.), ash (*Fraxinus* spp.), hickory (*Carya* spp.), and pine (*Pinus* spp.) in the south to more northern boreal species such as spruce (*Picea* spp.), fir (*Abies* spp.), and birch (*Betula* spp.) in the north (figure 1). The ownership of these forest lands also varies within the geographical area of the State with the southern one-third of the State being almost completely in private ownership, and the northern two-thirds in public and corporate ownership (figures 2 and 3).

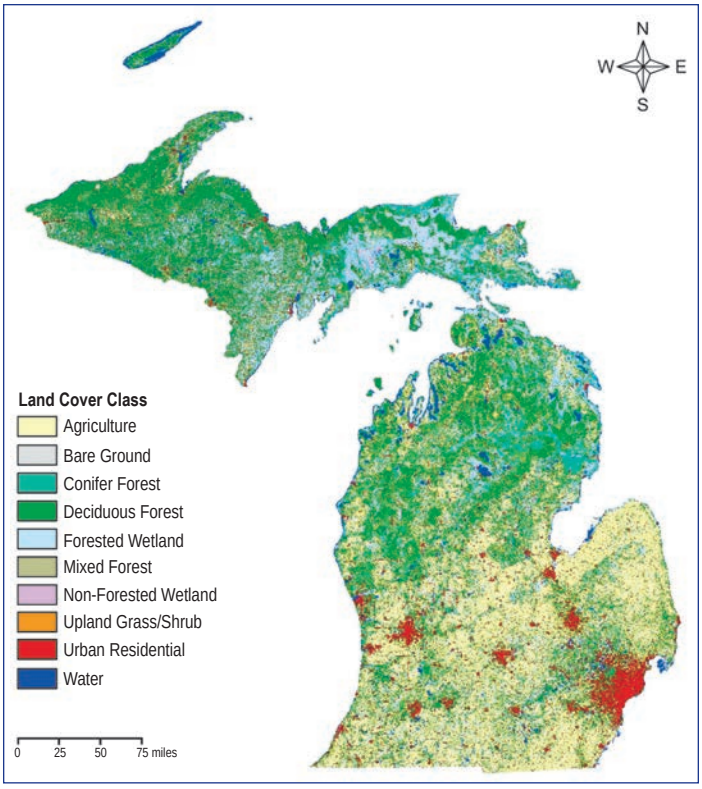

Figure 1. Michigan land cover, circa 2000. (Source: Michigan Department of Natural Resources)

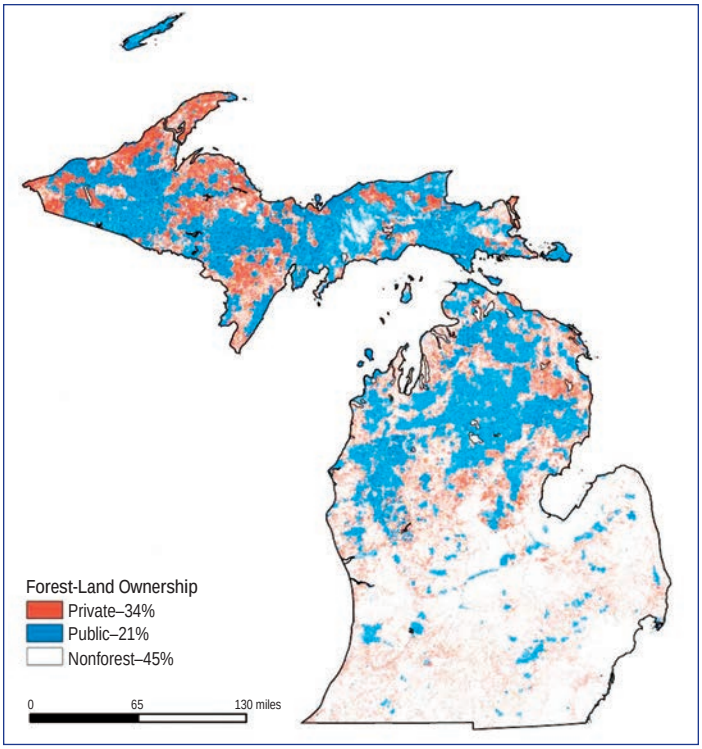

Figure 2. Forest land ownership in Michigan. (Source: Michigan Geographic Library 2010)

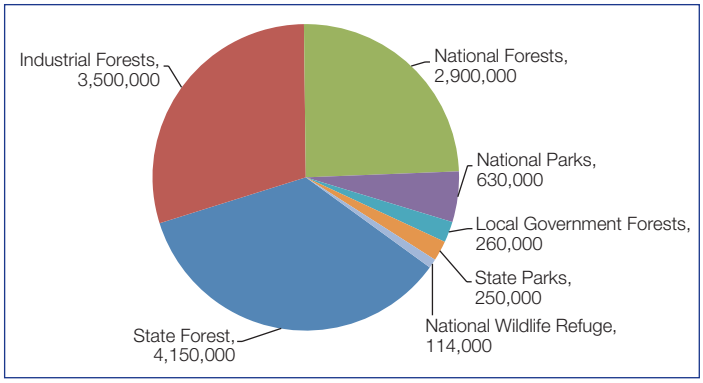

Figure 3. Forest ownership in Michigan by owner and acreage. (Source: Michigan Department of Natural Resources 2013)

Forest Types

In Michigan, 14 main forest types are classified by the USDA Forest Service Forest Inventory and Analysis (FIA) program data (table 1). The most abundant is the northern hardwood type, with about 71 tree species associated with it. Sugar maple (*Acer saccharum* Marsh.) is the major species in the northern hardwood type; other major components are red maple (*Acer rubrum* L.), beech (*Fagus grandifolia* Ehrh.), yellow birch (*Betula alleghaniensis* Britton), eastern hemlock (*Tsuga canadensis* L.), and black cherry (*Prunus virginiana* L.). Elm (*Ulmus* spp.), at one time, was also a major component of this type but was virtually eliminated by the Dutch elm disease in the mid- to late 1900s. Nearly all of this forest type is regenerated by natural reproduction (Barnes and Wagner 1981).

The second most prevalent forest type is aspen. This forest type consists mainly of two species of aspen: quaking aspen (*Populus tremuloides* Michx.) and bigtooth aspen (*P. grandidentata* Michx.). Also associated with this forest type is paper birch (*Betula papyrifera* Marsh.), balsam fir (*Abies balsamea* L.), and eastern white pine (*Pinus strobus* L.). This forest type is regenerated by clearcutting and allowing the shoots to develop along the roots of the parent tree in a process known as suckering.

Table 1. Michigan's forest types.

Forest type	Number of tree species	Acreage
Northern hardwoods	71	7,161,000
Oak/hickory	63	1,982,000
Swamp hardwoods	57	1,627,000
Aspen	50	2,676,000
Red pine	40	897,000
Northern white cedar	36	1,349,000
Paper birch	35	292,000
Balsam fir	32	563,000
White pine	32	234,000
Balm-of-Gilead	27	190,000
Jack pine	26	846,000
White spruce	25	147,000
Black spruce	22	465,000
Tamarack	22	149,000

Source: Pugh and others 2012

The two forest types that are most commonly regenerated by artificial methods are jack pine (*Pinus banksiana* Lamb.) and red pine (*P. resinosa* Ait.). In Michigan, most of the forest tree planting by acreage is of these two species. Clearcut stands of these two species are scarified and direct seeded, disc trenched and hand planted, or machine planted. For both species, the planting stock used is either a greenhouse container grown plug or a 2- to 3-year-old bareroot seedling.

History of Michigan Forests

Michigan has a long history of human interaction with its abundant natural resources. Humans first settled in the area about 10,000 years ago. When the first European explorers arrived in the early 1600s, about eight native tribes were scattered throughout the State with most being in the Lower Peninsula. Most of the native settlements were along rivers and the shores of the Great Lakes, because these waterways were the natives' major means of transportation. The first Europeans in the region were predominantly fur trappers and traders who were primarily interested in the lucrative beaver pelt trade with Europe. Exploitation of the forest resources did not begin to any large extent until the opening of the Erie Canal and the extensive settlement of Europeans in the early 1800s. The southern one-third of the State, which has the best agricultural soils and growing conditions, was deforested and settled by the middle of the 1800s. This area is still the main agricultural area. By 1880, Michigan became the leading timber producer in the country; the vast tracts of pine from the northern two-thirds of the State supplied lumber for the rapidly growing cities of the Midwest (Michigan Forest Products Council 2013).

Early Lumbering Era

Logging of eastern white pine began in Michigan in the 1850s and reached its culmination in 1890 with lumber production of 5.5 billion board feet. By 1910, eastern white pine had been mostly depleted. Lumber production dropped to a low of less than one-half billion board feet in the 1950s. This tremendous boom in timber production lasted about 100 years and is now known as the "Early Lumbering Era."

The prevailing wisdom of the Early Lumbering Era was that 'The plow will follow the axe,' meaning that the clearing of the forests also cleared the way for farming on what was anticipated to be highly productive land. Some of it was highly productive, but most did not prove to be suitable for farming. During the Early Lumbering Era, farmers tackled the task of clearing slash from cutover lands to put them into crop production. Some timber was found to be suitable for construction of homes, barns, fences, and other farm structures; the rest was burned. The practice of slash burning by farmers led to unthinkable conflagrations that destroyed homes and towns and cost the lives of many farmers and farm families. Three notable years were: (1) 1871 when 2 million ac (809,370 ha) burned and more than 200 lives were lost, (2) 1881 when 1 million ac (404,685 ha) and 282 lives were lost, and (3) 1908 when 2.4 million ac (974,245 ha) burned and 29 lives were lost (Botti and Moore 2006).

The Michigan landscape became more prairie-like than forest. As a result, prairie wildlife moved in and found a home. Prairie chickens, sharptail grouse, and coyotes were some of the species that found the new landscape to their liking. At the same time, fires continued to sweep the land, thwarting any efforts at forest regeneration, either natural or artificial. Much of northern Michigan became stump-filled grassland.

Early Reforestation Efforts

The Michigan Forestry Commission, established in 1887, conducted surveys of pine regeneration in the 1890s and found that ample numbers of young white pines were sprouting, but were inevitably wiped out by uncontrolled fires. A method of fire control was needed if reforestation efforts were to be successful.

In 1903, the Michigan Legislature dedicated about 34,000 ac (13,800 ha) of tax-reverted land as the first State forest in Michigan. The location was the area around Higgins and Houghton Lakes, in the north central Lower Peninsula. That area forms the headwaters of three major Michigan Rivers: the AuSable, the Manistee, and the Muskegon. A nursery was established at Higgins Lake. In the same year, plans began for restoring the State forest land to a productive condition. Soon after, several other State forests were dedicated throughout the northern two-thirds of the State.

The first order of business to restore the land was figuring out how to control the fires. Fire trucks and double-moldboard fireplows did not exist at this time. The answer to the fire problem was a system of fire lines that were 12 ft (3.7 m) wide, made with a horse and plow, and exposed bare sand, which is about as fireproof as anything can be. The lines were spaced 0.25 mi (0.4 km) apart in a grid pattern forming 40-ac squares (16.2 ha total) inside the grid. When a fire broke out,

it would burn up to a plow line and stop. Thus, the fires were brought under control on the State forests and reforestation began. Later, lookout towers were established and specialized fire-fighting equipment was developed at the Forest Fire Experiment Station at Roscommon, near Higgins and Houghton Lakes (Mitchell and Robson 1950).

Early reforestation on State lands focused on restoration of the pine ecosystem. Early plantings took place on the old stump fields, first using hand-planting crews with the Civilian Conservation Corps (CCC) or local labor sources, and later, in the 1950s, with planting machines developed at the nearby Forest Fire Experiment Station (figure 4). Much of the land in the stump fields had become locked into heavy quack grass (*Elymus repens* L.) sod that was serious competition for young pine seedlings. The new planting machines addressed the sod issue with a double moldboard that flipped the sod both right and left as the machine was pulled through the ground. That left a strip 8 to 10 in (20 to 25 cm) wide that was sod free and allowed newly planted pine seedlings to become established before the sod moved back in.

The new planting machines created another problem, however, because the quack grass harbored thousands of white grubs, the larvae of June bugs. These grubs crawled along the slit in the ground made by the planting machine and were very efficient at eating the pine seedling roots. It was common to see flocks of blackbirds walking the furrows behind the planting machines eating the grubs that were turned up. But the birds didn't come close to getting them all; that was the next hurdle to overcome.

In the 1950s and 1960s, the insecticide Aldrin was used to control the grub damage. Spray nozzles were added to the planting machines in such a way that the planter could tap a foot pedal and deliver a squirt of Aldrin on the roots of each seedling as it was planted. This approach was effective but was discontinued by the mid-1970s when the public became concerned about the effects of persistent pesticide use.

State forest planting peaked during the CCC years, 1933 to 1942, during which time nearly 485 million trees were planted on cut-and-burned land in Michigan (Symon 1983), an incredible average of nearly 48 million trees per year. Focus was still on restoring pine to the land where it had grown so well. Planting continued in this restoration mode until about 1975, when only about 300,000 trees were planted on State lands. The pine stump fields were pretty well planted up by then, but that did not mean a need for planting no longer existed.

Recent and Current Reforestation in Michigan

State foresters had experimented with direct seeding and natural regeneration of jack pine through the 1960s and early 1970s with mixed results. Strip clearcuts initially showed promise, but insect problems, most notably jack pine budworm, prevented the young trees from growing up. Clearcutting seemed to be the most practical and effective method of regenerating jack pine. Some areas had sufficient moisture to allow for direct seeding success; other areas needed to be planted to assure success. A new era in Michigan reforestation was dawning. The State had moved from a focus on restoration to one of maintenance.

By 1970, the openings resulting from the 19th century fires were back in production and attention was turned to keeping up with the harvesting of jack pine and red pine. New

Figure 4. Tree planting in Michigan in 1955 (left) and 1962 (right) with machines developed at the Forest Fire Experiment Station. (Photos from MDNR files)

equipment was needed to plant through fresh stumps and slash. A combination of Whitfield Forestland Planters and FESCO®/Mathis Plow Company lift type v-Plows mounted on John Deere 550 bulldozers filled the bill, and the reforestation of pine lands could keep up with the harvest level. This machine-planting configuration began around 1980 and served well for about 10 years (figure 5).

In the late 1980s, foresters began to have difficulty finding part-time help to operate the rented bulldozers. So, rather than risk serious injury to planters, a transition was made to contract hand-planting crews. That planting method has proven to be reliable and effective and is still in use today.

The development and use of refrigerated vans to haul trees from the nursery and store them on the planting site allowed for better survival rates and longer planting seasons. Mead Paper Company of Escanaba led the way on this effort. The company found that they could buy used vans after a change in Wisconsin law allowed longer trailers on their highways. The older, shorter, vans could be purchased for a fraction of the price of a new van. Michigan eventually purchased seven of these used refrigerated vans for a total of about $35,000—a cost equivalent to the price of one new one. Seedlings were thus delivered to the planting site in good condition and were kept under refrigeration until the day they were planted. The result was increased survival and extension of the planting season by 3 or 4 weeks.

After a century of reforestation, both natural and artificial, Michigan's forests have rebounded from the exploitation and fires of the late 19th century. The prairie chickens have disappeared altogether, and only a few remnant flocks of sharptail grouse remain. The coyote, however, will likely be here forever. Many birds and mammals of the mature forest have returned—eagles, osprey, various warblers, fisher, pine martens, and timber wolves are finding homes in Michigan's forests once again. It's a great story of resilience and recovery of the forest resource accomplished over a century with a little help from mankind.

Tree Seedling Production in Michigan

Private Nurseries

Compared with other States, Michigan has always had a large number of private tree seedling nurseries. The major markets for these nurseries have been seedlings for the Christmas tree industry and reforestation. Over the years, the number of these nurseries has varied because of the cyclic nature of the Christmas tree market. Today, about 25 private tree seedling nurseries are in Michigan producing about 10 million seedlings per year. A large percentage of these seedlings are sold for Christmas tree production and the rest are sold for reforestation or for transplanting to grow into larger nursery stock. With 54,000 ac (22,000 ha) on 830 farms currently producing 3 million Christmas trees annually, Michigan is ranked fourth in the Nation in production. Michigan Christmas tree growers grow more species for Christmas trees than any other State. More than a dozen species of trees are currently sold for Christmas trees. Scotch pine (*Pinus sylvestris* L.) historically has been the most widely planted species. In recent years, the trend has been toward production of more true firs (*Abies* spp.); Fraser fir (*A. fraseri* Pursh), concolor fir (*A. concolor* [Gord. & Glend.]), Korean fir (*A. koreana* E.H. Wilson) and Cannan fir (*A. balsamea* var. *phaneroepis*), are now widely planted. Although true firs take longer to grow than many of the pine and spruce species, they produce a higher value product.

Figure 5. Whitfield planting machines (left and right) mounted on John Deere bulldozers were used for several years, circa 1980. (Photos from MDNR files)

Federal Nursery

The USDA Forest Service, Ottawa National Forest, operates the J.W. Toumey Nursery in Watersmeet, MI. The nursery was named after James Toumey who was a forester with the Division of Forestry (predecessor of the USDA Forest Service) and the second dean of the Yale School of Forestry. The nursery was established in 1935, and is currently the only USDA Forest Service nursery in the USDA Forest Service Eastern Region. The nursery encompasses 110 ac (44.5 ha) with 66 ac (26.7 ha) currently in production. Current annual production is approximately 4 million bareroot tree seedlings, with a total inventory of about 8 million. In addition to the bareroot seedlings, the J.W. Toumey Nursery also produces 500,000 containerized seedlings annually using two greenhouses, and also produces native grass, forb, and shrub species for distribution to the national forests in the Lakes States area. The nursery is home to the Eastern Region seed bank and provides seed cleaning, storage, and tracking for national forests in the USDA Forest Service Eastern Region.

State Nursery

The Forest Resources Division of the Michigan Department of Natural Resources (MDNR) operates the Wyman Nursery in Manistique, MI. The nursery was named for Thomas B. Wyman who trained foresters at the Wyman School of the Woods in Munising, MI, from 1908 to 1918. The USDA Forest Service constructed the nursery using CCC members in the early 1930s. The USDA Forest Service operated the nursery until 1943, when it was closed because of a lack of labor force during World War II. One of the last crops the USDA Forest Service grew at the Wyman Nursery was 23.0 ac (9.3 ha) of kok-saghyz, (*Taraxacum kok-saghyz* L.E. Rodin) commonly known as Russian or rubber dandelion. That species was grown as part of a national experiment to find domestic sources of latex for rubber for the war effort (Barnett 2005). The USDA Forest Service never reopened the nursery; they were able to meet their planting stock needs from their other two nurseries, Chittenden Nursery near Wellston, MI, and the J.W. Toumey Nursery at Watersmeet, MI.

The Michigan Department of Natural Resources acquired the Wyman Nursery in 1950 and began producing tree seedlings for planting on 4.1 million ac (1.7 million ha) of State forest lands. Since 1950, the Wyman Nursery has produced 237 million seedlings. At various times the Michigan Department of Natural Resources operated four State forest nurseries. Today, the Wyman Nursery is the only operational State forest nursery in Michigan. The Wyman Nursery currently produces from 5.0 to 7.5 million bareroot seedlings per year on about 70 ac (28.3 ha) of nursery beds (figure 6). All of the

Figure 6. Two-year-old jack pine seedlings growing at Michigan's Wyman Nursery. (Photo from MDNR file 2010)

seedlings are grown for planting on State forests, State game areas, and State parks. The main species grown at the nursery are jack pine, red pine, eastern white pine, and northern red oak (*Quercus rubra* L.) (Michigan Department of Natural Resources 1989).

Kirtland's Warbler

One of the most successful and innovative tree planting programs in Michigan during the past 40 years has been the dedication and restoration of nesting habitat for the endangered Kirtland's warbler (*Dendroica kirtlandii* S.F. Baird) (figure 7). The Kirtland's warbler is one of the rarest of the wood warbler family (Parulidae). Its nesting range is in a few areas in Wisconsin, northern Ontario, and northern Michigan. The largest nesting concentration is in a few counties in the north central Lower Peninsula. This warbler is unique in that it nests on the ground only in large dense blocks of 5- to 20-year-old jack pine. About 150,000 ac (61,000 ha) are currently on public land dedicated for Kirtland's warbler habitat in the core nesting areas. Of this acreage, 38,000 ac (15,000 ha) are intensely managed on a 50-year rotation to provide continuous nesting habitat. The Michigan Department of Natural Resources, USDA Forest Service, and the U.S. Fish and Wildlife Service plant 3 to 5 million jack pine seedlings annually to maintain this habitat. Since the Kirtland's warbler is territorial, the best way to estimate its population is by an annual singing male census, where biologists count the number of singing males in the nesting areas. Because of this intensive regeneration work in the jack pine habitat, the annual singing male census in the core nesting area has increased from fewer than 200 in 1971 to more than 1,800 male warblers in 2011 (Michigan Department of Natural Resources 2013).

Figure 7. Tree planting programs in Michigan have been dedicated to restoring habitat for the rare Kirtland's warbler. (Photo from David Kenyon, MDNR 2006)

Forest Pests and Diseases

Much of Michigan's public forest land was acquired by tax reversion. Most of this land was originally old growth red and white pine which had been clearcut to meet a burgeoning demand for lumber for projects such as rebuilding Chicago after the fire of 1871. The resulting slash fueled great fires, which reportedly burned from the shores of Lake Michigan to Lake Huron. As a result, lichens replaced the organics in many of the light soils that supported pure conifer forests. These lichens rob the soils of much of the moisture provided by low to moderate rainfalls. Thus, regenerating such sites was a challenge in doughty years. White pine blister rust spurred the CCC to hand-pull hundreds of acres of *Ribes*.

Insects like the redheaded pine sawfly took advantage of these insect stresses and stresses from vegetative completion to build damaging populations. The Saratoga spittlebug damaged both young red and jack pine where sweet-fern was associated. Where winter snow accumulation in Michigan's Upper Peninsula often exceeds 4 ft, Scleroderris canker sets both red and jack pine back until they can attain a height of 6 ft. These challenges still exist today. New challenges include Diplodia shoot blight, which prevents using natural regeneration systems for red pine. On the hardwood front, both the Emerald Ash Borer and Beech Bark Disease have greatly impacted the forests of Michigan. The diseases have led to the loss of mature ash and beech; both of these species continue to send up sprouts that have little chance of maturing. Many of these sites will require planting to increase tree species diversity and to capture the productivity of the sites once again.

Future

Exactly like the past, when Michigan residents overcame many challenges to restore the productivity of the forests, future forest productivity in Michigan faces many problems. Climate change, exotic insect and disease pests, urban expansion, and forest fragmentation are only a few of the challenges that will engage foresters and nursery managers of today and tomorrow. With dedicated university research, proper land management, continuing education, and an appreciation and knowledge of past practices, these professionals will ensure that the forests of Michigan will continue to provide timber resources, recreational opportunities, wildlife habitat, and a quality of life for all citizens of Michigan.

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