State forest history

Glaciation to 1500s

The present physical geography of the state of Michigan is a direct result of the Wisconsin glaciation of the Pleistocene Epoch, the last major glacial episode that totally covered the state with ice. As the ice sheet gradually receded, southern Lower Michigan became mostly ice-free approximately 13,000 years ago. Native Americans settled on and utilized this post-glacial landscape, entering Michigan as early as 13,000 years ago (Talbot, Wright and Nash 2021). Upper Michigan became ice-free approximately 10,000 years ago. The landform and soils of Michigan are the result of post-glacial lakes, rivers, erosion and soil development processes acting upon the glacial deposits, resulting in diverse terrain. These features include moraines, drumlins, eskers, kames, outwash plains and former lake beds that are interspersed with numerous lakes, streams and depressions, including four of the world's largest freshwater lakes in the Great Lakes.

It was upon this raw post-glacial landscape that life gradually returned. The primary succession of plant life was heavily influenced by the nature of the glacial rock and sediment deposits, the climate (still very much influenced by the receding ice sheets) and the formation and disappearance of lakes formed at the edge of retreating glaciers. Theories of the succession of plant life from barren soil to tundra, and the migration of forest tree species and some animal species, are well established (Davis 1981; Pielou 1991). This post-glacial succession and development was driven by initial warming trends until approximately 5,000 years ago, when a gradual cooling cycle, which lasted 2,000 years, began (Andreson et al. 2012).

These climatic fluctuations were followed by changes in vegetation, from boreal to xeric to mesic, which remains as the primary contemporary vegetation condition. The resultant diversity in forest, savanna and aquatic plant and animal communities was also distinctly influenced by Indigenous cultures that inhabited the two peninsulas, most notably through hunting and fishing activities and their interaction with the pattern and intensity of fire on both savanna grasslands and pine lands. A comprehensive description of the complexity of the post-glacial climatic and human interaction with plant and animal communities can be found in Pielou 1991.

Michigan's terrestrial landscape is comprised of four distinct ecoregions: Southern Lower Peninsula, Northern Lower Peninsula, Eastern Upper Peninsula and Western Upper Peninsula. Each ecoregion is distinct in its climate, physical features, soils and vegetation. These distinctions are a result of the peninsular configuration of the state, which creates dramatic climatic differences on both peninsulas. The distinctiveness of the warm, vegetatively diverse Southern Lower Peninsula and the cold Upper Peninsula is largely due to their latitudinal positions and the continental land masses on their southern borders. The four Great Lakes that surround the state also provide a significant influence upon the climate in portions of both peninsulas (Albert 1995).

What is known of the circa-1800 Michigan vegetation communities is based on an interpretation of the federal government's General Land Office surveys from 1816 to 1856, with surveys of the Lower Peninsula beginning in 1816 and surveys of the Upper Peninsula beginning in 1840. The interpretation of cover types on these maps is drawn from section line and corner witness trees, similar landform, surface geology and soils data. Inclusions of dissimilar cover types that do not intersect a section line may not be

reflected upon the maps. Despite these limitations, the GLO survey maps provide a consistent landscape-level perspective of cover types around 1800. The maps are useful for assessing the type and scale of Indigenous settlement disturbance regimes (fire, flooding, wind, insects and disease) and for identifying the locations of historic and presently rare natural communities, and, by comparison, broad European settlement trends for different cover types.

The forest and other vegetation communities that existed circa 1800 consisted of a mosaic ranging from Indigenous-influenced savanna grasslands and southern hardwood forests in the southern Lower Peninsula to northern hardwood and pine forests in the northern Lower and Upper peninsulas. The Indigenous settlement landscape was dynamic, with community types in various stages of ecological succession, driven by long-term shifts in climatic conditions and short-term natural and human-influenced disturbance cycles. Four community types dominated the northern Lower and Upper Peninsula landscapes at the time of the GLO surveys: the beech-sugar maple-hemlock northern hardwoods community, the beech-sugar maple southern hardwoods community, hemlock-dominated communities and the mixed conifer swamp community. Eight other communities occurred on the landscape: mixed oak savanna, oak/pine barrens, beech-sugar maple-northern hardwoods without hemlock, mixed oak/hickory forest, mixed hardwood swamps, red/white pine forests, white pine/mixed hardwoods and cedar swamps. Lesser communities were spruce/fir/cedar forests, seral aspen/birch forests and black ash swamps.

Pine communities covered 4.1 million acres, or 11.8% of the forested landscape. These included white pine-, red pine- or jack pine-dominated forests, mixed red/jack pine forests, mixed pine/oak forests and the previously cited red/white pine forests and white pine/mixed hardwood forests. The pine forest communities were fire-driven ecosystems, dependent upon occasional catastrophic, stand-replacing fires for regeneration and frequent, low-intensity fires that eliminated competition and – in combination with wind, insects and disease – created a patchy structure. Conservative estimates of recurrence intervals for fires in jack pine forests in the northern Lower Peninsula and Upper Peninsula ranged from 59 to 140 years. For red and white pine stands, estimates of recurrence intervals in the region ranged from 130 to 240 years, although they were likely more frequent in areas of Indigenous influence (Whitney 1986; Price 1994; Cleland et al. 2004, Kipfmueller et al. 2021).

White pine communities were maintained by a repeating, cyclical sequence of catastrophic fires, with light surface fires occurring at shorter intervals (Frelich 1992). White pine occurred most abundantly in areas where catastrophic fire took place every 150 to 300 years. More frequent fires, toward the 100- to 150-year interval, tended to favor red pine. Intervals greater than 300 years tended to succeed to northern hardwoods. As a midsuccessional species, white pine occurred most frequently with red pine and most often followed jack pine (Frelich 1992). Noncatastrophic surface fires occurred at intervals of 20 to 40 years (Frissel 1973 as cited in Frelich 1992) and tended to kill hardwoods invading the understory. Gaps created by winds and surface fires created diversity in diameter distributions and formed increasingly multi-aged stands. White pine stands may have been maintained in the old-multi-aged stage for one to several centuries (Heinselman 1981), until another catastrophic disturbance came along.

The complexity of the landscape, composition and structure of circa-1800 forests is due to the underlying glacial landforms in the northern Lower Peninsula. Strong associations are evident between beech, sugar maple and hemlock on medium- and coarse-textured end moraines and coarse-textured

ground moraines. On fine-textured ground moraines and lacustrine deposits, hemlock, white pine and beech were dominant. Fine-textured end moraines were dominated by hemlock and red and white pine. Outwash plains were dominated by communities of jack, white and red pine. The diversity of circa-1800 forests is also reflected through analysis of a northern hardwoods community in Chippewa County, Michigan. Some elements of community structure are apparent by the density of 141 trees per acre (with sugar maple, hemlock, yellow birch and beech dominating in number) and the basal area of 154 square feet per acre (with hemlock, sugar maple, yellow birch and white pine dominating the canopy of the forest).

The complex community composition in the circa-1800 northern hemlock-hardwood forest community was driven by a combination of long-term, climate-driven trends and adaptations to disturbance exhibited by different tree species. A contemporary study of the Sylvania Wilderness Area in the western Upper Peninsula is informative for understanding the historical development of this forest community (Davis et al. 1994). The study included an analysis of a paleoecological record of pollen, which showed a dominance of a very fire-prone red and jack pine community approximately 7,000 years ago, correlating to the peak warm period of the current interglacial period. During the subsequent cooling trend, a somewhat less fire-prone community of white pine, oak and red maple succeeded upon the site and dominated from 7,000 to 3,000 years ago, with an average fire recurrence interval of 150 to 340 years (Frelich 1992).

Rapid increases in the abundance of hemlock and yellow birch became evident in the pollen record starting 3,200 years ago, as the frequency of fires decreased, with intervals extending to 1,400 to 2,200 years (Whitney 1896; Price 1994). Sugar maple and basswood entered the forest soon after the invasion of hemlock and yellow birch, and windthrow gradually became the predominant form of disturbance, with recurrence intervals of approximately 1,200 to 2,200 years (Whitney 1986; Frelich and Lorimer 1991; Price 1994). Where the intervals between fires were long, the white pine-oak-red maple forest was succeeded by hemlock and yellow birch at some locations and by sugar maple, yellow birch and basswood at other locations (dependent upon different soil-related conditions). This gave rise to the mosaic of hemlock, sugar maple, yellow birch and white pine northern hardwood forests that dominated the circa-1800 period.

Before European settlement, grasslands such as wet meadows, oak and pine barrens, dry sand prairies and tall grass prairies were scattered throughout Michigan, with the largest acreage in the southern Lower Peninsula. At least 39 grassland areas were present, totaling about 2.3 million acres. Fire was an important element in establishing and maintaining these grasslands. Caused by lightning and often set purposely by Native Americans, fire stimulated grass, edible plant and wildflower growth, reduced competition and discouraged encroachment of shrubs and trees.

1600s to 1900

European settlement began soon after the Great Lakes region expeditions in the 1600s by French explorers Etienne Brule and Robert René Cavelier de La Salle, beginning with Jesuit missions at Sault Ste. Marie in 1668 and at St. Ignace in 1671. Ease of access for fur trading determined the location of other early French settlements in St. Joseph in 1679, Detroit in 1701 and at Fort Michilimackinac in 1715.

Michigan became a territory in 1805 and the 26th state in 1837. Following the GLO surveys in the southern Lower Peninsula, land was cleared for Euro-American-style agriculture at a relatively slow,

laborious pace. However, northern Michigan land surveys led to the American discovery of extensive pine forests and fueled a rush by timber speculators beginning in the 1850s.

Mid-1830s government figures estimated the volume of standing pine timber in Michigan to be 150 billion board-feet (approximately 300 million cords). The lumber boom started in the 1850s in the Saginaw River watershed and quickly spread west and north. By 1897, more than 160 billion board-feet of pine had been cut, with only about 6 billion board-feet of standing timber remaining, mostly in the Upper Peninsula. In a mere 70 years, most of the original pine and hardwood forests of Michigan were gone.

The first major U.S. mining boom began in Michigan's western Upper Peninsula in the 1840s, and mining has played a significant role in shaping the region's culture, economy and natural landscape ever since. To date, mining efforts in the region have focused primarily on iron ore and copper, though silver and gold also have been mined. The region still has an abundant mineral wealth. Michigan's copper range, the greatest deposit of native copper in the world, extends in a narrow band from just south of Ontonagon to the tip of the Keweenaw Peninsula. The Keweenaw copper range was the nation's largest producer of copper from 1847 to the 1880s and a significant contributor to the regional and state economies. From the 1840s to the 1960s, more than 11 billion pounds of copper (worth $440 billion in today's dollars) were shipped from the Keweenaw Peninsula, bringing about significant increases in the area's settlement and development during the 1800s. The discovery of surface copper deposits in the western U.S. led to the decline of mining and population in the Keweenaw Peninsula.

The first European discovery of Great Lakes iron ore occurred in 1844, when a surveying party's compass readings began to fluctuate wildly at the site that would become Negaunee. Iron ore deposits and mining in Michigan have essentially been restricted to three major ranges, the Menominee, Gogebic and Marquette ranges. The Menominee and Gogebic ranges have essentially closed to mining.

Mining activities have also left significant marks on the western Upper Peninsula landscape. Copper and iron ore are typically separated from extracted rock locally. Keweenaw copper deposits are incredibly pure and were separated by crushing the ore in large stamp mills. A byproduct of the process was crushed basaltic lava, or black "stamp sands," that were discarded, often covering natural Great Lakes shorelines and local streams. Iron ore stamping has produced vast amounts of waste rock deposited in tailings that often disrupt local ecological systems, including wetlands and streams.

Mines required large amounts of timber to provide shaft supports, construct commercial and residential mine buildings, and provide heat. Local iron ore smelting, occurring either at furnaces near mines or along the Great Lake shoreline, had a huge impact on the forest resource. Smelting was an energy-intensive process, with some western Upper Peninsula furnaces estimated to have burned about 30 acres of hardwood timber a day. Copper was not smelted, so in the Keweenaw, vast tracts of hardwood were not liquidated to provide charcoal during the mining boom.

Much of the Marquette iron was smelted in Fayette, Newberry or St. Ignace, as it was easier to bring the iron to the smelter than it was to bring bulky charcoal to the mines. The intensive cutting of eastern Upper Peninsula hardwoods had begun to feed these smelters. Land clearing continued, as some soils were conducive to farming. White cedar swamps were being harvested to support building houses.

In the late 1890s, hemlock was in great demand in the eastern Upper Peninsula to extract tannin from its bark for curing leather. The bark was brought to tannery sites in Munising, Manistique and Sault Ste. Marie. As they were cut over, most of the hemlock forests converted to other forest types. Human disturbance has affected hemlock more than any other species within the eastern Upper Peninsula (Verme, 1996).

The effects of fur trading, mining and logging severely altered the Anishinaabe (Ojibwe, Odawa and Potawatomi) relationship with Michigan's land, plants and animals. For thousands of years, Michigan's forests provided the Anishinaabe with the resources to meet their needs and, in turn, they treated the land with respect and as a relative. Euro-American practices, treaties and racism catastrophically affected that interdependent relationship.

Following logging of the forests, people tried to farm cut-over lands. Vast amounts of residual slash had to be cleared from the landscape, and a common practice was to burn it. This, combined with the release of cinders from steam locomotives, sparked a period of devastating wildfires, including the firestorm of October 1871, which burned about 2.5 million acres. Fires occurred continuously over the following six decades. Notable fires took place in September 1881 (over 1 million acres), October 1908 (2.4 million acres) and July 1911 (156,480 acres). These fires killed people and consumed slash, homes and millions of trees, with an estimated 73 billion board-feet of timber. It is estimated that for every two trees that were cut for lumber, one additional tree was destroyed – mostly due to the wildfires (Dickman and Leefers 2003).

European settlement also degraded inland lakes and streams and Great Lakes water resources. Land clearing for agriculture, logging and settlement altered local streamflow patterns and volumes, eliminated some waters and introduced pollutants into others. Huge quantities of sediment from log drives and sawdust from sawmills were dumped into rivers and lakes. The mouth of the Manistee River accumulated enough sawdust to form a delta of several square miles. At sawmill locations throughout the state, sawdust dispensed into rivers created toxic and oxygen-deprived conditions for fish. These detriments and land-clearing efforts that exacerbated soil erosion significantly reduced the quality of fish habitat in rivers and estuaries. Drainage of wetlands and shallow water tables for agriculture did likewise. Dam and road construction fragmented formerly interconnected waters and helped eliminate or reduce many highly migratory fish populations. Dam construction also caused severe water quality changes and eliminated rare, high-gradient river sections characterized by a steep slope and fast-moving water. Overfishing of the most productive and larger bodies of water eliminated or reduced fish populations.

Intensive commercial fisheries existed both in the Great Lakes and the large rivers, and the numbers of commercial fishers increased through the mid-1800s (Garling et al. 1995). Interest in recreational fishing increased as people had more time to recreate and better fishing equipment was developed. In 1859, 14 counties in Lower Michigan prohibited commercial fishing with nets to accommodate recreational fishing. By the late 1800s, recreational fishing was well established in inland waters, while commercial fishing still dominated in the Great Lakes. While habitat was compromised, enormous exploitation was also occurring.

The creation of the Michigan Fish Commission (the predecessor of the Department of Natural Resources Fisheries Division) in 1873 is directly linked to the demand for more fish in Great Lakes waters and more "desirable food fish" in inland waters. Michigan implemented fish stocking as a management tool and

continues the practice today. From 1873 to 1897, the Michigan Fish Commission stocked millions of lake whitefish and lesser numbers of many other species into Great Lakes waters to address the rapid declines in commercially important fish. Many of these Great Lakes species and numerous non-native fish species were also stocked in many inland waters. During this time, common carp and other popular species such as brown trout, rainbow trout and steelhead were introduced into inland waters.

Human activity during the European settlement period also had profound affects upon land-dwelling wildlife. Since wildlife is inextricably connected to the habitat that supports it, large-scale changes in vegetative cover such as timber harvest, fire, agricultural land conversion and subsequent reversions back to forest cover have influenced many trends in wildlife populations. Some species benefited from these changes, while others declined. Species that benefited from the change to open plains and early successional aspen forests are white-tailed deer, sharp-tailed grouse, ruffed grouse and American woodcock. Each experienced population booms in the early through mid-20th century due to additional habitat that resulted from clear-cutting forests. White-tailed deer populations were greatly influenced by harvest pressures. By 1876, market hunters were killing 70,000 deer each year to supply lumber camps and shipped what they could not sell locally to cities such as Chicago and Detroit. At about the same time, fires burned over large areas of early successional habitat, causing a loss of forage. These two factors then caused a rapid decline in deer numbers.

The decline of other species can also be directly attributed to overexploitation by hunting. Michigan gained prominence as a source of wild meat for large Eastern and Midwestern markets. Market hunters removed large numbers of waterfowl, shorebirds and small game for meat, while other birds were taken for their plumage for stuffing or to adorn hats.

The demand for wildlife as food led to overexploitation of many Michigan species. Wildlife species extirpated during and following this period include bison, elk, woodland caribou, cougar, wild turkey, passenger pigeon, trumpeter swan, fisher and American marten. Wildlife and invertebrate species nearly extirpated or greatly reduced in the state include beaver, gray wolf, moose, black bear, resident Canada goose, lake sturgeon, piping plover, Kirtland’s warbler, prairie warbler, Karner blue butterfly, frosted elfin, Persius dusky wing, dusted skipper, Ottoe skipper, Dukes' skipper and Mitchell’s satyr.

With the industrial age and the rise of modern agricultural methods, the reliance on wildlife as meat and revenue sources declined. In many cases, wildlife population declines were so severe that they could no longer support commercial activities. Public attitudes began to change, and recovery began by increasing enforcement of laws and regulations protecting wildlife. Michigan enacted a series of laws protecting various species. Michigan’s first salaried game warden (one of the first in the country) was appointed in 1887, and Michigan’s first deer hunting license was created in 1895. In 1897, a bill was introduced in the Michigan Legislature in a futile attempt to establish a 10-year closed season on passenger pigeons. Toward the end of the 19th century, the importance of wildlife as a commercial resource began to decline, and the importance of wildlife as an economic commodity began to evolve. The value of an animal was no longer simply measured by the price it would attract in a market. The value became recreational, measured by the amount of money spent on licenses, equipment and other amenities necessary for its pursuit. Sport hunting thus largely replaced commercial activity.

Contemporary history (1900 to the present)

Many European settlers found the climate and the sandy, burned-over soils of the northern Lower Peninsula and the Upper Peninsula to be marginally productive for farming and simply abandoned many areas. The State of Michigan thereby inherited a large portion of the cut-over pine lands of the area due to nonpayment of taxes during the early 20th century. By 1907, almost half of homesteaded land had reverted to the state. Many reverted several times after being repeatedly sold by the state, and the question of what to do with these lands was a serious public policy issue.

One answer came through the rise of a new industry in Michigan in the early 1900s: recreation and tourism. This provided a new use for the miles of Great Lakes shoreline, inland lakes and streams, and other remaining natural resources. This trend was closely related to the growth of the automobile, the state highway system and a middle class whose increasing wealth and free time resulted in greater demand for recreational opportunities. During this period, it was recognized that the regrowth of forests and the recovery of natural ecosystems was the foundation for the recreation and tourism industry's well-being.

The Forest Commission Act of 1899 established an authority to oversee forests and authorized using abandoned, cut-over lands for forest reserves. The Forest Reserve Act of 1903 authorized the Forestry Commission to establish a state forest reserve on about 34,000 acres in western Crawford and Roscommon counties, which was the beginning of the state forest system. The Forestry Commission was abolished in 1909 with the creation of the Public Domain Commission, which was charged with receiving tax-reverted lands and overseeing the increasing public domain.

The federal Forest Reserve Act of 1891 gave the U.S. president the authority to establish national forests. The Huron and Hiawatha national forests were subsequently established in 1909, the Ottawa National Forest in 1931 and the Manistee National Forest in 1938.

To stabilize the forest landscape, early managers recognized that protection from wildfire was required. The post-logging slash fires burned millions of acres across the state, with many lives and much property lost and many acres of forest consumed. The state Legislature enacted the Forest Fire Act of 1903, which first authorized the designation of a chief fire warden, who was placed in charge of a fire warden force to prevent and control forest fires. Fire towers were constructed between 1912 and 1942 to provide a network for early detection. When the State Department of Conservation (precursor to the present DNR) was created in 1921, fire control was a primary responsibility upon the state forest reserves. The Forest Fire Law of 1923 authorized fire control outside of state lands.

Since 1935, the general stability of forested land in Michigan can be attributed to forest fire control and forest management, including regeneration. Between 1933 and the start of World War II, the Civilian Conservation Corps fought forest fires and planted approximately 485 million trees in Michigan, including extensive pine restoration plantings on 134,000 acres (Dickman and Leefers 2003).

Work to restore game species also continued as the CCC restored trees. In 1937, Congress passed the Federal Aid in Wildlife Restoration Act (Pittman-Robertson) to support states in wildlife restoration. This program, along with state hunting and fishing license revenues, continues to support wildlife restoration in Michigan, including adding about 640,000 of acres to the state forest system.

As the landscape changed, so did the wildlife living on it. In the early 1900s, the regrowth of burned-over lands and hunting restrictions allowed white-tailed deer numbers to rebound to approximately 1.5 million by 1949. However, as the regenerating forests matured and openings closed in, forage and subsequently deer numbers declined starting in the 1950s. An increase in the timber market in the 1970s, along with a deer range improvement program, reversed the downward trend and led to the highest deer numbers (approaching 2 million) in the history of Michigan in 1989. Disease concerns became a major issue, with the discovery that bovine tuberculosis was widespread in the wild white-tailed deer population of the northern Lower Peninsula in 1994.

Dedicated restoration programs facilitated the return of other wildlife species, reflecting a cultural change toward conservation. Around 1907, moose migrated (probably over on winter ice from Ontario) to Isle Royale. In 1934-1937, the (then) Michigan Department of Conservation undertook a project to replenish the mainland Upper Peninsula moose herd with animals from Isle Royale. Seventy-one moose were relocated. The project was unsuccessful. In 1985 and 1987, an additional 59 moose were successfully relocated from Ontario to Marquette and Baraga counties. In 1918, seven elk from western states were released near Wolverine. 1918 also saw the enactment of the Migratory Bird Treaty Act, which stopped hunting species such as the piping plover (primarily for its feathers). Wild turkeys were reintroduced into Michigan beginning in the 1950s. Restoration of marten populations began around 1958, with the relocation of animals from Ontario into the Porcupine Mountains in the western Upper Peninsula. Additional releases were conducted in the Upper Peninsula in the 1970s and in northern Lower Peninsula in 1985. Fishers were first reintroduced in the 1960s in the Ottawa National Forest in the western Upper Peninsula. Resident Canada geese were relocated from Minnesota in the 1960s and 1970s. During the 1980s, Michigan began a trumpeter swan reintroduction program as part of the North American Restoration Plan. These successes were countered by the decline of other species due to less favorable habitat conditions, such as common loon, Kirtland's warbler, prairie chicken and sharp-tailed grouse.

From 1897 through 1964, the Michigan Fish Commission (later called the Michigan Department of Conservation) did not actively manage Great Lakes waters other than to regulate commercial harvest. Regulation was without a clear understanding of limits on fish productivity and the potential effects of overharvest, essentially allowing commercial harvest to continue unencumbered.

Large changes in the fisheries for both the Great Lakes and inland waters were underway. Arctic grayling were extinct by early the 1900s despite efforts to produce the species in hatcheries. Several other species (and subspecies) were deemed extinct due, at least partially, to overexploitation: blue pike, longjaw cisco, blackfin cisco and deepwater cisco (Eagle et al. 2005). Sea lamprey invaded the Great Lakes in the early 1900s through the Erie Canal, with a high abundance of reproducing populations by the mid-1900s. With both an inland and Great Lakes component to its life cycle, this parasitic lamprey was particularly devastating to native lake trout populations. A sea lamprey control program developed through the Great Lakes Fishery Commission in 1958 continues today.

Another invasive species, alewife, became prominent in the Great Lakes in the 1950s. Lake trout numbers were very low because of commercial exploitation and sea lamprey parasitism. Without an effective predator such as lake trout, alewife numbers swelled, and die-off occurred in large magnitude along the lakeshore. At the same time, a growing interest in Great Lakes recreational fishing became apparent. The Department of Conservation introduced hatchery-raised Pacific salmonids to control

alewife populations and produce a sport fishery. A similar management philosophy led to stocking lake trout in Lake Superior to supplement existing native populations. The migratory salmonids have since adapted to reproduction in freshwater and use inland rivers to spawn and provide growing habitat for juveniles.

Environmental and fishery management practices since the mid-1900s assisted in rehabilitating many aquatic ecosystems. Reforestation programs have stabilized soils, hydrologic and sediment processes, and the waters therein. The federal Clean Water Act of 1972 addressed water pollution, and fisheries and wildlife management has rehabilitated many valued species on land and in the water. The ban of DDT and other persistent pesticides in the 1970s helped reduce contaminants in fish and led to a rebound of some bird populations such as bald eagles, osprey and peregrine falcons, which were hard-hit by the liberal use of pesticides shortly after World War II.

Non-native insects and diseases have counterbalanced the regrowth of Michigan's forests. Over the last century, invasive species such as chestnut blight, Dutch elm disease and, more recently, beech bark disease and emerald ash borer have caused declines in several native tree species. Oak wilt, hemlock wooly adelgid and spotted lanternfly are among the current invasive species of concern due to their potential impacts on more of Michigan's native trees.

Perhaps the most insidious invasive species that impact Michigan's forests in subtle but profound ways are earthworms. Likely due to glaciation, the Great Lakes region's vegetation communities established and evolved without earthworms until species from Europe and Asia were introduced along with European settlement. With multiple species slowly working their way across the region, they are associated with changes to soil structure, nutrient dynamics, mycorrhizal (involving the symbiotic association of the mycelium of a fungus with the roots of a seed plant) relationships and arthropod communities, as well as reduction of leaf litter and maple tree seedling density and declines in herbaceous plant diversity (Corio et al. 2009).

Invasive plant species have had negative impacts on Michigan's ecosystems as well. Autumn olive, spotted knapweed, garlic mustard and Japanese knotweed outcompete native plants for resources and change vegetation composition and dynamics. Both established and new invasive species will continue to be a threat to the species and ecosystems represented within the state forest.

By the early 1940s, almost 5 million acres of land were under management of the Department of Conservation. As of 2020, approximately 20.1 million of Michigan's 37.4 million land acres are again forest land. This represents 53.8% of the state's total land area, and an increase of 2.1 million acres since 1980. This forest land is located predominantly in the northern two-thirds of the state. Michigan's 18.7 million acres of timberland is the fifth-largest in the United States, exceeded only by Georgia, Oregon, Alabama and North Carolina. Timberland acreage has increased 7% since 1980 (U.S. Forest Service data).

Present vegetation communities and animal populations have been in an almost constant state of instability and adaptation over the past 20,000 years. This is due, in part, to a changing climate, fundamental changes in the configuration of the land and the composition of surface materials (Davis 1986) and human activity. Particularly in the 19th century, widespread extraction of the state's natural resources (including timber, minerals, fish and game) occurred on a monumental scale. There are many legacies from this period, which include the deforestation, burning and reforestation of large portions of

the state; the severe degradation and slow recovery of aquatic habitats from fragmentation, erosion and disruption of natural hydrologic cycles; the loss of many wildlife species due to loss of habitat and overexploitation; and rapid population growth of other wildlife species that were well-adapted to the early successional landscape in the early to mid-20th century.

Another legacy was the formulation of progressive policies and management to restore, enhance and use natural resources in a sustainable fashion. Additionally, Michigan's 12 sovereign Native American tribes now partner with the Department of Natural Resources and the U.S Forest Service on public land management practices. Michigan's 12 tribes also manage their own lands through tribal conservation departments, implementing management strategies that honor and respect their relationship with the land (Little Traverse Bay Band of Odawa Indians 2024).

The past century's resource-based activity has led to several economic and social conditions, many of which carry through to the present day. For example, a transition from a timber-based economy to a diversified, timber-, recreation- and agriculture-based socioeconomic system is occurring in many areas of the northern Lower Peninsula. Changes have been more gradual in the Upper Peninsula, but a trend from a timber- and mineral-based economy to a timber- and recreation-based system can be perceived.

The state will never again see vast forests like those prior to 1800. Yet inventory data indicate that the forests have been on a steady path toward recovery since the heavy logging era of the late 1800s. Timber, wildlife recreation and other natural resource-based industries will remain significant, contributing segments of Michigan's social and economic fabric for the foreseeable future.