

Forestry and Tree Planting in Iowa

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Iowa's Forest History

Trees provide multiple benefits for wildlife, shade, windbreaks, beauty, recreation, clean air, clean water, and wood products to everyone living in Iowa. After it was discovered that Iowa's soils were extremely productive, the transformation of native vegetation resulted in one of the most altered landscapes in the world. Early maps (1832 to 1850) show about 6.7 million ac (2.7 million ha) or 19 percent of Iowa was covered with timber, out of the total of 35.5 million ac (14.4 million ha) in the State (figure 1). Over time, the forest habitat has been fragmented and dramatically reduced in size. Iowa has never

returned to growing as many acres of forest as it had 380 years ago (figure 2). Historic forest maps provide a footprint to begin prioritizing areas to improve the quality, quantity, and connectivity of existing forests today.

During the time of early statehood, Iowa forests produced many important commercial timber species that are common in the central hardwood region. These important tree species included black walnut (*Juglans nigra* L.), 11 species of oak (*Quercus* spp.), basswood (*Tilia americana* L.), American elm (*Ulmus americana* L.), red elm (*U. rubra* Muhl.), several species of hickory (*Carya* spp.), white ash (*Fraxinus americana* L.),

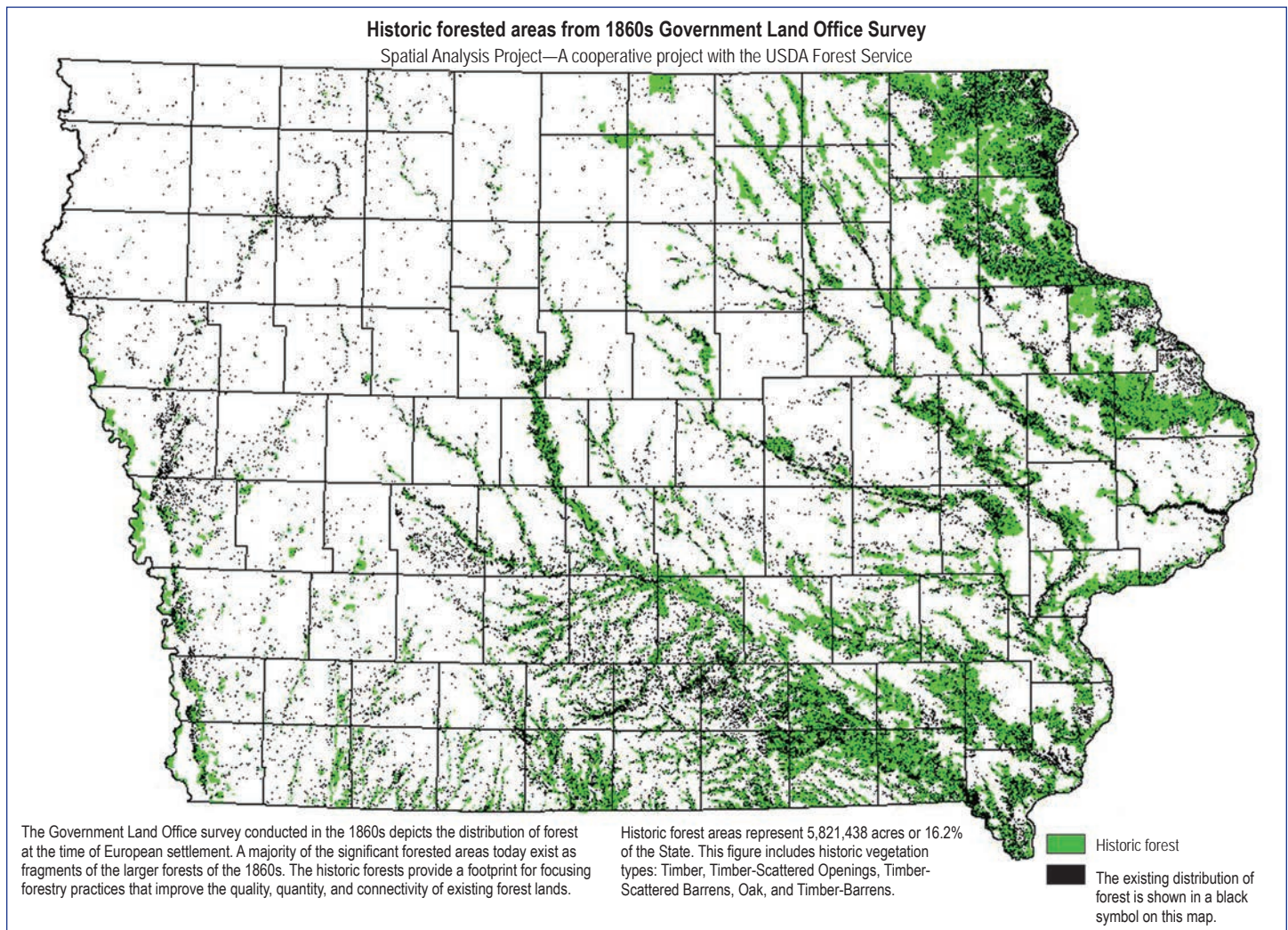


Figure 1. Forested areas in Iowa during the early 19th century. (Source: Kathryn Clark, Geographic Information System [GIS] Analyst, Iowa Department of Natural Resources, using General Land Office maps as surveyed from 1836 through 1859)

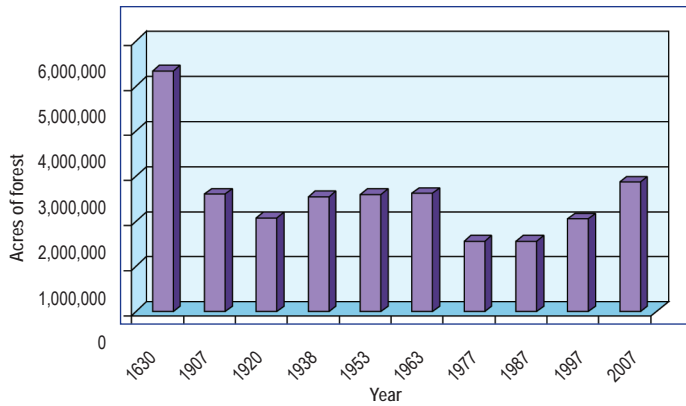


Figure 2. Acres of forest in Iowa, 1630 through 2007. (Source: Smith and others, 2009)

green ash (*F. pennsylvanica* Marshall), sugar maple (*Acer saccharum* Marshall), black maple (*A. nigrum* Michx. f.), and silver maple (*A. saccharinum* L.).

Iowa opened for settlement in 1833, and by 1910, most of the land had been converted to agricultural production. Early settlers used trees for lumber or other wood products or cleared areas to grow agricultural crops. As local populations increased, growing demand for housing materials led to greater use of Iowa’s forest resource in the latter half of the 1800s.

While clearing trees to grow food crops was beneficial in many areas, in some locations the clearing of forests led to poor crop yields and severe soil erosion. Small mills were numerous throughout the State to process locally harvested trees, enabling farmers to supplement their income. During this time, steamboats were a popular mode of transportation on the Mississippi, depending heavily on riverbank timber for fuel. This increased timber demand further depleted Iowa’s timber resource as well as the quality of Iowa timber during this time.

The lumber industry in Iowa began with the establishment of the first sawmill in 1831 on the Yellow River in the north-eastern part of the State. Soldiers from Fort Crawford, under the direction of Lieutenant Jefferson Davis (later to become President of the Confederate States of America), constructed a dam. The lumber was cut using power created from a water wheel. For many years, waterpower was the energy source for the numerous sawmills that multiplied rapidly along the Mississippi River and its main tributaries.

Between 1850 and 1900, the area around the town of Clinton in eastern Iowa was regarded as the sawmill capital of the Nation. Huge log rafts were floated down the river from Wisconsin and Minnesota, cut into lumber at Clinton, then shipped to growing communities east, west, north, and south

via the river and the railroads. For a while, Clinton held the reputation as the largest producer of finished lumber in the world and boasted of 17 millionaires in lumbering and related businesses. The lumber was used for producing finished goods such as doors, windows, staircase posts, pillars, moldings, and all sorts of fancy “gingerbread” ornamentation that covered many older Victorian homes in the mid-1800s (Iowa Public Television 1979). In 1865, Iowa sawmills produced 21.5 million board feet (MMBF) of lumber. By 1892, production had risen to more than 195 MMBF.

Trees normally would grow back rapidly after they were cut. But with the invention of barbed wire in 1873, the forests faced another threat as people found it easier to use their woodlands for grazing. Although the livestock did not always destroy the timber, the heavy livestock compacted the soil, ate or trampled seedlings, and changed the character of the woodland flora and fauna. Coal mining also took its toll on forests as trees were cut to shore up mine shafts. By 1900, more than 4.0 million ac (1.6 million ha) of Iowa’s original forests had been removed for other uses. A decline in prosperity of the Iowa lumber industry began as desirable timber that had previously been locally harvested and rafted to the Iowa mills became exhausted.

In 1974, the U.S. Department of Agriculture (USDA), Forest Service’s Forest Inventory and Analysis (FIA) inventory found that Iowa had reduced the forest land cover to its lowest level ever recorded, at 1.5 million acres. At that time, every county in the State had some forest land, from 25 percent in Allamakee County to less than 1 percent in 31 of the State’s 99 counties.

Net Change in Forest Land

Since 1850, 1,051,934 acres of forests have emerged in what are considered to be new locations; another 1,794,958 acres of forest that existed before 1850 are still around today. Iowa had approximately 6,471,581 acres of forest area in 1850, which means that 4,676,623 acres of original forest have been removed since this time. Overall, Iowa has experienced a net loss of 3,624,689 acres of forest, or more than one-half of the forest area in existence at the time of European settlement (figure 3). No data exists to determine if the best quality forest was lost or to describe the composition of the original forests that were not lost. Much of the forest that was removed came from land with relatively high-quality soil for the purpose of crop production.

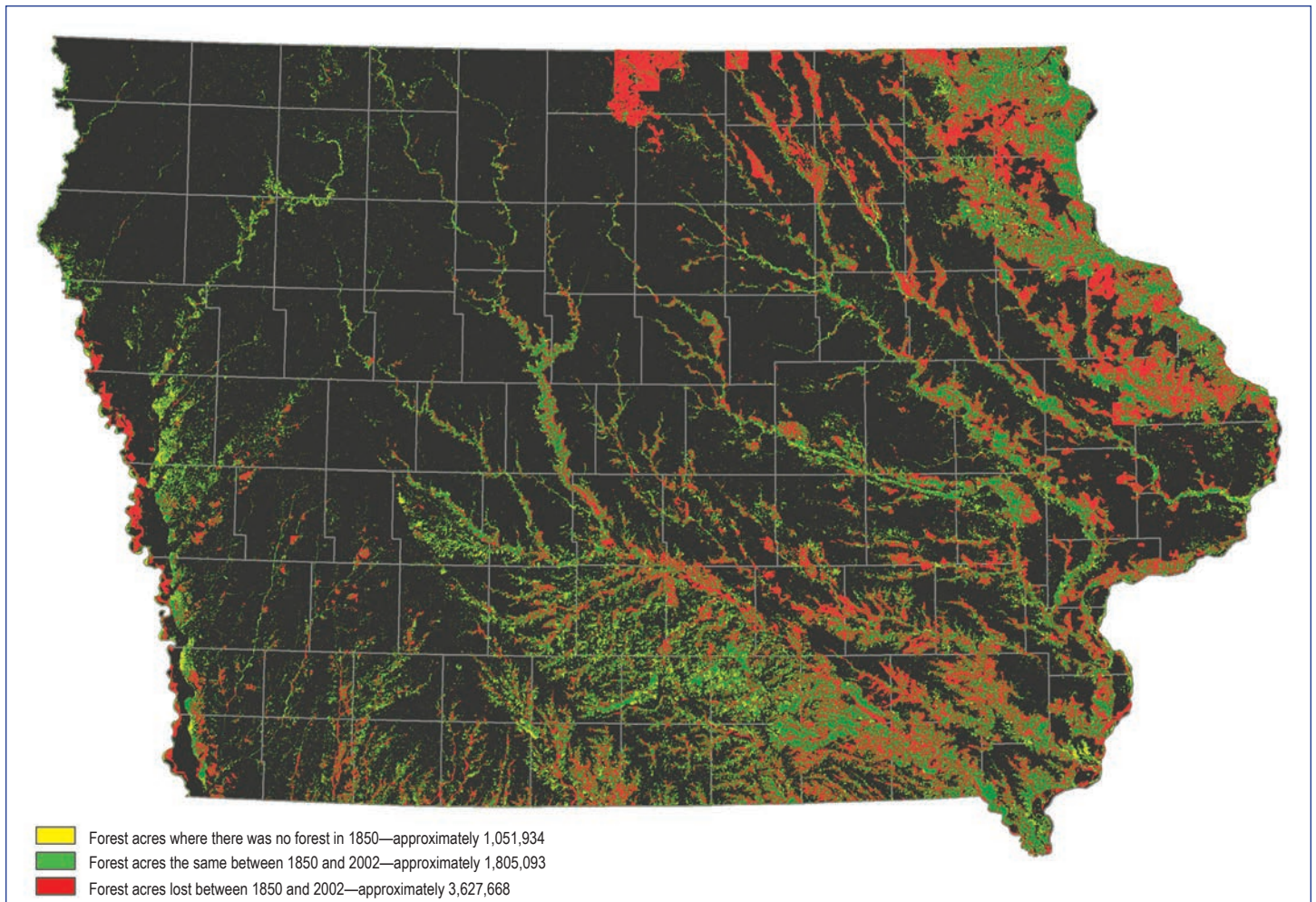


Figure 3. Changes in Iowa's forest land, 1850 through 2002. (Source: Kathryn Clark, Geographic Information System [GIS] Analyst, Iowa Department of Natural Resources, using General Land Office maps as surveyed from 1836 through 1859, Iowa Cooperative soil survey, and Iowa Department of Natural Resources geological survey)

Iowa's Climate

Iowa, located in the heartland of the United States, is bordered by the Mississippi River on the east and the Missouri and Big Sioux Rivers on the west. Iowa has a relatively low relief, with elevations running from a high of 1,670 ft (510 m) above sea level in Osceola County in northwestern Iowa to 480 ft (145 m) above sea level in Lee County in the southeastern corner of the State (NOAA 2013).

Iowa's climate is influenced by its mid-continental location and the sheltering effect of the Rocky Mountains. A wide range of temperatures occur throughout the year, with hot summers and cold winters. Strong winds blow across Iowa throughout the year, which makes any exposed soil vulnerable to wind-blown erosion. This effect is most obvious by the creation of the Loess Hills, located along the State's western boundary.

Iowa often experiences seasonal extremes and frequent local, rapid weather changes because of the convergence of cold,

dry Arctic air; moist maritime air from the Gulf of Mexico; and dry Pacific air masses (NOAA 2013). The average temperature in the summer ranges from 71.0 °F (21.7 °C) in the northern part of the State to 73.0 °F (22.8 °C) in the southern part. December to February winter temperatures average 22.0 °F (-5.6 °C), with an average winter difference of 6.5 °F (3.6 °C) between north and south. Temperature minimums of -25.0 °F (-31.7 °C) are not uncommon in northern Iowa (NOAA 2013).

These climatic factors combine to influence the length of the growing season across the State. Late spring frosts and early fall freezes reduce the growing season to 135 days in northern Iowa. The longest growing season is in southeastern Iowa, with an average of 175 days.

The northwest part of the State is the driest, with an annual precipitation of 28 in (71 cm), while the southeast is the wettest, with an annual precipitation of 36 in (91 cm) (NOAA 2013). Statewide, winter snowfall averages 32 in (64 cm).

Northern Iowa receives frequent, often blowing and drifting snow typically associated with strong winds. Southern Iowa may experience substantial snowfall but has more frequent ice storms resulting in a snow cover that is often covered by a surface crust of ice or hard snow. Harsh conditions seldom remain for more than a few weeks in most of the State, particularly in the southern half.

Like most States, periods of severe drought and periods of excessive precipitation can have a dramatic impact on terrestrial and aquatic vegetation and on their associated fish and wildlife species. Every 30 years or so, a drought period occurs that remains for several years. The most famous drought was in the 1930s, when the Plains States were called the “Dust Bowl.” Two “100-year” floods (1993 and 2008) caused billions of dollars in damage to private property and wiped out habitat for a variety of wildlife species. Tree mortality increased for riparian species like silver maple, cottonwood, and black walnut in the 1990s and it is expected that the trend will regain momentum in the upcoming decade as a result of the 2008 flooding.

Iowa's Land Distribution and Ownership

Forest cover in Iowa is now about 3.1 million ac (1.3 million ha), or 8 percent (figure 4). Land used for agricultural crops represent 58 percent of the land usage, with an additional 4 percent being idled in the Conservation Reserve Program (CRP). Prime agricultural farm land is primarily located in the northern half of the State, much of it along river valleys. The conversion of Iowa's native ecosystems in the past enables the State to produce one-tenth of the Nation's food supply.

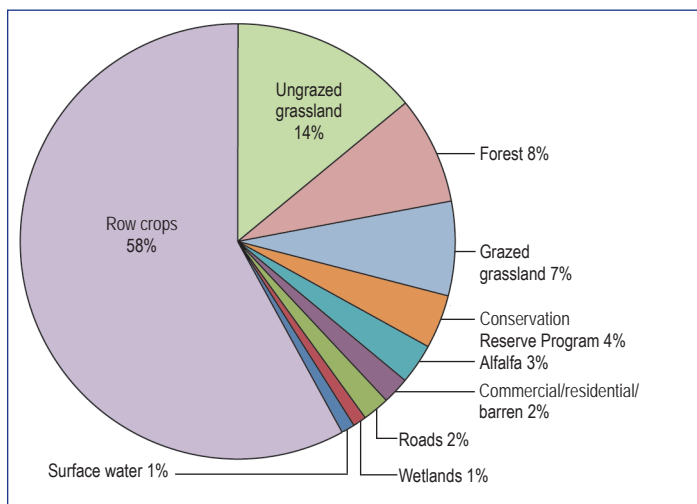


Figure 4. Iowa's land composition by percentage, 2002. (Source: Landsat Thematic Mapper Satellite Imagery)

Public Forest Land

The Iowa Department of Natural Resources (DNR) purchases land to manage and protect natural resources, to maintain unique ecosystems for future generations, to maintain a pool of biodiversity for future generations, and to provide recreational opportunities to all the people of the State. Through their land acquisition program, wetlands, forests, scenic areas, prairies, wildlife and fish habitat, rare species habitat, and other resources are being protected and managed. Public areas are important for maintaining the State's native biological diversity, which is often much harder to preserve on private lands.

In 2008, Iowa had 816,000 ac (330,220 ha) of area in public ownership, of which slightly less than 637,000 ac (257,800 ha) were classified as land (figure 5). Within the land category, 44 percent is classified as forest. In 2002, public agencies owned more than 9 percent of the forest land in Iowa, only a slight increase from 8 percent in 1974. Public forest land allows for different management activities, depending on which bureau within the DNR (Forestry, Parks, or Wildlife) oversees a certain property.

The State Forestry Bureau manages 34,597 ac (14,000 ha) of forest on its 45,230 ac (18,300 ha) of public land, with the remaining areas in roads, lakes, prairie, or cropland. State forest areas are subdivided into 10 State forests that represent all of the major forest habitat types of Iowa along with a range of ages. These forests are mainly managed for timber production, wildlife habitat, water quality, and air quality.

The State Parks Bureau has 31,703 acres of forest on its 57,754 acres of public land. Some of these areas have some of the oldest trees in the State growing on them. The State Wildlife Bureau has the largest holding of forest, with 94,547 acres within its 347,852 acres of public land.

Forest management is permitted on areas owned by the State Wildlife and State Forestry Bureaus. Parks and preserves generally do not practice active management, an approach that allows for natural selection on their properties. Salvage sales are an exception; they often take place after strong windstorms, flooding, or tornados cause damage to their resources.

Other large public landowning bodies are the 99 County Conservation Boards, which collectively own more than 143,000 ac (57,870 ha) of property, of which 65,354 ac (26,448 ha) are forested.

Federal agencies own 190,000 ac (76,890 ha) of land within Iowa, of which 37,632 ac (15,230 ha) are forested. The U.S. Army Corps of Engineers and the U.S. Department of the

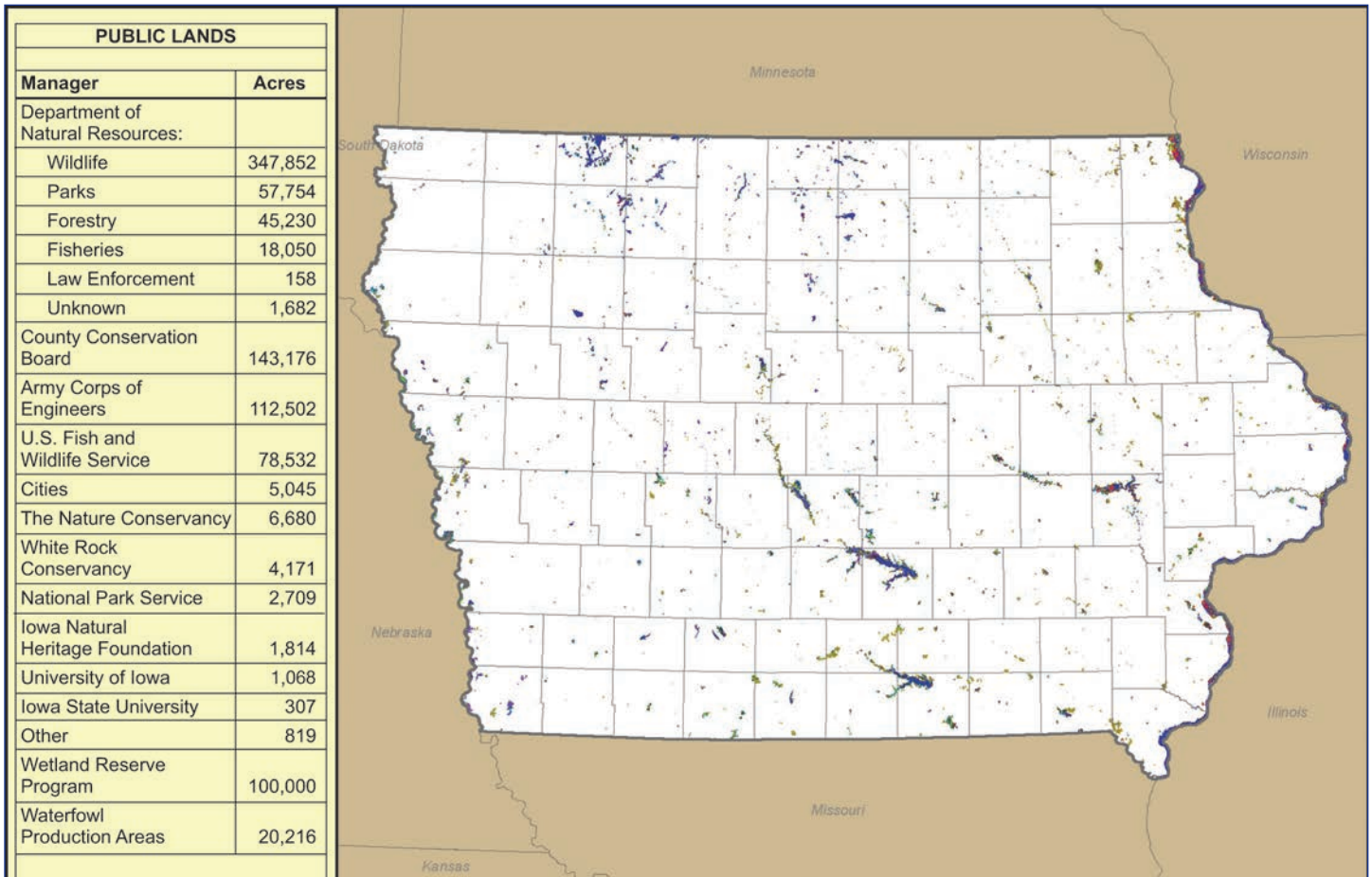


Figure 5. Iowa public land composition in acres, 2002. (Source: Kathryn Clark, Geographic Information System [GIS] Analyst, Iowa Department of Natural Resources, using satellite land cover from 2002 and public lands database)

Interior, U.S. Fish and Wildlife Service, own the most Federal land. Iowa has a smaller proportion of public land than almost any other State in the country and has no national forests. The Federal agencies that do own property manage their land for wildlife refuges, flood control, and navigational systems with accompanying recreation areas.

About 40 percent of the acres of publicly owned land are on highly erodible soils, indicating a need for permanent vegetation on these areas to improve water quality, stabilize soil, and improve habitat for wildlife. The average corn suitability rating for the land owned by the DNR is 32 on a scale of 100, indicating that most DNR-owned land is not suitable for agriculture.

Private Land

Privately owned woodlands have decreased dramatically in size since the middle of the 20th century. In 1954, the average woodland owner owned 45 ac (18 ha) of woodland; this

number declined to 31.0 ac (12.5 ha) in 1990 and 17.0 ac (6.9 ha) in 2003. In 2006, most forest landholdings were less than 9.0 ac (3.6 ha); moreover, the number of private woodland landholdings nearly tripled from 55,000 in 1990 to 150,000 in 2008 (Butler 2008). These numbers are alarming because they reflect the extent to which interior forests have been reduced over time and the extent to which they may be reduced in the future.

Forest Cover Types

Iowa forests are 98 percent hardwoods (figure 6). The shade-intolerant white oak-red oak-hickory forest type represents the largest forest type. The second most prevalent forest type is mixed upland hardwood. Shade-intolerant black walnut represents a small but economically important position in Iowa’s forests (figure 7). The only native conifers in Iowa are white pine (*Pinus strobus* L.), eastern red cedar (*Juniperus virginiana* L.), and balsam fir (*Abies balsamea* [L.] Mill.). Tree species diversity is highest in eastern Iowa and decreases

as moving west. Because of the prevalence of wildfire before statehood, most trees in the State today are fire-adapted species; however, with the suppression of fire that accompanied Iowa's settlement, thinner barked, shade-tolerant trees have been able to grow within the dominant oak-hickory forest type.

Iowa's State tree is the oak, although it is not specific to 1 of the 11 oak species native to the State. White oak (*Quercus alba* L.) and bur oak (*Q. macrocarpa* Michx.) trees are typically the oldest living oak species, with some exceeding 400 years in age. Oaks are disturbance-dependent species, meaning that they have a competitive advantage over other trees in areas susceptible to wildfire. The oak-hickory forest type is the largest in Iowa; however, this forest type has declined in recent years, from 37 percent of total forest area in 1990 to 26 percent in 2008. Lack of active management and disturbance on private and public forest lands are the leading causes of oak-hickory forest decline in Iowa.

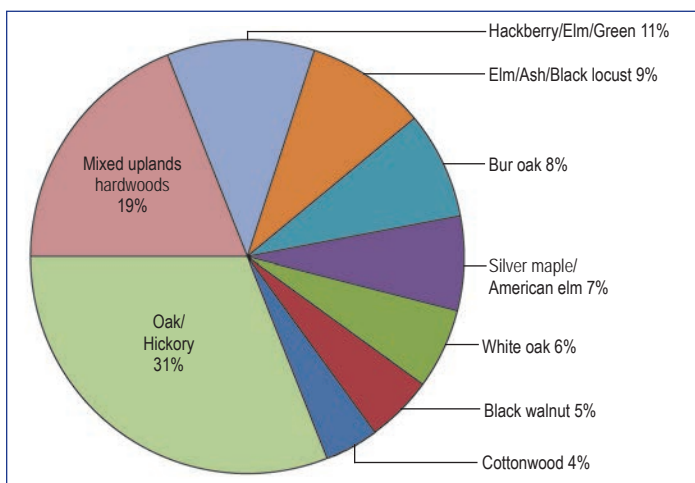


Figure 6. Forest type as a percentage of total forest in Iowa, 2008. (Source: Miles, 2010)



Figure 7. Black walnut is Iowa's most valuable timber species. (Photo by Paul Tauke, Iowa Department of Natural Resources)

Forest Management in Iowa

Iowans are aware their forest resource has economic potential by harvesting timber when income is needed. This harvesting method does not lead to sustainable reproduction of traditional forest types that have existed in Iowa. On the other end of the spectrum, leaving the forest alone by “doing nothing” has consequences, since natural management regimes, like fire, have been removed from the landscape. The attitude that the forest can regenerate itself is a continual challenge to overcome when convincing people that the condition of Iowa's forest resource is in decline.

Within the Forestry Bureau, 16 district foresters are dispersed throughout the State to help the more than 150,000 private forest landowners manage their forest land and successfully establish tree plantings. In total, four area foresters and nine natural resource technicians manage Iowa's four State forests. District foresters and area foresters are supervised by the private lands forest supervisor and the State forest section chief, respectively. Four more specialized foresters oversee forest health, fire, urban, and special projects issues. The State Forest Nursery is also managed by the private lands forest supervisor as well as a secretary, a nursery forester, three natural resource technicians, and an inmate crew capable of growing and shipping up to 4 million tree seedlings per year. Finally, the Forestry Bureau as a whole is under the direction of the Forestry Bureau chief.

State Funding for Forestry

The Forestry Bureau has five general sources of funding: (1) general fund income, which is allocated by the State of Iowa through the Legislature and Governor's Office; (2) Federal funding, provided by the USDA Forest Service to support priority programs; (3) conservation funding, generated by the State Forest Nursery; (4) the Forest Enhancement Fund, which provides \$0.05 for every seedling sold to support district forester positions in northeast Iowa; and (5) partner funding from organizations such as Alliant Energy, Mid-American Energy, Black Hills Energy, Trees Forever, Iowa Woodland Owners Association, Iowa Tree Farm, and Iowa Bankers Association. In 2010, funding from the five sources provided 40, 22, 25, 5, and 8 percent of the Forestry Bureau's budget, respectively (Iowa Department of Administrative Services—State Accounting Enterprise 2010).

The budget for the bureau was about \$5.5 million per year for fiscal years (FYs) 2008 and 2009. Because of across-the-board budget cuts, the Forestry Bureau lost more than \$550,000 in general funding during FY 2010, though it

received an increase in Federal funding of approximately \$250,000. Overall, the Forestry Bureau saw a net decline of roughly \$367,000 from former levels during FY 2010.

General fund dollars are especially important for use in matching Federal funding, and there could come a point when not enough general fund dollars are available to match available Federal funds. The DNR State Forestry Bureau currently is able to bring in \$1.86 to \$2.05 of Federal funding for every general fund dollar it receives. Partner funding is dedicated to producing educational materials for the Trees for Kids and Trees for Teens programs, and most of such funding goes toward residential tree distribution programs.

Iowa's State Forest Nursery

The State Forest Nursery in Iowa was originally established in Ames in the 1930s by the Civilian Conservation Corps. The land was later purchased by the Iowa Conservation Commission in 1940. The nursery is operated by the Forestry Bureau and provides low-cost native tree and shrub material to encourage more planting in the State. Without it, forest landowners would be forced to pay more to plant trees on their property and, in many cases, would likely revert to buying their trees from out-of-State nurseries to get lower prices. The nursery has sold more than 150 million bareroot seedlings since its establishment, including 64.5 million in the past 20 years (figure 8, table 1).

In addition to bolstering the State's economy, use of native tree material ensures that insects and diseases that are not established are not brought in; moreover, seedlings from outside

Iowa may not be as adapted to the State's climate and may therefore be more susceptible to such problems because of stress. Nonnative seedlings are often less productive at growing wood and mast (forage for wildlife) as well. Flowering schedules may be off for species brought into Iowa, causing those trees to be unable to produce fruit or seed, which affects food for wildlife and limits reproduction for that species.

The State Forest Nursery has a main central facility in Ames and another growing facility in Montrose. The Montrose operation is located on 45 ac (18 ha) and has 23.0 ac (9.3 ha) in production. The sandy loam soils at this site are ideal for growing conifers and hardwoods. The site is approximately 3 hours south of the Ames facility, allowing for earlier lifting in the spring and later lifting in the fall, which helps get more grading done when the soils at the Ames facility are frozen. Only one full-time person staffs this facility, which can grow

Table 1. Average seedling sales for top 10 seedling species grown at the Iowa State Forest Nursery from 2005 through 2010.

Black walnut	150,000
Red oak	135,000
White oak	115,000
Swamp white oak	95,000
Bur oak	90,000
Eastern Red cedar	85,000
White pine	70,000
Silver maple	60,000
Ninebark	55,000
Wild plum	50,000

Source: Aron Flickinger.

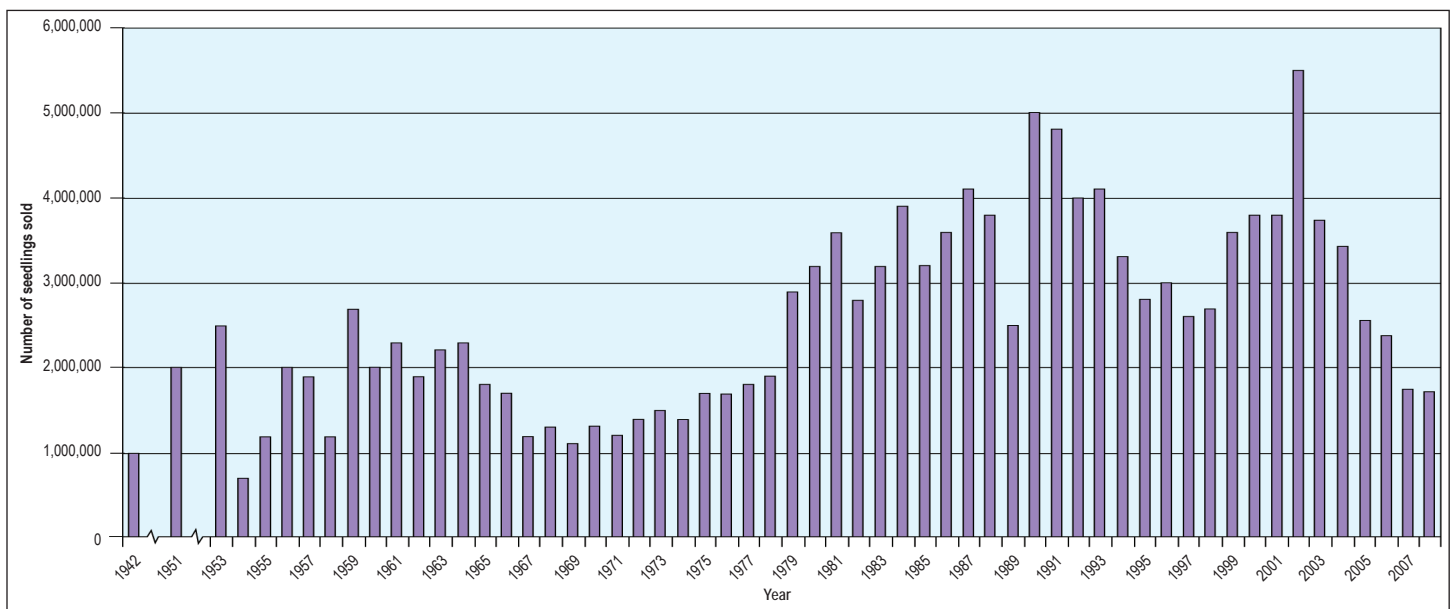


Figure 8. State Forest Nursery seedling sales, 1942 through 2007. (Source: Aron Flickinger)

up to 1 million seedlings annually. The labor force comes from a nearby correctional facility to help during the lifting and weeding seasons. The facility has an onsite orchard with hazelnut (*Corylus americana* Walter), white cedar (*Chamaecyparis thyoides* [L.] Britton, Sterns & Poggenb.), serviceberry (*Amelanchier arborea* (Michx. f.) Fernald), and green ash seed to help reduce the cost of purchasing seed.

The Ames location has 100 ac (40.5 ha) of land with 45 ac (18.2 ha) under production. At Ames, 2 to 4 million trees are grown annually, including most of the shrubs and many of Iowa's native hardwood species. The soils at Ames are heavier than at Montrose, which can create challenges for growing good root systems and causes more wear on equipment. The main building was built in 1975 and, through the years, a total of 10,000 square feet of refrigeration has been added onto the grading room, which has increased the storage capacity to 1.5 to 2 million seedlings. This cooler allows for more fall lifting to allow more seedlings to be available for filling customer orders when the weather is suitable in the spring.

Iowa Code specifies that the nursery's budget for growing costs be dependent on its seedling sales within a particular fiscal year, which makes for serious financial stress during years with poor sales. State rules and economic restraints can also make it difficult for the nursery to market its products and cover its operating costs.

Nursery Growing Season

Growing good-quality seedlings begins with soil tests in the nursery lab. Samples are taken during the summer to determine soil needs. Fertilizers, pH adjusters, and organic matter are then added to the soil as necessary. In early fall, some seedbeds are fumigated to remove disease problems and reduce weed populations.

Most of the seed for the 50 species of plants grown are purchased from seed collectors, but a growing percentage of seed is collected by nursery personnel. Seed orchards are continually being established to protect native seed sources and to provide more accessible seed for future planting needs. Most seeding is done in the fall. The seeds are pressed into freshly tilled soil and covered with a mulch of ground corn cobs. The seeds germinate the next spring as soon as the soil warms up sufficiently.

Supplemental water is added through the irrigation system when necessary. Fertilizers are added at required intervals throughout the growing season. Weeds are controlled mainly

by chemical means, although some mechanical and hand weeding is also necessary. Insect and disease problems are diagnosed and handled on an individual basis as needed. Seedlings are root pruned after they reach saleable height and the soil is 50 to 70 °F (10 to 20 °C). All of these steps together maintain good seedling growth and vigor; along with a balanced root-to-shoot ratio.

Most of the hardwoods and shrubs grow 1 year before being sold; the conifers take 2 or 3 years (depending on the species) to reach saleable height. As many seedlings are harvested in the fall as weather permits; the remainder are harvested in the spring. Orders for seedlings are shipped out in the fall or spring, based on customer request. The seedlings are harvested by a machine that cuts the roots at a depth of 6 to 10 in (15 to 25 cm) and, with several people assisting, shakes the dirt from the roots. The seedlings are then placed in plastic-lined crates and taken into a cooler, where they are stored until they can be counted, sorted, and sealed in polyethylene bags. The seedlings are then stored in another cooler until they are prepared for individual orders and shipped throughout the State within wax-lined paper bags.

Tree Planting in Iowa

The reasons for planting trees are numerous. Between 1,000 and 2,000 people buy trees from the State Forest Nursery each year. Most people are planting trees as part of a conservation practice offered by the USDA's Natural Resources Conservation Service (NRCS) or Farm Service Agency (FSA). People who qualify for these programs own land that is adjacent to important water corridors or have highly erodible land that they want to protect. An increasing number of people own smaller pieces of land for either an acreage to live on or a place to view or hunt wildlife.

In Iowa between 1998 and 1999, about 3,630 ac (1,470 ha) of trees were planted, which ranked the State number 6 for tree planting out of the 20 Northeastern States (figure 9). During years in which conservation programs promoting tree planting are particularly successful or widespread, State Forest Nursery sales are typically above average. Conversely, when conservation programs cannot compete with commodity prices, tree sales go down. With a legislatively mandated requirement to operate at the cost of growing trees, the viability of the State Forest Nursery is a challenge because demand for seedlings is dependent on many programs outside of its control.

Private landowners have responded positively to market



Figure 9. Native conservation seedlings from the State Forest Nursery planted on private land. (Photo by Bruce Blair, Iowa Department of Natural Resources)

incentives and government programs, including subsidized afforestation on unproductive agricultural land, which is one reason that forest land has increased in the State in recent years. The ability of the State Forest Nursery to supply large quantities of native nursery stock at a relatively low cost has provided Iowans with excellent opportunities to develop forests on their land. Without the nursery, Iowans would have had to pay more for their seedlings, which would have left them with fewer resources for weed control and other activities critical for successful tree planting establishment; if the price had increased, it is likely that fewer acres would have been planted during this time period. It is important that promotions of tree planting continue to ensure that landowners stay in touch with their properties and leave legacies for future generations. This connection with the land is especially important when considering the extent to which landholdings have shrunk in the past half-century.

Conservation Programs and Incentives for Forest Landowners

Roughly 90 percent of Iowa's forests are privately owned, and Iowa DNR foresters work with approximately 2,000 forest landowners annually. Interactions between foresters and landowners begin with evaluations of forest resources, discussions of forest landowner objectives, and consideration of forest management alternatives. District foresters provide free consulting services for forest landowners. They can work with landowners to apply for tree planting cost-share assistance at local FSA or NRCS offices to reduce the cost to the landowner for tree planting, forest stand improvement, and wildlife habitat improvements. Landowners can receive

stewardship plans to provide frameworks for achieving their management goals and objectives in sustainable ways. Meeting with private landowners gives professional foresters the opportunity to provide education about the benefits of proper long-term forest management, and in a State for which agriculture is the most lucrative way to make money from land in the short-term, these interactions are especially important.

A variety of conservation programs support forestry practices in Iowa (figure 10). Conservation programs that encourage tree planting can be a disadvantage when competing with agriculture, which generates income more quickly and consistently; however, lowering the input costs of tree planting is one way to make forest-related activities more economically feasible.

The Forest Land Enhancement Program has not received funding for private forest landowners to improve their woodlands that it was originally to receive, and, as a result, the program no longer exists. Only \$146,000 was available to Iowa in 2003, and funding has decreased more in subsequent years.

The Wildlife Habitat Incentive Program (WHIP) began in 2003 and, for the most part, has provided steadily increasing funding for Iowa (from \$52,000 in 2003 to \$93,000 in 2006). This Federal program is administered through the NRCS, with technical assistance provided by foresters, wildlife biologists, or NRCS staff. Programs eligible for this funding assistance include tree planting, forest stand improvement, and brush management.

The Environmental Quality Incentives Program (EQIP) has provided variable funding for forestry practices through the years and has provided funding for projects similar to those funded by WHIP. In 2001, more than \$288,000 was provided to forest landowners, the most offered in any year through 2006. In 2009 and 2010, approximately \$500,000 per year of EQIP funding was set aside for forestry practices on private lands.

Resource Enhancement and Protection (REAP) is a State program that provides funding for forest landowners to get trees planted or to improve the woodlands on their property. As its name implies, REAP invests in the enhancement and protection of the State's natural and cultural resources. Iowa has an array of natural and cultural resources, and REAP is likewise diverse and far reaching. Depending on the individual programs, REAP provides money for projects through State agency budgets or in the form of grants. Several aspects of REAP also encourage private contributions that help accomplish program objectives. REAP is funded from the State's Environment First Fund (Iowa gaming receipts) and

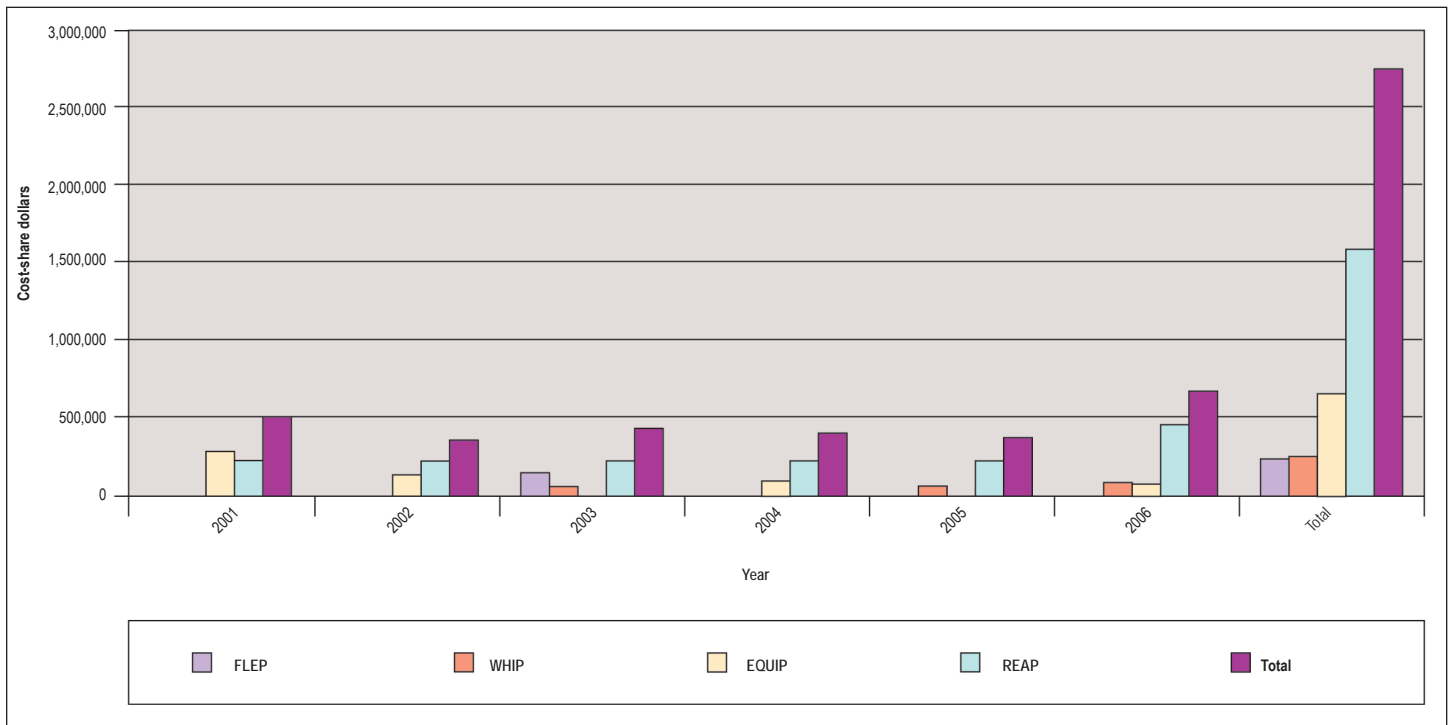


Figure 10. Cost-share dollars spent on forestry practices per program, 2001 through 2006. EQIP = Environmental Quality Incentives Program. FLEP = Forest Land Enhancement Program. REAP = Resource Enhancement and Protection. WHIP = Wildlife Habitat Incentive Program. (Source: Paul Tauke, Iowa Department of Natural Resources)

from the sale of the natural resource license plates. From 2001 to 2005, an allocation of \$225,500 was available annually for forestry practices; that amount increased in 2006 to \$473,000.

A summary of CRP enrollment from the July 2009 report shows that Iowa had the most rental payments of any State with \$197,520,000. These rental payments were associated with 105,241 contracts on 52,965 farms protecting 1,705,312 acres. Within the protected areas, 28,550 acres, or 1.7 percent of CRP acres, were planted for trees. If 700 trees were planted on each of these 28,550 CRP acres, nearly 20 million total trees would be planted. A program like CRP benefits water quality and provides long-term soil protection on highly erodible soils. Landowners are less likely to remove trees after a 15-year contract, and the tree planting provides society a better return than that provided by agriculture, because those trees will continue to protect the soil and water, sequester carbon, and provide wildlife habitat. Trees make sense for long-term protection of sensitive land because, after being established, they are more difficult to remove; planting grass provides many good benefits but may not provide them for the same amount of time because it is much easier to remove. Nurseries that provide conservation seedlings and consultants who plant these seedlings for landowners benefit from tree planting incentive programs as well.

The amount of land enrolled for conservation practices by the NRCS increased between 2002 and 2004 in Iowa (table 2); however, a decrease in the number of acres of trees actually planted also occurred during the same time. Tree planting represented only slightly more than 1 percent of the conservation acres funded by the NRCS; the permanent establishment of woody vegetation is something most farmers steer away from, as grassland is much easier to establish, maintain, and, if so desired, reconvert to agricultural land. A lot of potential acreage for conservation exists in Iowa, however, the preferred type of conservation is some type of grass cover.

Oak-Hickory Regeneration

Since 1954, Iowa has been losing more than 7,000 acres of oak-hickory forest annually (Miles 2010). As a result, oak-hickory management is a priority in several areas of the State

Table 2. Base conservation by USDA Natural Resources Conservation Service in Iowa, 2002 through 2004.

	2002	2003	2004
Acres planned for conservation	1,174,262	1,153,154	1,440,157
Acres of trees planted	6,399	4,398	3,518
Highly erodible land treated (acres)	405,678	381,708	

Source: <http://www.ia.nrcs.usda.gov/programs/conservationoperations.html> (March 2010)

(figure 11). Some areas are relatively easy to manage because of their high concentrations of oak trees; areas that used to be oak-hickory but have made the transition to other, mostly shade-tolerant, species are much harder to restore to oak-hickory. While it is important to ensure that the latter areas remain as forests, the sheer amount of resources that would be necessary to restore them to oak-hickory forests makes such a task impossible.

Managing native vegetation communities in Iowa is a challenge because of the State's highly fragmented forests and near-complete removal of historical disturbance regimes like fire. Active forest management is now needed to help oaks adequately regenerate in Iowa's maturing forests; whenever

possible, the DNR State Forestry Bureau actively manages oak in State forests using even-age silvicultural techniques.

An ecosystem's forest type affects the wildlife habitat, herbaceous cover, wood products, recreational opportunities, and economic value of that ecosystem. Wildlife that depend on oak-hickory trees for habitat and food may not be able to survive without them; many of the common herbaceous plants found in oak-hickory stands cannot tolerate heavy shade; outdoor recreation enthusiasts looking for enjoyment from the wildlife and plants usually found in an oak-hickory forest may not receive the same level of satisfaction from shade-tolerant forests; and, finally, without oak trees, the livelihood of sawmills will be threatened.

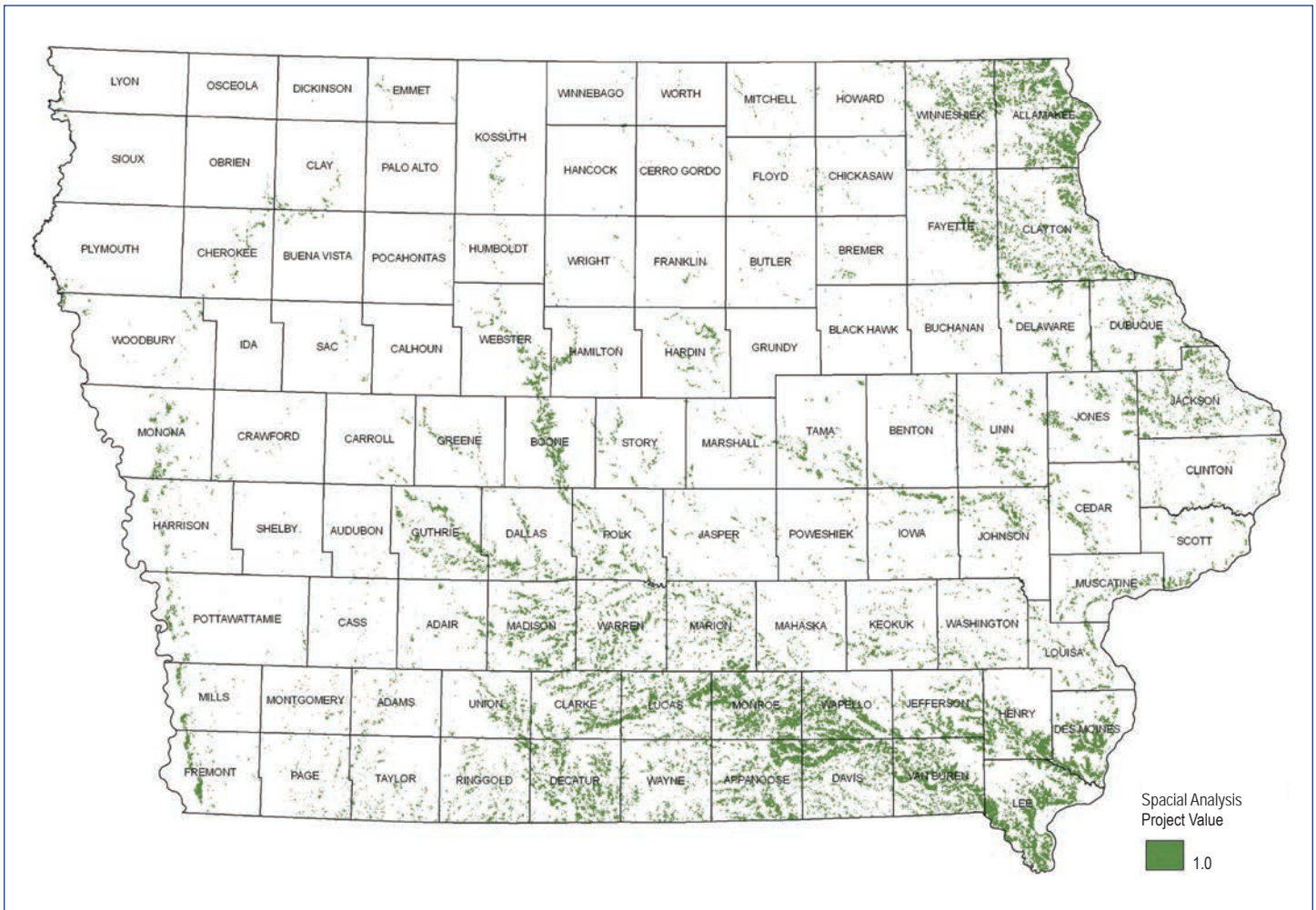


Figure 11. Priority areas for oak regeneration. (Source: Kathryn Clark, Geographic Information System [GIS] Analyst, Iowa Department of Natural Resources, using 2008 Forest Inventory and Analysis data and satellite land cover from 2002)

Preserving Tree Genetics

The goal of Iowa's tree improvement program is to preserve the genes of locally adapted trees. Maintaining a pool of genetic diversity for all native species on sites located across the State would ensure that Iowa's trees are in a suitable position to withstand climate change and threats from disease and insects in the future; this pool would also provide a dedicated seed source to supply future seed needs for nurseries to ensure a native local seed source is available.

The tree improvement program has collected from a diverse gene pool of black walnut trees in Iowa. As the most valuable black walnut trees are harvested, branches are collected to propagate seedlings with identical genetics. This collection will give landowners a better pool of trees from which to choose for growing and will have positive implications for future yield and genetic and biological diversity; after enough of these trees are selected, the sample of genes will also be large enough to represent more than 95 percent of the genetic variation within this species. Since 2003, the program has been testing for a fast-growing black walnut tree capable of growing above vegetation and wildlife browsing lines to quickly capture a site. The most successful tree so far, which is being reproduced and tested in field trials, experienced growth of almost 9.0 ft (2.7 m) in 2 years and 25.0 ft (7.6 m) in 5 years.

The other focus of the tree improvement program is to preserve the genes of the native butternut (*Juglans cinerea* L.) in an effort to prevent its extinction from butternut canker (figure 12). Branches are collected from native trees and then grafted onto walnut root stock in an effort to maintain a population of native Iowa butternuts. Seedlings from 20 Iowa trees and more than 100 trees from other States are being tested at



Figure 12. Butternut seedling established at Loess Hills State Forest. (Photo by Aron Flickinger)

the Loess Hills State Forest in western Iowa and Yellow River State Forest in northeast Iowa (the latter site is in an area of the State that is still highly susceptible to the disease, while the former site is outside of the butternut canker range).

Challenges to Tree Planting in Iowa

Forest Health

Iowa forests contain more than 1 billion trees from 68 species. Of these trees, 25 percent are susceptible to fatal insect or disease problems, such as oak wilt, oak decline, emerald ash borer, Dutch elm disease, and pine wilt. Iowa's forests are facing an unprecedented level of native and invasive pests that threaten to create a new wave of mortality unseen since the arrival of Dutch elm disease. While most forests are relatively diverse, these threats will have a substantial impact on the composition of the State's forests and urban tree canopies in the future. Each year, the Iowa DNR State Forestry Bureau cooperates with numerous agencies to protect Iowa's woodlands from insects, diseases, and other damaging agents. In a recent report the DNR identified five key pests that have emerged as a severe threat to Iowa's native woodland and community: gypsy moth, emerald ash borer, bur oak blight, thousand cankers disease of black walnut, and Asian longhorned beetle (Iowa DNR 2012).

Gypsy moth catches were at an all-time high in 2010, exceeding the previous record by a factor of more than three times. As a result, more than 170,000 acres of forest land were treated in 2011 to reduce the exploding population. The populations were reduced and only 225 Gypsy moths were captured in 2012. In 2010, emerald ash borer was found in Iowa, resulting in a quarantine that placed restrictions on how far ash wood material, including firewood, could be moved. In 2012, emerald ash borer was found in four new sites within Allamakee County. This county remains the only quarantined county. Bur oak blight (figure 13), identified in Iowa in 2007, has continued to spread and cause advanced decline and premature mortality for bur oaks in rural woodlands and community forests. Thousand cankers disease of black walnut has not yet been identified in Iowa. The Iowa DNR is actively monitoring for the walnut twig beetle, however, which carries thousand cankers disease. Asian longhorned beetle has not been identified in Iowa, the locations that have this pest have been devastated. Quarantines are in place to help prevent the spread of and eradicate the beetle. These five emerging pests will place an additional financial burden on Iowa's communities by threatening nearly all 26 million community trees.



Figure 13. These bur oak trees show different levels of decline; the tree on the right is healthy, the tree on the left is infected with bur oak blight (*Tubakia*), and the tree in the top left corner is dead. (Photo by Aron Flickinger)

They threaten 55 MMBF (56 percent) of the wood products volume that is currently desired for harvesting and more than 6 billion board feet (53 percent) of the existing timber volume standing in Iowa’s forests today.

Leaf tatters causes a reduction in interveinal leaf tissue in newly emerged oak leaves as they grow larger, which makes them look deformed or “tattered”; the first sign is curling of the young succulent white oak leaves (figure 14). Not all trees develop tatters, as leaves must be exposed to certain conditions after they have emerged from their buds and may escape tatters if they have grown a certain amount; however, oak trees of all ages growing in both urban and rural areas are susceptible to damage. Leaf tatters was first reported in Iowa, Indiana, and Ohio in the 1980s and in Wisconsin and Minnesota more recently.



Figure 14. White oak leaves protected with pollination bags; the rest of the leaves on the trees showed tatters. (Photo by Aron Flickinger)

Animal Depredation

Where the deer population is high, deer browsing can impact plant species composition and community structure (figure 15). Deer browsing has a profound impact on the establishment of regeneration, the density of hardwood seedlings, and the presence of understory plants. Their impact is reducing biodiversity and hurting Iowa’s largest forest type, oak-hickory, the very habitat they depend on in the fall and winter for food and shelter. Deer also impact vegetation by moving parasites and invasive plant seeds, through bedding and by rubbing their antlers on trees. In the winter, they seek shelter in forests, while during the growing season they feed on the herbaceous portion of woody plants under the shade of trees.

Species that fall victim to browsing are unable to regenerate, while those that are not browsed on, including invasive plants such as garlic mustard, continue to thrive. Over time, this selective browsing can lead to a reduction in forest biodiversity, which can then lead to a change in habitat. Reductions in understory plants, for example, can lead to declines in insect activities, including those of pollinators. Browsing activity also affects moisture at the forest floor and the vertical structure within the forest. Soil moisture and humidity decline as more light is able to reach the ground and heat up the area.

Rabbits and mice can also do damage to new tree plantings. They seem to show a preference for oak species, particularly white oaks. Rabbits eat the terminal leaders of seedlings during the winter, and their preference for oaks causes them to fall behind the growth of other tree species in plantings. Mice girdle seedlings during the winter, and their preference for oaks also causes these trees to fall behind the growth of other species (figure 16).



Figure 15. Deer damage to a young conifer planting. (Photo by Bruce Blair, Iowa Department of Natural Resources)



Figure 16. Tree shelters are now necessary for establishing seedlings in some parts of the State, but they provide new habitat for mice as well. (Photo by Bruce Blair, Iowa Department of Natural Resources)

Funding

Perhaps the biggest challenge to Iowa's natural resources may be a lack of funding. The Iowa DNR represented only 0.34 percent of the overall State budget in 2008, and the department experienced further cuts in 2010. Within the DNR, the State Forestry Bureau portion of the general fund was \$2,045,015 or 0.0328 percent of the State budget for FY 2010 (CAFR 2010). On average, Iowa taxpayers each contribute \$7.82 of their tax bill to Iowa's natural resources each year; of this \$7.82, \$0.84 goes to the DNR State Forestry Bureau. For every \$685 collected in income taxes, \$0.25 will go toward Iowa's forest resource.

Iowa's Outlook for Tree Planting Into the Future

Iowans enjoy many attributes of their trees or forests. This enjoyment is shown by the increasing number of acres of forest cover during the past two decades across the State, an increasing housing market on acreages (land with trees or grass), and the number of people visiting local conservation areas for recreation as they turn to local options for vacationing. Because of the high value of Iowa's land for crop production, the future for tree planting will fluctuate.

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