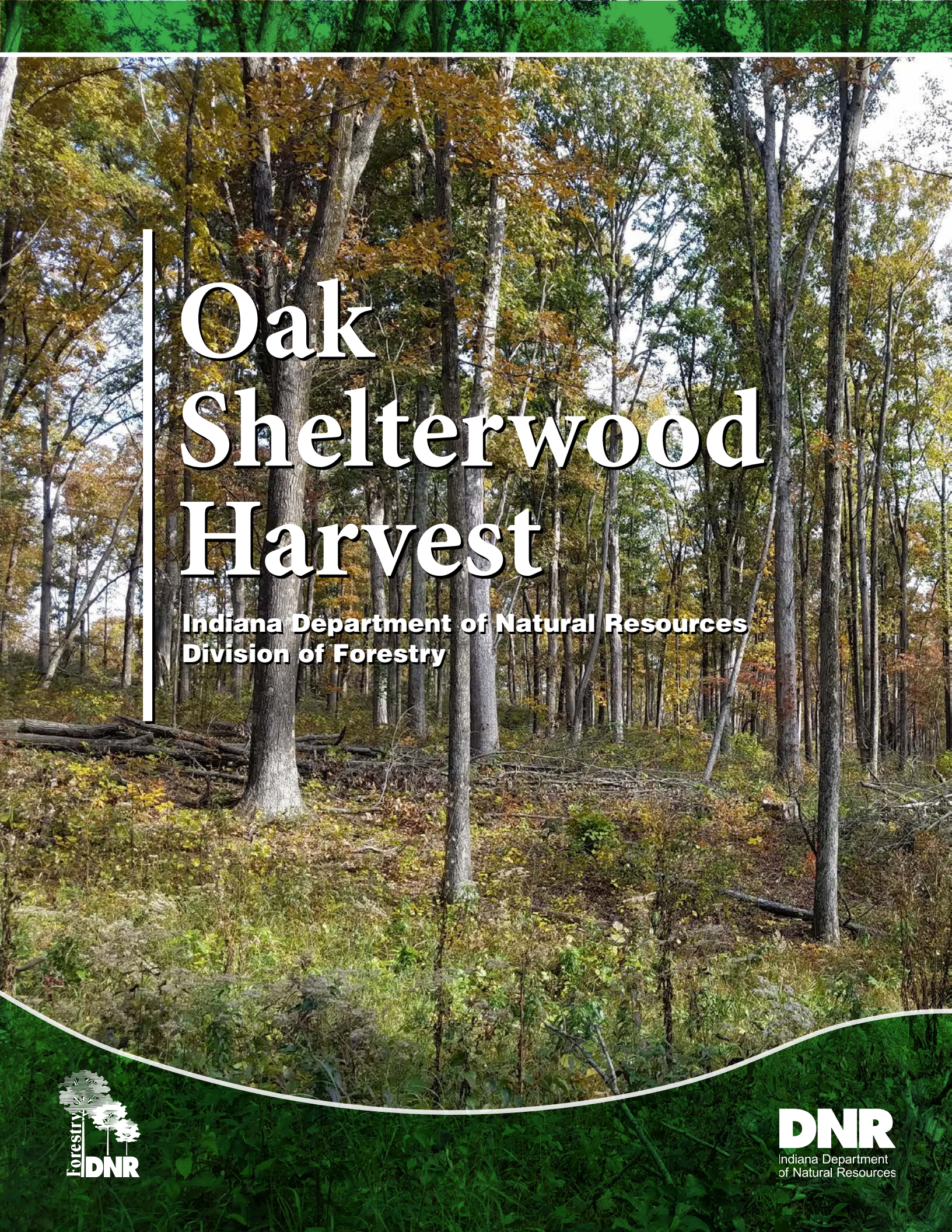

Oak Shelterwood Harvest

Indiana Department of Natural Resources
Division of Forestry

Forestry DNR

DNR
Indiana Department
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Oak-hickory forests have been part of the Indiana landscape for thousands of years. Oaks became the predominant species about 7,000 years ago, concurrent with the warming of the climate, the presence of fire, and the arrival of humans. Humans have been the driving disturbance factor in Indiana forests ever since. Fire was used to clear land for agricultural use and to drive or create conditions for improved habitat for wildlife like bison and deer. The presettlement forests dominated by oak and hickory reflect these early land-use practices. In the late 1700s, the arrival of Euro-American settlers into Indiana brought fire and the tendency to burn woodlands. Forests began to be cleared for homesteads, then for agriculture. Land was cleared, then abandoned and allowed to return to forest. By the mid-1800s, a growing human population led to larger amounts of the forest being cleared for agriculture and to supply hardwood lumber. Overharvest and land abuse continued into the 20th century. All of this disturbance perpetuated the oak-hickory forest type on the Indiana landscape.

When abandoned, eroded lands were either replanted or allowed to revert back to forest. Over time the use of fire decreased, reducing the frequency and severity of disturbance. While oak-hickory still dominated the forest, more publicly accepted forest management practices of the 1960s and 70s, such as single-tree selection harvesting, accelerated the process of succession toward shade-tolerant species such as sugar maple and American beech.

The eroded condition of land acquired for Morgan-Monroe State Forest, circa 1938. DNR photo

As a result, Indiana's forests of today are probably not reflective of the vast, presettlement forests of the 1700s. Parker and Merritt (1995) have characterized them as representative of "the culled over remains of once magnificent forests and will continue to bear the scars of mismanagement well into the future."

Indiana's oak-hickory forests are maturing and in many places progressing to a different forest type. While there is an abundance of mature oaks in the overstory, there is considerable lack of young oak seedlings. Over the past 70 years, some forest management practices and other factors have created structural and compositional changes that do not allow enough sunlight to reach the forest floor for oak acorns to germinate and grow.

Most of Indiana's oak forests are gradually being replaced by shade-tolerant trees like American beech and sugar maple. This understory is dominated by beech. Photo by D. Rogler, DNR

"Shade-tolerance" refers to the amount of sunlight a tree needs to germinate and grow. Trees range from very shade-intolerant (e.g., tulip poplar) to very shade-tolerant (e.g., sugar maple). Oaks fall in between. Oaks will germinate and survive under a full canopy for a couple of years, but then, without sunlight, will not advance beyond the seedling stage.

To increase the chances of regeneration of oaks across the state forests, Indiana is applying oak shelterwood harvests in select areas. Regeneration of oak is a primary strategy of the 2020 Indiana Forest Action Plan.

After the initial harvest, prescribed fire is applied to the stand. This low-intensity surface fire mimics the natural disturbance regime that historically favored the regeneration of oak species. Photo by Chris Neggers, Indiana Chapter The Nature Conservancy

Mature oak stand after a shelterwood harvest mid-story removal. The remaining high-quality trees are widely spaced, providing room for sunlight to reach the forest floor. Photo by Chris Neggers, Indiana Chapter The Nature Conservancy

What is a shelterwood harvest?

The shelterwood harvest method is a tree regeneration forest management practice that is conducted in three stages over a 20- to 25-year period. The first cut is a preparatory cut—the smaller trees in the understory and midstory are selected for removal to improve sunlight conditions for acorns to sprout and grow. The largest and the best trees remain in the canopy, encouraging crown development and acorn production. Prescribed fire can also be used to achieve understory control during this first cut.

During the next three to five years, oak seedlings will start to grow. The next step is an establishment cut, which removes a portion of the canopy while still maintaining the largest, most vigorous trees. This partial removal allows tree canopies to respond with increased acorn production and seedlings on the forest floor to receive the additional light they require to continue to grow. This light will also allow other intermediate shade-tolerant tree species to develop. When the new growth reaches 5-6 feet in height, the final harvest is applied, removing the remaining canopy trees. This method gives the intermediate shade-tolerant species a head start as well as the ability to compete with more shade-intolerant species. And by then these trees are above the height at which deer can reach the tops to browse.

Oak shelterwood harvests effectively alter environmental conditions at the forest floor by creating gaps in the canopy through the harvesting of selected trees, while leaving a certain percentage of trees standing on the site.

This harvest method has several advantages over other harvest methods for regeneration of oak. Because it is done in multiple stages, an oak shelterwood harvest is more visually appealing than methods that remove all trees at once. The young trees receive enough light

from the first two harvests, yet are protected by the canopy. The oak regeneration is established before the final harvest removes the remaining canopy trees. Because of the increased light reaching the forest floor, the density and diversity of understory plants increases. The structure of a shelterwood harvest creates abundant understory vegetation along with the mature trees for the first five to 15 years, supporting a diverse assembly of early-successional and late-successional forest birds.

Panoramas of a shelterwood research plot in the Hardwood Ecosystem. The intent of this forest management treatment is to provide an intermediate amount of sunlight for a period of time that will allow mid-tolerant tree species to become established and grow. Top: 2008: before the preparatory harvest. Bottom: 2015: Seven years after the preparatory harvest. Photos by HEE/DNR

Shelterwood has an advantage over single-tree selection harvest in that it creates more gaps in the canopy, allowing more light to reach the forest floor. In contrast, the canopy gaps created by single-tree selection quickly fill with the expanse of the crowns of surrounding trees and not enough light gets to the forest floor, so these gaps are filled by the shade-tolerant trees present in the understory.

With little or no management, the maple-beech component will increase in state forests. The same is true of harvesting by single-tree selection harvesting, because that method's effects also favor the regeneration of maple and beech.

Aerial view of a shelterwood harvest showing the canopies of the large residual trees and the gaps created to allow sunlight to reach the forest floor. Photo by Chris Neggers, Indiana Chapter The Nature Conservancy

Lack of understory vegetation is typical of forests dominated by sugar maple due to the density of the canopy. Photo by D. Rogler, DNR

Why Oaks?

Oaks are keystone species, meaning they have an unusually strong effect on other species in the given forest community. Not only are they important in maintaining biodiversity, they also provide food and support for a substantial number of wildlife species and insects. Loss of these dominant keystone species through succession will result in a less diverse forest of plants, wildlife and insects.

In spite of their name, oak-hickory forests are composed of many more species beyond oaks and hickories. Compared to maple-beech forests, oak-hickory forests have greater diversity of tree species and a richer understory of herbaceous plants and shrubs.

While there is currently an abundance of oak in the overstory of much of Indiana's forestland, there is a lack of young oak seedlings and saplings across the landscape. Oak stands with a maple-beech understory have shown a 90% drop in species richness and cover due to the high density of seedlings, saplings and small trees congesting the understory. This results in a loss of the herbaceous layer and is perhaps the most important unreported impact resulting from forest succession.

In Indiana state forests, sugar maple and American beech account for over one-half of all saplings, while oak and hickory comprise only 3.1% and 1.9% of all saplings, respectively, despite the fact that one-half of all large diameter trees are oaks and hickories (Gallion 2018).

Oaks are some of the most valuable trees in Indiana for wood products. Flooring, cabinets, furniture, veneer and barrels are all made of oak.

Shelterwood Harvests and Wildlife

No other current tree genus fills the functional role of oaks for wildlife in Eastern forests.

- Oaks produce acorns that are a primary fall and winter food source for many wildlife species, including deer, turkey, and wood ducks.
- Leaves, twigs, and young shoots of oaks provide food for a diversity of invertebrates.
- White oak is the preferred nesting tree of the state-endangered Cerulean Warbler.
- Cavities that develop in living and dead oak trees supply nesting sites for many birds.
- Oak forests generally have a rich understory of herbaceous plants, which support various neotropical migrant birds and insect populations.
- Bat activity in shelterwood harvest areas is greater than in unharvested areas.

Oak shelterwood harvests can potentially provide preferred habitat for the Cerulean Warbler during the initial cuts while allowing oak regeneration for future nest trees and foraging habitat. In addition to using large white oaks for nesting, insects are more abundant on oaks in comparison to other tree species and are the principal food consumed by adults and fed to young. Photo by Clayton Delancey

Birds and Insects

The relationship between oaks, insects and birds is complex. These trees have evolved with the local wildlife and harbor more insects, providing greater amounts of food for the many species of birds found in Indiana forests.

The tree genus to which oak belongs, Quercus, provides more food support for birds. More species of insects feed on oak than on any other group of trees of Central Hardwood forests. More than 550 species of butterflies and moths are supported by oaks found in the Central Hardwood forests. Caterpillars that feed on oak leaves and buds are the foundation of the food chain, as they are packed with the fats and proteins

Due to the high abundance of caterpillars found on oak trees, they are the preferred foraging trees for Carolina Chickadees to gather food for their chicks. In the 16-18 days it takes to bring a mature clutch of chickadees to maturity, the parents bring 6,000 to 9,000 caterpillars to the chicks. Photo by Doug Tallamy

necessary for baby bird development and pigmentation.

Other insects found on oaks include aphids, thrips, and beetles, as well as arthropods and spiders. For migrating birds in spring and breeding birds in Indiana forests, these insects and other invertebrates provide a protein-rich meal.

Indiana state forests are uniquely positioned to conserve the oak component of Indiana's forests. Large forest acreages, combined with the ability to employ the best available science in forest management, allows the state forest system the capacity to ensure that oaks are kept on the landscape for the future.

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