



Impacts of Extreme Climate Events on Tree Regeneration in the Northern Forest

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Project Abstract

Climate change increases the likelihood of extreme climate events that impact trees in both summer and winter. However, it is unclear how forest managers should plan for the impacts of extreme climate events that significantly impact forest structure and composition. Researchers will determine how tree regeneration in the Northern Forest responds to extreme drought, heat, and midwinter warming events to better inform forest management.

Researchers are conducting two experiments that simulate future extreme climate conditions using saplings of ten Northern Forest tree species. First, they will determine survival, growth, and physiological adaptations of trees to drought and heat stress at experimental locations across a climate gradient representative of the Northern Forest region. Second, they will quantify the phenological sensitivity of Northern Forest trees to extreme midwinter warming events of different magnitudes. With these results, they will identify forest tree species that are best and least adapted to future extreme climate events and the physiological characteristics that promote resistance and resilience to extreme climate change.

Progress in 2022

We have made significant progress including finalizing all six planting sites and building deer exclosures with partners. We prototyped a few different planting beds this past summer and have finalized our design and purchased the containers. All of the saplings have been ordered from the New Hampshire State Nursery and Porcupine Hollow Farm (MI) for spring delivery and planting. We have coordinated with the American Chestnut Foundation and have secured chestnut seeds that we will start in our greenhouse this spring. We have also been advertising and interviewing candidates for the MS position and expect to make formal offers in January/February. We held a full co-PI meeting in December and reviewed project progress, plans, roles, and responsibilities.

Problems or Changes

Leadership changes at MaineTREE changed our key contact to Logan Johnson. However, MaineTREE is still onboard for the project. Species selection was slightly modified based on seedling availability. We decided to go with this final species list (bolded names were not part of the original proposal): balsam fir, red spruce, white pine, **eastern red cedar**, **red pine**, sugar maple, **red maple**, paper birch, red oak, and American chestnut.

Plans for 2023

Hold first full cooperators meeting on Zoom (February or March, still scheduling). Finalize MS student search and have them start in summer or fall 2023. Finish purchasing supplies and equipment (iButtons, irrigation supplies, potting medium). Planting >1,200 saplings across all our sites in May. Planting will be



NSRC Progress Report 2022

coordinated with project cooperators and with volunteers. Maintaining trees throughout summer 2023 and conducting initial and preliminary measurements.



Collage of all six of our research installations after setting up the fencing in 2022. Ready for plants in spring 2023.

Collaboration

Researchers collaborate with forest landowner partners at six locations in Maine and engage a broad scope of stakeholders. They engage students and community members in hands-on tree physiological measurements, provide fact sheets and guided tours for landowners to discuss how research results can be used in forest management planning, present results at regional forestry conferences, incorporate findings into the Forests of Maine Teachers' Tours with the Maine TREE foundation, and disseminate project findings through an informational video about how trees respond to climate change to distribute across the Northern Forest region.

We have collaborated with partners at each of our research installations when establishing the research infrastructure in 2022. We have also expanded our cooperators to include the Appalachian Mountain Club. They will serve an advisory role (attending annual meetings) and may participate in field events when available.