HARDWOOD TREE IMPROVEMENT
& REGENERATION CENTER E-NEWSLETTER - July 2007

Articles in this issue:

Beautiful Butternut: Saving a Tree in Trouble

Keith Woeste and Michael Ostry, USDA Forest Service

What is being done to conserve butternut? Butternut is a splendid, useful tree, and although it seems unlikely that butternut canker will cause butternut's complete extinction, there is grave concern over the long-term impact of this epidemic. For example, butternut is now extremely rare in the upper South where the canker disease has been particularly severe, and butternut may be permanently lost from many of the midwestern streamsides and woodlands where it once thrived. Scientists with the USDA Forest Service have, for the past 20 years or so, been attempting to **identify butternuts that are resistant to butternut canker.** Long-term repositories for butternut have been established in several locations, and researchers are planning to breed disease-resistant, locally adapted butternuts for reintroduction of the species to its former habitats.

Surveys have been undertaken by both State and Federal agencies to try to identify habitats in which butternut was once common so that the number and health of trees there can be monitored. These habitats are also candidates for butternut reintroduction in the future.

Butternut (*Juglans cinerea* L.), also called white walnut, lemon-nut or oil-nut, is a small- to medium-size tree that seldom exceeds 75 years of age. It is native to all the States of the Midwest and the southernmost parts of Canada. Butternut produces a large, thick-shelled nut, typically 11/2 to 21/2 inches in length. The husk or hull of butternuts is yellow-green and covered with sticky hairs. The nut inside is usually cylindrical with a sharp tip. The nutmeat is rich in oils and sweet, its flavor makes it a favorite of wildlife and those people lucky enough to find them and patient enough to crack them. Butternut does not usually tolerate shade. Butternuts growing in the open often have short trunks and broad, spreading crowns. These large-crowned trees can bear heavy nut crops, usually in alternating years. Butternut wood is softer and lighter in color than black walnut; it is workable and has a high commercial value. Butternut sap can be made into syrup. Native Americans used butternut bark, roots and husks for medicine.

What has caused butternut's decline? Over the last 40 years or so a fungal disease known as butternut canker (caused by the exotic fungus *Sirococcus clavigignenti-juglandacearum*) has **killed 80 to 90 percent** of the butternut trees in the United States , and butternut is listed as an endangered species in Canada . Butternut canker spreads quickly, and it has been found in every part of the butternut's range. Butternut canker is also lethal: infected trees, depending on their size and vigor, die fairly quickly, and in many places where butternut was once common it is rare or can no longer be found. Most butternuts are highly susceptible to the disease, and all ages and size classes of trees can be infected. Infections appear first in the upper crown where they can be hard to detect, but cankers will eventually develop on the stem and buttress roots of mature trees. These cankers can become quite large and, merging with other cankers, finally girdle the tree.

(Butternut cankers, Minnesota DNR)

What can landowners and tree care professionals do to care for butternut? Proper pruning and tree care will maintain the vigor of butternuts, and **vigorous trees are better able to withstand infections.** In the forest, kill trees that are competing for sunlight with the crown of the butternut tree. Trees that have dieback and cankers on large branches or signs of oozing cankers on the trunk are almost certainly doomed. Infected trees can continue to be a good source of nuts for consuming or for seed for some time, so the management goals of the landowners need to be considered before removal. **Dead trees should be burned or taken off site,** since they remain a source of inoculum for some time after they have died. Salvaging the valuable wood for use is a good practice. It is not known if chipped, infected wood can serve as a source of inoculum, but it seems likely.

How can I identify butternut trees? The butternut tree is similar in appearance to the common eastern black walnut and a hybrid between butternut and Japanese walnut, but several features distinguish the species. Butternut bark usually (but not always) has wide, somewhat shallow, smooth-topped ridges superimposed on darker fissures. Young butternut stems often appear shiny and olive green, with abundant small, round, white lenticels. The lenticels of hybrids tend to elongate and they tend to be patchy rather than evenly distributed. Butternut twigs contain pith that is dark brown and chambered, and the bud scars (the points at which last year's leaves were attached) are topped by a fringe of hairs. Black walnut twigs have light-brown pith and the leaf scars have no hairs. Pith of hybrids is chambered and often but not always light colored (sandy or light brown rather than the dark, walnut brown of butternut pith). Nuts of the black walnut are covered by a smooth or sometimes textured (but at maturity never hairy or sticky) husk and the nuts themselves are typically egg-shaped or rounded and lacking the pointy tip found on butternuts. Hybrid butternut – Japanese walnut trees will usually be found near homes or farm lots, tend to have heavy nut crops annually, and retain green leaves late into the fall.

What can I do to help? Remember that what appear to be butternut trees growing in farmyards and heavily modified landscapes are often *hybrids* between butternut and the exotic species Japanese walnut. **But if you notice a forest-grown butternut bearing seeds, make a note of the location and collect the seeds if you can.** Keith Woeste, a butternut researcher with the HTIRC, collects the information and grows samples of the seeds for reintroduction research. Some butternut trees that have survived this epidemic were isolated and escaped infection, other trees appear to have resistance to the disease.

Finally, you have already made a contribution by reading this article. A lot of landowners, natural resource professionals, environmentalists and tree care professionals still do not know about the butternut canker epidemic. And they are in a position to help.

You can learn more about the butternut story at these websites:

http://www.na.fs.fed.us/spfo/pubs/howtos/ht_but/ht_but.htm http://www.forestry.state.al.us/publication/100/Butternut.pdf

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Challenges of Regenerating Oak: A case study of natural oak regeneration after clearcutting on the Hoosier National Forest

By Robert Morrissey and Douglass Jacobs, HTIRC

The Challenge

Oaks are valued timber and wildlife trees in the Central Hardwood Forest Region (CHFR), but **there is grave concern regarding the future of oak ecosystems because of the lack of success in naturally regenerating oaks.** Development of oak ecosystems is a result of changes in forest structure that occur over time due to interactions of tree growth, mortality, and regeneration within forests, which is further supplemented by natural and human-caused disturbances like fire, grazing, or timber harvesting. Oaks tend to be intolerant or mildly tolerant of shade, thus, even-aged management methods, such as shelterwood and clearcut harvests, are best suited to regenerate these species.

Clearcutting is one of the most controversial subjects in forestry across the country today. It is often associated with clearing of large tracts of land, resulting in soil degradation and erosion, total destruction of viable wildlife habitat, and scenery that is not aesthetically appealing. In response to these concerns, selection management, which harvests fewer trees across an area at more frequent intervals, has become increasingly popular. Although selection management is typically more aesthetically pleasing because it leaves some forest cover on a harvested area, it may also lead to high-grading (take the best and leave the rest) in terms of tree species, quality, and genetic composition, or changes in species composition and structure across forests.

Numerous studies have observed a decrease in the oak component of forests after clearcutting throughout the CHFR. The lack of success of natural oak regeneration has often been attributed to human influences, such as selection harvesting, and fire suppression. This typically results in stands with an oak overstory, which developed under different environmental and disturbance history, and an understory with an abundance of shade tolerant species such as sugar maple, American beech, and ironwood. These species are able to grow and survive in low light levels in the understory for many years, especially when understory disturbances, such as fire or grazing, are removed from the natural system.

This study examined the influence of site conditions on natural oak regeneration and the competitive success of oaks 21 to 35 years following clearcut harvests. We compared the current population of oaks to an earlier study conducted within the same forest areas in 1986. These two data sets provided a unique opportunity to evaluate competitive ability of oak species over time and across 70 clearcut sites on the Hoosier National Forest (HNF) in south-central Indiana.

The Right Place at the Right Time

Our study found that the average relative density (RD; # dominant oak trees by plot/total # of trees by plot) of dominant oak trees increased since 1986, when these stands were originally sampled (Figure 1). Our findings indicate that over that period, oaks were able to better compete for growing space. Most studies indicate that oaks cannot adequately compete against fast-growing species such as yellow-poplar and black cherry, two strong competitors found throughout our study sites. **The question then is why were the oaks able to persist and attain dominant canopy positions?**

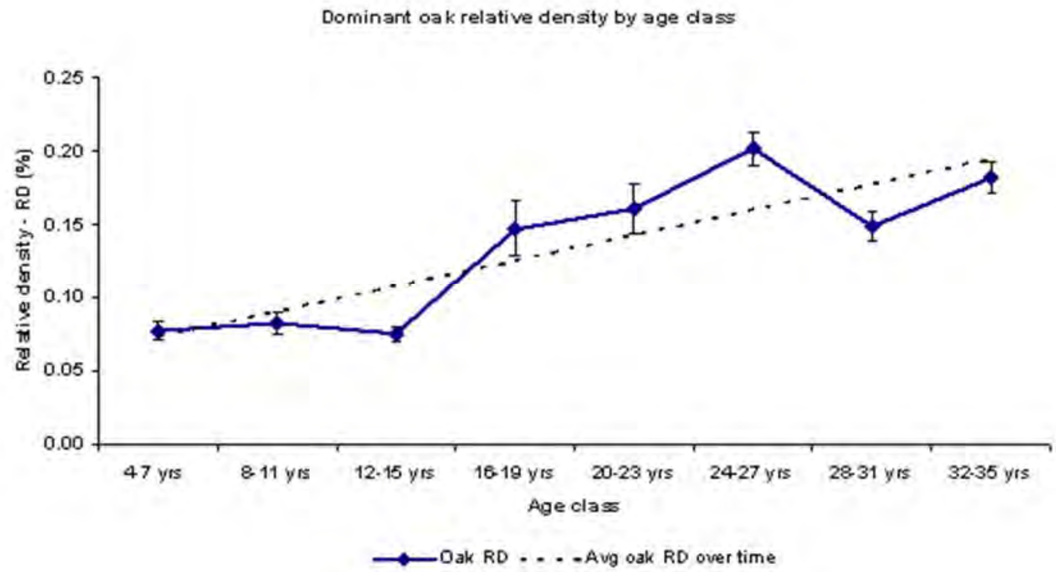

Figure 1. Average relative density (RD; # dominant oak trees by plot/total # of trees by plot) of dominant oak trees by age class from 70 clearcut stands on the Hoosier National Forest; data was combined from the 1987 date and the current dataset. The broken line indicates the average RD of dominant oak trees across all age classes as stands age and develop.

Most studies indicated that higher quality sites were commonly dominated by less valuable species such as sugar maple, red maple, yellow-poplar, and white ash, while oak species competed best on poorer sites. The success of oaks in competing for growing space over this period demonstrates a strong relationship to site conditions, including natural region, aspect (the direction a slope faces), and to a lesser degree, slope position.

Figure 2 indicates the average number of dominant oak trees per acre found in two natural regions of south-central Indiana, the Shawnee Hills and Highland Rim regions, during the most recent sample period. The Highland Rim area tends to have more shallow soils relative to the Shawnee Hills region, thus those sites do not retain soil moisture as efficiently; it is apparent that the Highland Rim region has a greater number of dominant oak trees per acre, most notably on the mid and upper slope positions. Aspect also plays an important role in the success of oaks. Sites with southeast (SE) to northwest (NW) aspects tended to have higher densities of oak species; those sites receive more sunlight throughout the day, thus, they tend to be warmer and drier in nature. Slope position was also important and its effect was most noticeable on lower slope positions; these sites tend to have greater resources of water and nutrients, thus, they are more productive, and the result was that fast growing species were better able to exploit these areas and outgrow the oaks rather quickly, making it difficult for them to attain dominant canopy positions. Oak species are known to be more tolerant of drought than many of the moist-site species found throughout the CHFR, as they tend to have higher photosynthetic rates during drought periods in contrast to neighboring species.

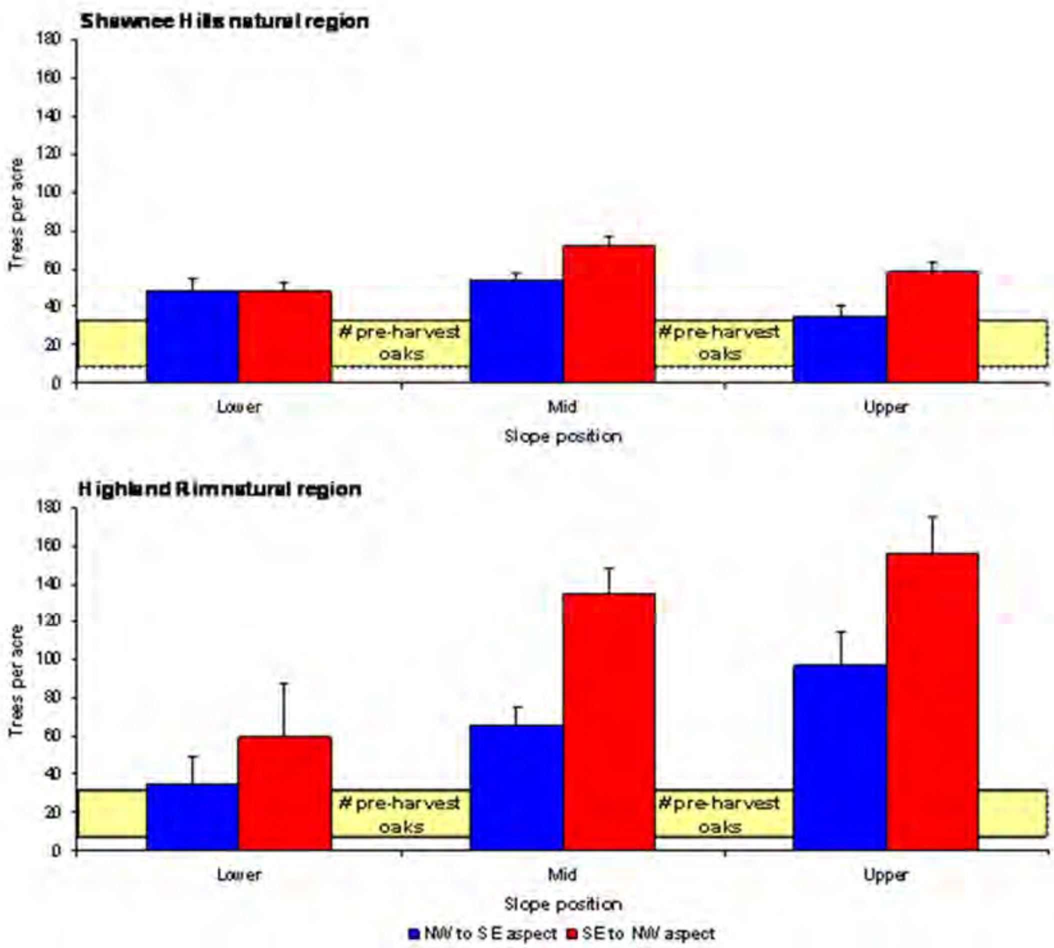

Figure 2. Dominant oak trees per acre by aspect and slope position; the NW to SE aspect tend to have lower daily average temperatures and greater soil moisture relative to SE to NW aspects which receive more sunlight throughout the day. The area labeled “# pre-harvest oaks” indicates the estimated average number of oak trees per acre (10 to 30 trees) in mature stands before clearcutting.

Two other important considerations in the competitive success of oaks relate to the occurrence of several recent drought events in the region and the importance of oak stump sprouts after harvest. There were at least four major drought events during this period; the effects were most evident in dead and damaged yellow-poplar found throughout the sites; yellow-poplar is a site-sensitive species and is known to be particularly susceptible to drought events. **Reduced growth and numbers of yellow-poplar stems related to the drought events resulted in increased growing space for oaks because they were better able to tolerate these dry periods.** This may also be related to the prevalence of oak stump sprouts; it was determined that at least 45% of all dominant oak stems were originated from stump sprouting after harvest. The larger established root systems to access water resources and faster growth of stump sprout stems may help to explain increased competitive success of these oaks. Most sites currently have a comparable number of dominant oak stems when contrasted with pre-harvest oak levels. **With some intermediate cutting, many of these stands could be managed to resemble the structure and composition of the pre-harvest forest area.**

More Work to Do

Drought events have likely favored the oak species group, but there is still a large yellow-poplar component on many of these sites. If they are allowed to grow and develop without future disturbance, such as drought events, intermediate cutting, disease or pest infestations, it is expected that they will outgrow and out-compete the oak species. **Fast-growing yellow-poplar and black cherry stems pose competitive pressures for oak stems now and in the future.** To help put this into perspective, yellow-poplar and black cherry composed only 4% of the pre-harvest stands, but they currently make up 38% (25% and 13%, respectively) of all dominant trees. Reliance of dominant oak stems on stump sprouts, coupled with the potential that oak species will have a smaller pool of stump sprouts in the future because of the relatively lower oak densities in our regenerated areas, suggests that regenerating these stands in the future through clearcutting may not be successful. Additionally, high densities of yellow-poplar and black cherry will provide highly competitive regeneration in future forest stands through increased numbers of stump sprouts plus greater seed availability. An intermediate cutting would serve to reduce the ability of yellow-poplar and black cherry to reproduce in these future stands, as well as increase the available regeneration pool for oak species and growing space for the selected oak crop trees. **The current structure and composition of these forest areas is such that an intermediate cutting that favors oak crop trees would serve to increase the oak composition in the canopy of these stands and help revert forest composition to pre-harvest conditions, which had a higher percentage of dominant oak trees.**

(See http://www.fs.fed.us/na/morgantown/frm/perkey/ctm/ctm_index.html for information on crop tree management.)

In order for even-aged management systems to be effective in naturally regenerating oaks, it is essential to plan before harvesting mature stands. Establishing advanced oak regeneration in the understory is key to successful regeneration of oak stands, but dense mid- and understory canopies may have to be removed through manual cutting, herbicide, or prescribed fire. Professional foresters can address other concerns regarding clearcutting as well by prescribing them in a manner that reduces erosion through proper planning of forest skid trails, roads, and buffers around waterways, and protect scenery through careful harvest boundary layout that serves to reduce the visual impact of clearcuts. Clearcuts do not necessarily destroy wildlife habitat, but rather they alter the composition and structure of the habitat for use by another group of wildlife species adapted to that type of cover, both at the stand and landscape levels. Clearcuts can be a very effective forest management tool for land managers, and the decision to use clearcut harvesting should be related to landowner objectives such as forest health, quality, and productivity, wildlife habitat structure, or species composition. If regenerating oaks is a management objective, active management following the clearcut harvest may be needed to release oaks from competition with fast growing species like yellow-poplar and black cherry.

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For a more complete look at the results of this study: http://www.extension.purdue.edu/extmedia/FNR/FNR-260.pdf

Conservation Practices and Carbon Offset Credits: Income Opportunities for Landowners

Lenny Farlee, HTIRC, Purdue University

As a forest manager working with private land owners, I was always on the lookout for **incentives that would encourage sustainable forest management practices on private lands.** Conservation practices, like tree planting, woodland improvement, or riparian buffer installations, can be costly and the return on the investment may be many years down the road. Fortunately, government and private conservation organizations have recognized many of these practices benefit not only the landowner, but also local and regional economic and environmental health. Cost sharing and set-aside incentives have encouraged and enabled thousands of landowners to conserve and manage hundreds of thousands of acres.

A relatively new incentive for good land stewardship is emerging. This revenue source may be available for practices you have already installed or management systems you are already practicing. It's based on a market trading system for carbon dioxide (CO_2). The Chicago Climate Exchange (CCX) is the worlds' first and North Americas' only voluntary, legally binding rules-based greenhouse gas emission reduction and trading system (http://www.chicagoclimateexchange.com). CO_2 emitters, like utilities, manufacturers, or municipalities, can join CCX and agree to reduce their emissions by a certain percentage from year to year. If they are unable to reduce their emissions by the agreed-upon amount, they may purchase mitigation carbon credits from entities whose practices are storing (sequestering) CO_2. Some land management practices recognized to sequester CO_2 include no-till or low-till agricultural systems, grassland planting, establishment and management of tree plantations, and maintaining and managing forest lands. **Many landowners in the Central Hardwood Region, who have already installed these practices or plan to do so, may be eligible to take advantage of this new marketplace.**

The amount of income from selling carbon credits depends on the capacity of management practices to sequester carbon and the market value of CO_2 at the time of sale. Below are some examples based on a CO_2 value of $3.50/metric ton and sequestration values established for these practices:

- Permanent no-till croplands: 0.5 tons CO_2 per acre per year X $3.50 = $1.75/ac/yr.
- Permanent grass cover: 0.75 tons CO_2 per acre per year X $3.50 = $2.62/ac/yr.
- 7 year old mixed hardwood tree plantation: 4.54 tons CO_2 per acre per year X $3.50 = $15.89/ac/yr.

Managed forests may also be eligible for the carbon trading programs. A project for managed woodlands in Michigan provides for carbon credit sales using forest inventory and growth data to establish the amount of carbon sequestered.

The Hardwood Tree Improvement and Regeneration Center (HTIRC) and Purdue University Department of Forestry and Natural Resources have been partnering closely with the Delta Institute to offer a pilot program to Indiana's forest landowners for working forests and afforestation projects. They are testing the protocols now with inventory data from Michigan. Watch for more information on this program in the next few months.

Most landowners will need to use the services of an aggregator registered with the CCX to sell their accumulated carbon, due to minimum trading quantities imposed by the exchange. Registered aggregators are listed on the CCX web page under "members":

http://www.chicagoclimateexchange.com/content.jsf?id=64

Several aggregator options are available to plantation and forest owners here in the Central Hardwoods area:

The Delta Institute (http://deltacarbon.org/),and the Iowa Farm Bureau (http://www.iowafarmbureau.com/carbon/) offer aggregation services for landowners in the Central Hardwood Region. Other aggregators may be available in your area and new aggregators are entering the market regularly. Most aggregators charge a fee to provide aggregation services. The fee is typically between 8 and 10% of the carbon credit value, but landowners should confirm fees as they may change over time. The CCX also currently charges $0.20 per ton of CO_2 traded.

Indiana Senator Richard Lugar's 604 acre family farm near Indianapolis was the first in Indiana to participate in the CCX carbon program

The property is a corn and soybean farm with about one third of the land planted to high quality hardwood tree plantations including black walnut. An article outlining Senator Lugar's enthusiastic endorsement of this program as part of a total farm management plan can be found at:

http://lugar.senate.gov/energy/press/speech/climate.html

Conservationists have lamented for years that we are not adequately rewarded for the benefits provided to society by our practices. It looks like one environmental service is starting to pay off. Learn more about the possibility of getting credit for your carbon by contacting an aggregator or the Chicago Climate Exchange.

For questions or comments on this article contact:

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Growing Trees from Seed

Starting trees from seed requires knowing the germination requirements for the species you wish to grow. Most native tree seeds require treatments to break seed dormancy before the seed will germinate. These are done naturally by weather cycles, moisture, sunlight, and wildlife in the forest environment. When we collect seeds, we will have to simulate these natural events to germinate the seeds successfully. The Woody Plant Seed Manual, a US Forest Service publication available at http://www.nsl.fs.fed.us/wpsm/ gives detailed germination and nursery culture instructions by genus and species of trees.

A general germination guide for some common tree species can be found at:http://www.ipm.iastate.edu/ipm/hortnews/2000/8-11-2000/germtreeseed.html

A good beginners' guide for tree seed germination techniques is available at http://trees-seeds.com/seed.htm .