USDA Forest Service
U.S. DEPARTMENT OF AGRICULTURE

Northern Research Station

Rooted in Research

ISSUE 38 | AUGUST 2024

Assessing Assisted Migration Under Climate Change Scenarios

Climate Change, Forests, and a Potential Strategy

Climate change is bringing rapid changes to the environment, including new temperature ranges and precipitation regimes. Some trees may no longer thrive and regenerate in their current locations, which in turn may reduce the ecosystem goods and services they have produced in the past.

One adaptive solution being studied is assisted migration, a strategy of planting tree species or genotypes that are better suited to an area's projected new conditions to help sustain the forest ecosystem. Research ecologist Eric Gustafson and research foresters Christel Kern and John Kabrick, all with the U.S. Department of Agriculture, Forest Service, Northern Research Station, used a process-based model to simulate long-term effects of assisted migration under different climate change scenarios. They shared their findings in a paper published in Forest Ecology and Management: Can assisted tree migration today sustain forest ecosystem goods and services for the future?

"Assisted tree migration is an emerging practice for building resilient forests in a changing climate," Kern says, "and because the practice is new, we don't know what the outcomes would be. Models that use large time scales and spatial scales can give us ideas about what those outcomes could be."

Making the Impossible Possible

The researchers ran simulations using the LANDIS-II forest landscape model on an area in northern Wisconsin, testing the forest's response to three different climate scenarios: a limited climate change scenario (RCP 2.6), an intermediate climate scenario (RCP 6.0), and an extreme scenario (RCP 8.5). The projections extended 300 years into the future, which allowed the simulated current and future forest to respond to changes in composition and climate.

"The model allows experiments that are impossible in the real world," Gustafson says. "Giant landscape experiments aren't possible, and 300-year experiments aren't possible. The model makes the impossible possible—and it's much less expensive."

An assisted migration planting in Quebec. USDA Forest Service photo by Christel Kern.

KEY MANAGEMENT CONSIDERATIONS

- Researchers ran simulations using the LANDIS-II forest landscape model to understand potential effects of assisted migration in northern Wisconsin forests under three climate scenarios.
- Under a limited climate change scenario, assisted migration can boost species diversity, increase biomass production, and maintain ecosystem goods and services.
- Under an extreme climate change scenario, assisted migration alone was not expected to maintain ecosystem goods and services.
- Simulation modeling can help reduce uncertainty associated with assisted migration.

Results and Effects of Assisted Migration and Climate

Limited and Intermediate Scenarios

Under the limited and intermediate climate change scenarios, the model indicated that planting species with similar silvics and site adaptations as the current species—but sourced from climate regions that more closely resemble what the area is transitioning to—would sustain major forest functional types. Under a limited climate change scenario, assisted migration also increased aboveground biomass production and species diversity. Under an intermediate climate change scenario, aboveground biomass production substantially increased, but species richness did not change. Certain forest goods, including timber products and maple syrup production, were maintained with assisted migration under both climate scenarios.

Extreme Scenario

Under the extreme climate change scenario, assisted migration alone did not maintain ecosystem goods and services. Even the most aggressive assisted migration strategies were not sufficient to mitigate the effects of severe climate change on productivity, notably the negative effects of moisture stress and increased respiration. The extreme climate change scenario was more likely to influence certain forest attributes, such as total woody biomass, total harvested biomass, species richness, and age class richness, than could be mitigated by assisted migration. These results suggest that many species may struggle to survive under extreme climate change, regardless of assisted migration strategies.

Reducing Uncertainty

Assisted migration is an emerging practice with many unknowns and potential unintended effects. The simulations showed that assisted migration affected ecosystem services in ways that the researchers had not anticipated, mainly because they did not explicitly consider wildlife (e.g., masting and seed production) and aesthetics (e.g., fall color) in their selection of assisted migration species. While their assisted migration scenarios led to a more diverse seed size selection, the forest overall produced less brilliant fall colors.

The research team acknowledged that assisted migration is one strategy among many common strategies, including strategies that focus on resilience and resistance through thinning and natural regeneration. Because assisted migration is a more active approach that can have more unintended consequences, it may require more caution and investigation.

"There's no turning back once you embark on a strategy like this," Gustafson says. "Uncertainty is the biggest hurdle to implementing assisted migration, and even to those of us who think it's a necessary, feasible, and effective strategy, there are unknowns. The uncertainty makes it a little bit controversial. Our study was an attempt to use a novel approach to reduce some of that uncertainty."

PROJECT LEADS

Eric Gustafson is a research ecologist for the Landscape Ecology and Sustainability in the Lake States Forests research work unit with the Northern Research Station.

John Kabrick is a project leader and research forester for the Ecological Sustainability of Forests and Grasslands in the Central Hardwoods research work unit with the Northern Research Station.

Christel Kern is a research forester for the Landscape Ecology and Sustainability in the Lake States Forests research work unit with the Northern Research Station.

FURTHER READING

Gustafson, Eric J.; Kern, Christel C.; Miranda, Brian R.; Sturtevant, Brian R.; Bronson, Dustin R.; Kabrick, John M. 2020. **Climate adaptive silviculture strategies: How do they impact growth, yield, diversity and value in forested landscapes?** Forest Ecology and Management. 470–471: 118208. https://doi.org/10.1016/j.foreco.2020.118208.

Gustafson Eric J.; Miranda, Brian R.; Dreaden, Tyler J.; Pinchot, Cornelia C.; Jacobs, Douglass F. 2022. **Beyond blight: Phytophthora root rot under climate change limits populations of reintroduced American chestnut.** Ecosphere. 13(2): ecs2.3917. https://doi.org/10.1002/ecs2.3917.

Gustafson, Eric J.; Sturtevant, Brian R.; de Bruijn, Arjan M.G.; Lichti, Nathanael; Jacobs, Douglass F.; Kashian, Daniel M.; Miranda, Brian R.; Townsend, Philip A. 2018. **Forecasting effects of tree species reintroduction strategies on carbon stocks in a future without historical analog.** Global Change Biology. 24(11): 5500–5517. https://doi.org/10.1111/gcb.14397.

Forest Service Research and Development works with partners to deliver the knowledge and tools that land managers need to sustain the health, diversity, and productivity of our Nation's forests and grasslands for present and future generations. The Northern Research Station (NRS), one of seven FS R&D units, is rooted in the geography of the Northeast and Midwest. NRS science supports a sustainable future.

For questions on Rooted in Research, please contact Andrea Brandon-Hennig. Technical editing by Carol Hollar-Zwick. Design and layout by Jeremy Siegrist.

Forest Service | **Northern Research Station**