Adaptive Management

Many of the management practices that are already "smart forestry" can have valuable win-win benefits for climate change adaptation.

The Earth's climate is changing. Many trends have been tracked, some reaching back tens of thousands of years. Trees and forests are sensitive to a range of environmental conditions, including the climate. In addition to climate, there are other factors to which forests respond, such as human activities and management, biological relationships, and invasive pests. All of this creates a dynamic within which forests grow and change.

What might a forester do to embrace the changing environment and maintain productive forests? The interactions between forests and climate change will occur over decades. Forest management practices and forest owner decisions will need to evolve with time. In terms of the next few years, there is probably not anything critical that must be done. However, employing current forest management practices to enhance forest diversity and health will increase resiliency and best position forests for the future, with or without climate change. Active forestry remains the best option.

What are some of the practices to best prepare forests for the future? Forest managers and owners have options that can be exercised in current management plans.

Increase species diversity, where appropriate. Each forest type has an inherent amount of species diversity. For example, jack pine forests have fewer species than northern hardwoods. Maximizing the natural diversity potential of a given forest type can help forests be resilient to both current and future pressures and provide more options for the future.[1]

Harvest operations in a mixed pine stand. Photo by US Forest Service, Huron-Manistee National Forest.

Encourage diverse stand structures and age classes to improve the "response diversity" of a forest. Thinning may become increasingly important in some forest types as climate change increases the likelihood of summer moisture stress. Variable thinning can help create a diversity of age classes and encourage a wider range of species, which is a way of reducing risk.

Northern hardwoods is Michigan's most common forest type. Using group selection, rather than single-tree selection, can encourage a wider tree species mix and diverse stand structure. Current research suggests gaps should be 50-100 feet in diameter. Gap shape can vary. Gaps can be placed near less common tree species currently present in the stand, such as yellow birch, white pine, red oak, or hemlock.

Monitor for invasive exotic plants, which are a serious and increasing problem. Consider the use of herbicides, among other control techniques, to eradicate these species to the extent possible. These problem plants often work in concert with exotic animals (e.g. slugs, earthworms) and native animals (e.g. deer, rodents) to create alternative ecological states of considerably lower diversity. Impaired communities may be less resilient to the effects of climate change.

White-tailed deer fawn. Photo by Christopher Hoving, Michigan Department of Natural Resources.

Excessive **deer browsing** plays an important role in this matrix. White-tailed deer are expected to be one of the species favored by projected climate conditions. Deer are already a major factor in the failure of forest regeneration[2] and work in concert with other species (native and exotic) to push forest systems to less productive states. Hunting pressure is currently insufficient to attain deer population targets, especially on private forestland. Different strategies may be required to control burgeoning populations.[3]

Watch for the presence of damaging exotic insects and forest pathogens. New threats will continue to occur. Incorporate response alternatives into forest management planning. A few of the impending threats to Michigan forests include Asian long-horned beetle, hemlock and balsam woolly adelgids, thousand cankers disease, and oak wilt.[4]

Carefully evaluate forest regeneration (trees and understory plants). Changes should be noted. For example, boreal forests in parts of northern Minnesota are being regenerated to oak and red maple.[5] In Michigan, sugar maple regeneration on more marginal sites may decline if earthworm activity reduces the humus layer.[6] Most forest management practices are designed to provide environmental conditions that promote regeneration. However, regeneration success can often be diminished (or eliminated) due to other factors.

Consider assisted migration/ managed relocation when appropriate. These are terms for intentionally introducing tree species or genetic material from areas that currently experience climate conditions expected in the future. In other words, planting tree species or seed stock from warmer zones in anticipation of a warming climate. Trees have different seed dispersal strategies, some more aggressive than others. Slow-moving species may not be able to naturally migrate fast enough to take advantage of appropriate new habitats created by warming conditions. Fragmented forests and other physical barriers can prevent natural migration. Humans can selectively facilitate tree migration by planting, although landscape-level projects would be very costly and risks need to be considered.

When planting is desired, **using containerized stock in the fall** may become preferable to bare-root planting in the spring, currently the traditional planting season. Newly established seedlings in the spring often die from summer droughts, which are expected to become more frequent and severe. Containerized stock come with a soil plug and may become more acclimatized to their new location prior to summer dry periods.

Consider shortening rotation lengths for some at-risk, even-aged species. A "rotation" is the number of years between stand establishment and final harvest. Aspen, jack pine, and spruce-fir forest types are harvested and regenerated through clearcutting, based on their natural disturbance regimes. As mid-century approaches, rotations may need to be shortened if climate change leads to a loss of productivity. At that time, converting the stands to more suitable forest types may need to be considered.

On currently drier and marginal sites, maintaining closed-canopy forest cover may not be an option. These sites may continue with substantially less forest cover. Planting programs may not be sufficient to maintain forest cover.

Management for savannas, prairies, and barrens may become more appropriate for some places on the landscape. Photo by Heather Keough, Huron-Manistee National Forest.

Establish plantations of appropriately-adapted species, when needed to provide certain forest products or habitat conditions. Breeding programs typically require decades to develop stock suited to particular conditions. The role of short-rotation, intensive-culture energy plantations of hybrid poplar and hybrid willow may become more desirable and financially feasible.

Monitor forests and the success of forest management practices. Forests are dynamic ecological systems that will respond to climate change in both predictable and unpredictable ways. Forest responses will not be uniform across the region or landscape. It will be important to work with the research community to help identify and describe forest change.

The **desired future conditions** of current forest management, for the most part, should be current forest types that are best suited to the site. However, novel successional pathways or new species mixes may need to be considered. Forest management practices may need to be re-considered to accommodate alternate goals and objectives.

1: Swanston, C.W. and M.K. Janowiak (editors). 2012. Forest Adaptation Resources: Climate Change Tools and Approaches for Land Managers. GTR-NRS-87. www.treesearch.fs.fed.us/pubs/40543
2: Cote, Steeve et al. 2004. Ecological Impacts of Deer Overabundance. Annu. Rev. Ecol. Evol. Syst. 35:113-47.
3: Vercauteren, Kurt et al. 2011. Regulated Commercial Harvest to Manage Overabundant White-tailed Deer: An Idea to Consider? Wildlife Society Bulletin, 35(3): 185-194.
4: Handler et al. 2014. Michigan Forest Ecosystem Vulnerability Assessment and Synthesis. GTR-NRS-129. www.nrs.fs.fed.us/pubs/45688
5: Fisichelli, Nicholas et al. 2013. Temperate Tree Expansion into Adjacent Boreal Forest Patches Facilitated by Warmer Temperatures. Ecography 36: 001-010.
6: University of Minnesota, Natural Resources Research Institute. 2013. Forest Ecology and Worms. www.nrri.umn.edu/worms/forest/soil.html

This bulletin is part of a series about climate change and forests. More detailed information about forest adaptation and climate change can be found in Handler (2014) and Swanston & Janowiak (2012). Three additional Michigan State University bulletins provide climate background "Climate Basics" – E3151, "Greenhouse Gas Basics" – E3148, and "Frequently Asked Questions About Climate Change" – E3150.

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