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On the Search for Success: Revisiting Group Selection in Promoting Northern Hardwood Forest Biodiversity

The Shifting Face of Northern Hardwood Forests

If you walk through a northern hardwood forest in the Lakes States region today, you'll likely experience something different than your ancestors would have centuries ago. Instead of a variety of species, including eastern hemlock (*Tsuga canadensis*), paper birch (*Betula papyrifera*), and eastern white pine (*Pinus strobus*) saplings, you'll likely see a proliferation of sugar maples (*Acer saccharum*), their iconic leaves soaking up the sunlight. According to Christel Kern, a research forester with the U.S. Department of Agriculture, Forest Service's Northern Research Station (NRS), "There has been growing concern about northern hardwood forests composed of sugar maple monocultures. One pest or pathogen could wipe out an entire stand." Recently Kern, along with Michigan Technological University professor Christopher Webster and master's student Samuel Knapp, revisited a long-term study site in Wisconsin's Chequamegon-Nicolet National Forest to further investigate cohort development and biodiversity.

A carpet of sugar maple seedlings in a northern hardwood forest. USDA Forest Service photo.

KEY MANAGEMENT CONSIDERATIONS

- Contrary to what was previously thought, group selection, a common tool in the management of uneven-aged stands, may not lead to increased tree species and natural regeneration.
- Additional site preparation beyond the current status quo, such as soil scarification, planting, and herbivore protection, may be needed to achieve biodiversity goals.
- A stand's composition 2 years post-harvest is a strong indicator of its future makeup. This discovery can serve as a highly useful tool for foresters wishing to determine the success or failure of stands early on, allowing them to adjust management practices accordingly.
- Advance regeneration may be vital for adequate stocking within large canopy openings. Targeting group-selection openings where shade-intolerant advance regeneration already exists can facilitate future overstory tree diversity.

Beginning in the 1990s, research foresters posited that single-tree selection—removing only individual trees from an area and thus perpetuating a generally shady understory—may have been partially to blame for increases in shade-tolerant species, to the detriment of forest tree diversity. To counter this unintended effect and promote the establishment of sun-loving species, group selection was proposed as an alternative, with multiple trees harvested in clumps to create canopy gaps that allow more sunlight to reach the forest understory. In 1994, the Divide Canopy Gap Study was established to test the efficacy of group selection in the Chequamegon-Nicolet National Forest. At this site, 60 areas were treated with one of five varying canopy gap sizes (with diameters ranging from 18 to 150 feet), while 12 unharvested areas served as experimental controls. Thirteen years later, in 2007, the surprising results of the Divide Canopy Gap Study were released: contrary to what had been predicted, opening size seemed to have little effect on regeneration diversity. Group selection alone was not enough to increase biodiversity, a realization that had already

Christel Kern and coworker tediously search a berry patch for tree seedlings in a large gap created by group selection. USDA Forest Service photo.

struck some foresters in the region whose implementation of group selection had led to similar on-the-ground results.

Returning to the Divide Canopy Gap Study

With this in mind, Kern, Webster, and Knapp revisited the Divide Canopy Gap Study, now more than two decades after the experiment started. Had diversity composition gotten better or worse in the decade since these sites were first studied? In December 2020, the results of their reassessment were released in a Forest Ecology and Management paper titled "Harvested Opening Size Affects Cohort Development and Failures in a Second-Growth Northern Hardwood Forest." According to Kern, "Even 23 years after that [initial] harvest, there really had been little change from what was found in the study 10 years prior." Notably, the largest openings in the study were the most likely to display regeneration failure, with shade-tolerant species continuing to out-compete sun-loving ones to the detriment of tree diversity. Yet, Kern did observe that larger gap openings had more complex regeneration dynamics when compared to smaller openings. "Sometimes large openings were a total success. They had a dense layer of saplings and a variety of species coming in. Or they were the polar opposite. Very few trees in a raspberry patch remained that way decades later." Most importantly, Kern determined that a stand's composition 2 years post-harvest was a strong indicator of the stand's future makeup and long-term success. "What we saw at year 2 predicted what we saw at year 23," Kern says. "This is important because it suggests that managers could begin to mitigate failure areas very early on [with additional site management] instead of waiting to see what happens years later."

"It's not as simple as just harvesting and walking away. Monitoring, mechanical treatments [like soil scarification], planting or artificial seeding might be needed."

A Study Spanning Generations of Scientists

For Kern, group selection remains a useful technique for practicing foresters, provided it is coupled with thoughtful observation and, more often than not, a hands-on approach. "It's not as simple as just harvesting and walking away. Monitoring, mechanical treatments [like soil scarification], planting, or artificial seeding might be needed."

According to Kern, documenting both successes *and* failures is key as she and others work to support the management and biodiversity of northern hardwood forests. Thinking ahead, Kern is excited to study how to rehabilitate failed gap openings. In the coming years, Kern and partners from the Chequamegon-Nicolet National Forest will implement additional management techniques on select failed areas within the Divide Canopy Gap Study. This will allow her to test the efficacy of rehabilitation practices and then communicate those results to foresters. Speaking about the value of a long-term experiment like this, Kern says, "There are few studies that document trends for this long. We're starting to get into midterm results, and that's a special research niche for the Forest Service. We have generations of scientists maintaining and following these forestry experiments over decades."

Project Lead

Christel Kern is a team leader and research forester with the Northern Forest Science and Applications unit. Learn more about Kern's work at https://www.nrs.fs.fed.us/people/Kern.

FURTHER READING

Knapp, Samuel P.; Kern, Christel C.; Webster, Christopher R. 2021. Harvested opening size affects cohort development and failures in a second-growth northern hardwood forest. Forest Ecology and Management. 482: 118804. 10 p. https://doi.org/10.1016/j.foreco.2020.118804.

Kern, Christel C.; D'Amato, Anthony W.; Strong, Terry F. 2013. Diversifying the composition and structure of managed late-successional forests with harvest gaps: What is the optimal gap size? Forest Ecology and Management. 304: 110-120. https://doi.org/10.1016/j.foreco.2013.04.029.

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