

Adaptive Silviculture for Climate Change Network: Learning From Land Manager-Research Partnerships

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The Adaptive Silviculture for Climate Change (ASCC) project is a collaborative effort that has established a series of experimental silvicultural trials across a network of different forest ecosystem types throughout North America. Scientists, land managers, and a variety of partners have co-developed a series of experimental sites as part of this multiregion study to research long-term ecosystem responses to a range of climate change adaptation approaches (Swanston et al. 2016). Silvicultural treatments at each study site were developed by using a modified process from Swanston et al. (2016). The treatments represent three general climate adaptation options: (1) resistance—maintaining relatively unchanged conditions over time; (2) resilience—allowing some change in current conditions but encouraging an eventual return to reference conditions following disturbance; and (3) transition—actively facilitating change to encourage adaptive responses (definitions modified from Millar et al. 2007).

Urban environments face unique challenges, including extensive invasive plant cover, forest health issues such as emerald ash borer, habitat fragmentation, small management units, pollution, and accelerated climate change due to heat island effects (Ordóñez Barona 2015). The sites of the ASCC Network to date have been developed in wildland forest settings. A new development in the ASCC Network is the extension of the ASCC scientist-manager experimental framework to an urban forest setting. This development will greatly enhance the scope of the ASCC Network, while requiring novel silvicultural approaches to address pressing urban forest challenges, given that the operational, economic, and social feasibility of harvesting to implement ASCC treatments may be limited. At the same time, special

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opportunities presented by urban settings include integration of ASCC experiments into education and outreach opportunities, and public engagement throughout all stages of project implementation and monitoring. Study sites established through urban ASCC projects also have high social value and potential for human dimensions research.

Through a partnership among university researchers, the Northern Institute of Applied Climate Science, the Mississippi Park Connection, and the City of Saint Paul Parks and Recreation, we created the first example of an ASCC experiment in an urban setting. Key management priorities of this area include facilitating recovery from ongoing emerald ash borer-related mortality (~ 25 percent of the canopy layer), sustaining large cottonwood trees used by wildlife, maintaining low-invasive plant abundances, and public engagement. Key climate challenges include precipitation variability and warmer nighttime temperatures. Novel management tactics, including gap creation to sustain large cottonwoods and plantings of future-adapted lower Mississippi River Basin ecoregion species, were implemented in this study. Project design and forest inventory will be completed by fall 2019.

In addition to urban affiliate sites, two more core sites were added to the ASCC Network. The first site is being led by the Canadian Forest Service on the Petawawa Research Forest, Ontario, Canada. Key challenges include sustaining white pine in the face of hardwood encroachment and white pine blister rust. The Petawawa ASCC project will represent the first international ASCC experimental site. A second site is being developed in cooperation with the Colorado State Forest Service. The prospective Colorado State Forest ASCC project, located near Walden, Colorado, extends strategies developed for dry mixed-conifer at the San Juan National Forest, Colorado, ASCC site into higher elevation forest types. The study area is a mixture of spruce-fir and lodgepole pine forest types recently imperiled by bark beetle outbreaks.

The ASCC Network is creating a common data management system to facilitate long-term, cross-site research. This system will enable cross-site studies examining topics such as comparisons of treatment implementation, functional responses of the regeneration and herbaceous layers, and ecosystem responses to disturbance. The need for developing a responsive data management system became apparent after Hurricane Michael narrowly missed the ASCC site in Ichauway, Georgia, in October 2018. This unanticipated natural disturbance has prompted a study examining the implications of ASCC treatments focused on chronic stresses (such as drought) for susceptibility to unpredictable events such as wind storms.

The ASCC Network continues to extend forestry climate change adaptation research from the experimental sites to the broader landscape. Forest growth-and-yield modeling (Climate-FVS; Crookston et al. 2010) is being used to extend San Juan National Forest ASCC strategies to warm-dry, mixed-conifer Forest Inventory and Analysis (FIA) plots across Colorado. We are examining treatment implementation, durability, and alternatives such as artificial regeneration of drought-resistant species. The ASCC Network is also investigating the potential of species mixtures to increase stand productivity, resistance, and resilience using region-wide Interior West FIA data (Ammer 2019). The results will provide a basis for further on-the-ground research at the Interior West ASCC experimental field sites, thereby continuing the cycle of learning from land manager-research partnerships.

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