Northeastern States Research Cooperative

USFS FY2020 Award

Projects Starting 2021

NSRCFOREST.ORG

2021 PROJECTS BY PRIORITY ISSUE

Biodiversity and connectivity	Integrating Genetic and Ecological Data Using a New Circuit Theory Approach to Measure and Map Wildlife Connectivity across the Northeast
Biodiversity and connectivity	Predicting Density and Occurrence of Keystone and Umbrella Species Using Drone-based LiDAR
Climate change and energy: mitigation, adaptation, carbon accounting	The State of the Northeastern Forest Carbon Cycle: High-Resolution Carbon Accounting For The Regional Forest Sector
Indigenous Forest Knowledge Fund	Haudenosaunee Forest Principles
Indigenous Forest Knowledge Fund	NEBI: Connecting N'dakinna (Land), Bilowagizegad (Climate), and Alnobak (People)
Invasive pests and diseases	Pheromone-based Monitoring and Control Program for Browntail Moth in the Northeast
Land use, sustainable forestry, and forest fragmentation	Assisted Migration: A Viable Silvicultural Technique for Facilitating Adaptation of Northern Forest Tree Species to a Warmer and Drier Future World?
Land use, sustainable forestry, and forest fragmentation	Evaluating the Efficacy of Audubon's Bird-friendly Maple: Can Managing Sugarbushes for Birds Provide Additional Benefits to Biodiversity, Ecosystem Services, and Forest Resilience?
Land use, sustainable forestry, and forest fragmentation	A New Silvicultural Guide for Northern Conifers in the Northeast
Land use, sustainable forestry, and forest fragmentation	Quantifying the Genetic Impacts of Forest Management Strategies on Sugar Maple (Acer saccharum) in the Northern Forest
Recreation and tourism	Influence of Multiple Impacts on User Experience and Decision Making in the Northern Forest
Rural community and economic development	Escaping to the Northern Forest: Migration, Housing, and Community Implications in the Time of COVID
Rural community and economic development	Vermont Town Forest Census for Covid, Carbon and Capacity-Building

BIODIVERSITY AND CONNECTIVITY

Integrating Genetic and Ecological Data Using a New Circuit Theory Approach to Measure and Map Wildlife Connectivity Across the Northeast

James Murdoch, University Of Vermont

The northeastern United States represents a vital region for wildlife connectivity. The region provides key habitat that allows for movement and genetic exchange of animals across several states and provinces, which promotes healthier and more resilient populations. It also represents a critical linkage for movement of species northward as climate conditions change. However, habitat fragmentation, alteration, and loss represent persistent conservation problems that substantially impact wildlife populations by limiting how and where species move across the landscape.

Non-profit organizations, state and federal agencies, and academic researchers have made numerous attempts to measure, map, and identify wildlife connectivity. However, nearly all efforts have been assessments of physical and ecological requirements of species and have largely neglected genetic characteristics, which are critical to understanding animal movement across the landscape.

NSRC researchers will integrate ecological and genetic data using a new circuit theory approach to map connectivity for 10 managed species with high ecological, economic, and cultural importance: moose, deer, bear, bobcat, coyote, red fox, gray fox, fisher, marten, and turkey. Their goal is to provide a precise and comprehensive depiction of wildlife connectivity across the region that can be used to support management decision-making at multiple spatial scales. Researchers will apply the approach to the Green Mountain National Forest with partners at the USDA Forest Service to evaluate effects of routine forest management activities on connectivity to improve strategic decision-making that maximizes benefits for species while considering other objectives. They will develop a decision-making tool for the Green Mountain National Forest that can be applied to other forest management issues in the region.

BIODIVERSITY AND CONNECTIVITY

Predicting Density and Occurrence of Keystone and Umbrella Species Using Drone-based Lidar

Alexej Sirén
University Of New Hampshire
University Of Vermont

From a cavity in a mature maple to a patch of regenerating spruce-fir, forest structure impacts wildlife. Yet, forest and wildlife managers need a more efficient way to map forest attributes at broad spatial scales to better understand the influence of microhabitat features. Drones fitted with Light Detection and Ranging (LiDAR) sensors have been used to measure and map vegetative structure, such as tree canopy geometry, species diversity, and dead and fallen trees.

NSRC researchers will use drone-based LiDAR to identify and predict forest structural conditions critical for snowshoe hare and American marten in the Northern Forest. Identifying the habitat overlap between an early- and a late-successional species should indicate high biodiversity and inform forest management and conservation in the region. Researchers will work with existing data on hare abundance, marten occurrence, and vegetative structure. They will compare LiDAR with Structure from Motion (SfM) technology and sample a range of forest sites. They will then identify stand attributes and landscape conditions that maximize hare abundance yet provide habitat for martens. To determine if co-occurrence of these species results in higher biodiversity, researchers will collect data on songbird and mammal species richness.

Researchers expect findings to reveal how microhabitat influences biodiversity at varying scales and inform forest management to balance wildlife and economic needs. This research will provide tools and guidance for large landowners to map and manage forests and economic opportunities for small businesses and hobby drone users to map smaller parcels. This work will increase forest survey efficiency and broaden public participation in natural resource management and biodiversity conservation.

CLIMATE CHANGE AND ENERGY: MITIGATION, ADAPTATION AND CARBON ACCOUNTING

The State of the Northeastern Forest Carbon Cycle: High-resolution Carbon Accounting for the Regional Forest Sector

Daniel Hayes
University Of Maine

Ten Northeast and Mid-Atlantic states have joined in the Regional Greenhouse Gas Initiative to develop strategies and policies for reducing greenhouse gas emissions and mitigating their carbon impacts. These include New York, Vermont, New Hampshire, and Maine which have each adopted policies to achieve net or near zero emissions targets in the next 25 to 30 years. NSRC researchers will develop and report a spatially- and temporally-explicit carbon budget for the forest sector of the northeastern states that is comprehensive of the major components.

Researchers will build on current inventory-based carbon estimation methods by integrating state-of-the-art remote sensing data and techniques for wall-to-wall mapping of forest biomass dynamics at high spatial and temporal resolution. This approach improves estimation accuracy and precision for all of the major carbon pools and transfers in the forest-sector carbon budget of the northeastern states, including soil storage, aquatic export, harvest removals, and the fate of wood products.

Finally, they will reconcile and translate the scientific budget with the key policy questions including the current and potential forest-sector carbon offsets to regional- and state-level fossil fuel emissions. The overall result will be a comprehensive estimate of the average annual net forest carbon sink, which will be compared to state-level emissions data to calculate the offset provided by forest carbon uptake.

INDIGENOUS FOREST KNOWLEDGE FUND

Haudenosaunee Forest Principles

Robin Kimmerer, SUNY

Haudenosaunee people are the traditional caretakers of over twenty million acres of forests in what is now called New York State. A growing number of forest managers today are required by policy (NYSDEC) or certification programs (SFI, FSC) to integrate Indigenous stewardship and access into management plans.

The goal of this project is to bring together Indigenous community leaders, knowledge holders, and practitioners to consider the ways that Haudenosaunee forest protocols and traditions can be applied to contemporary forest management practices. Together, we will develop a set of Haudenosaunee Forest Principles based on the Haudenosaunee Environmental Protection Process, a guideline developed by the Haudenosaunee Environmental Task Force (HETF) in 2007.

The development of these Principles will also result in the creation of lesson plans designed to teach and demonstrate traditional forest knowledge from Indigenous elders and practitioners to youth during *Native Earth*, a program for Indigenous students to explore the intersection between traditional ecological knowledge and environmental science. The lessons will be piloted during Native Earth workshops for youth to engage in participatory research and education as directed by community needs and goals.

INDIGENOUS FOREST KNOWLEDGE FUND

NEBI (Water): Connecting N’dakinna (Land), Bilowagizegad (Climate), and Alnobak (People)

Adam Wymore, University Of New Hampshire

The goal of this project is to provide Indigenous college students in New Hampshire with research opportunities that combine indigenous knowledge of watersheds with empirically collected data from forested watersheds. Vital to life in N’dakinna (present-day Northeastern United States) is access to clean and safe surface waters. For the Indigenous people of N’dakinna, the Abenaki and Pennacook, nebi (Abenaki for water) provides the interconnected web that organizes life, providing access to fish, clean drinking water, and a network of waterways for transportation, trade, and communication. The relationship to water throughout contemporary New Hampshire maintains these relationships including access to food and clean water and supporting agriculture.

One contemporary challenge for Indigenous communities and water resource management alike is the uncertain effects of global change. This includes rising temperatures, shorter winters, extreme flooding, and prolonged drought. Human population pressures also impact water resources including changes in land use and degraded water quality.

The proposed project will engage Abenaki college students to develop 1) a virtual storyboard that preserves and shares Indigenous knowledge, language, and history about regional watersheds and 2) a unique research project using long-term surface water chemistry data to understand the effects of climate change on forested watersheds.

INVASIVE PESTS AND DISEASES

Pheromone-based Monitoring and Control Program for Browntail Moth in the Northeast

Angela Mech
University Of Maine

Native to Eurasia, the browntail moth was first detected in New England in 1897. Known to feed on over 50 species of woody hosts, the moth became a serious defoliating pest of forest and ornamental deciduous trees and spread throughout the region. After 1915, populations declined and became restricted to a few coastal habitats in Maine's Casco Bay area and Cape Cod, Massachusetts.

Browntail moth populations in Maine have seen population growth spurts every 15 years or so, but these were quickly controlled or declined and failed to cause extensive damage. In 2015, populations exploded to 100-year highs, causing both forest and human health problems. Since then, the moth has spread across 4 million acres of Maine, Nova Scotia, and New Brunswick. This outbreak has caused over 150,000 acres of hardwood defoliation and tree mortality in areas that have experienced repeated years of defoliation. In addition, caterpillars have toxic hairs that cause severe rashes and respiratory problems in humans. The hairs go airborne, so direct contact with caterpillars is not required for serious symptoms, and outbreaks negatively impact tourism and outdoor recreation.

NSRC researchers will contribute to a browntail moth management plan by developing a monitoring program using mating pheromones. This program will be used to detect current and future outbreak populations prior to buildup and allow for rapid control measures. Pheromones will be used to test if a mating disruption control program is an effective management option. Results will aid federal, state, and regional managers in developing plans to reduce browntail moth populations and their impacts in our region.

LAND USE, SUSTAINABLE FORESTRY, AND FOREST FRAGMENTATION

Assisted Migration: A Viable Silvicultural Technique for Facilitating Adaptation of Northern Forest Tree Species to a Warmer and Drier Future World

Heidi Asbjornsen, University Of New Hampshire

Greater frequency and intensity of drought in the Northern Forest region will likely impact survival, growth, and reproduction of different tree species under future climate conditions. At the same time, the rate at which climate is changing in the region is outpacing tree species' ability to migrate into future suitable habitats. Both of these phenomena threaten sustainability of the region's forest ecosystems and communities. Forestry assisted migration, the intentional movement of climate-adapted tree species into anticipated future suitable areas outside their current range, may be a useful silvicultural tool for promoting future resilient forests.

NSRC researchers and local stakeholders in the four-state region will evaluate the capacity of ten assisted migration tree species to acclimate to new environments and drought in a periodically drier, warmer future Northern Forest. They will also quantify how morphological, anatomical, and physiological tree species traits show plasticity, or flexibility, to handle drought and the potential for particular traits to be indicators of seedling success.

The research builds on an existing project, Adaptive Silviculture for Climate Change (ASCC), which initiated an assisted migration experiment across a network of seven sites throughout the Northern Forest. At the main study site, Second College Grant in New Hampshire, researchers will conduct a drought experiment to assess seedling acclimation potential and trait plasticity. Measurements will be collected at the other six ASCC sites to evaluate seedling responses across broader temperature and precipitation gradients at the landscape scale. The results will inform guidelines for selecting suitable assisted migration species as part of climate change adaptation strategies to promote future resilient forests.

LAND USE, SUSTAINABLE FORESTRY, AND FOREST FRAGMENTATION

Evaluating the Efficacy of Audubon Vermont's Bird-friendly Maple: Can Managing Sugarbushes for Birds Provide Additional Benefits to Biodiversity, Ecosystem Services, and Forest Resilience?

Steven Faccio, VT Center For Ecostudies

Maple sugaring is experiencing rapid growth across the Northern Forest in the scale of operations, acreage
impacted, and number of people involved. As a result, it is becoming increasingly important to better understand how sugarbushes can be managed to benefit both maple production and biodiversity conservation. Maple syrup can be produced from forests that are managed in dramatically different ways. Traditional sugarbush management may result in park-like stands dominated by mature sugar maple with open understories—stands that likely support a low diversity and abundance of birds and other wildlife.

In contrast, Audubon Vermont's Bird-Friendly Maple Project recommends forest management activities that promote sugarbush stands with a diversity of tree species and vertical habitat structure. Although these forests are more likely to support a diverse bird population, the efficacy of Audubon's bird-friendly management guidelines to provide measurable benefits to bird populations is unknown. Additionally, the long-term sustainability of maple sap production is entirely contingent on healthy forests, but our knowledge is limited on how the complex drivers of increased maple sap production intensity, differing management strategies, and climate change will affect biodiversity, ecosystem services, and overall ecological health of sugarbushes.

By conducting field surveys of biodiversity and ecosystem service metrics across a gradient of sugarbush production and management intensities, NSRC researchers will pioneer this knowledge base and develop tools and policies that provide sustainable sugarbush management guidelines that are relevant across the Northern Forest landscape. This will result in updated guidance for sugarmakers and specific revisions to the bird-friendly maple management guidelines in order to achieve the desired benefit for bird populations.

LAND USE, SUSTAINABLE FORESTRY, AND FOREST FRAGMENTATION

A New Silvicultural Guide for Northern Conifers in the Northeast

Laura Kenefic,
USDA Forest Service

Since early in the twentieth century, silvicultural guides have been written for specific United States forest types. These guides provide information about site potential, species ecology, stand composition and structure, damaging agents, and recommended approaches (silvicultural systems) for growing healthy trees and producing desired outcomes. Just like the forests themselves, silvicultural recommendations have changed over time with the advancement of science and emergence of concerns and values, such as biodiversity and climate change, that were unknown to our predecessors. Yet, the silvicultural guide for the northern conifer forest type covering 6 million acres of
New England is close to 50 years old with little relevance to the conditions and challenges facing forest managers today.

NSRC researchers will remedy that problem by synthesizing and interpreting an additional half-century of forest research to develop scientifically robust and ecologically sound silvicultural recommendations within the context of contemporary forest management needs. Researchers will ensure applicability and inclusion of diverse perspectives through a process of co-production in which an advisory panel of stakeholders from state and federal agencies, Tribal entities, landowners, forestry practitioners, and others provide guidance on content and delivery.

Outputs include a new silvicultural guide for northern conifers based on the best available science and published by the USDA Forest Service, a professionally produced companion video, and a field workshop for practitioners. Outcomes will include more effective near-term management with improved long-term sustainability of northern conifers and the communities they support in the Northern Forest region.

LAND USE, SUSTAINABLE FORESTRY, AND FOREST FRAGMENTATION

Quantifying the Genetic Impacts of Forest Management Strategies on Sugar Maple (Acer Saccharum) in the Northern Forest

Danilo Fernando
SUNY

To examine how forest management practices affect genetic diversity of sugar maple, NSRC researchers will quantify the effect of two common management strategies (even-aged and uneven-aged) on northern hardwood stands with a strong sugar maple component. Managers use both practices to achieve a variety of objectives; however, no one has explored their impacts on tree genetic diversity. Researchers will measure differences in genetic diversity between stands treated with shelterwood (for even-aged) and selection (for uneven- aged) methods and no management within the last 100 years (as the control group) by examining three age classes (seedlings, saplings, and mature trees) per stand, with two replications in each of the four Northern Forest states.

Researchers will use sugar maple genetic markers that are subjected to natural selection and related to the fitness of individual trees. They will analyze 720 leaf samples across the Northern Forest to quantify metrics of genetic diversity within and between stands and states in relation to each tree age class under each management practice.

Findings will help refine management practices, such as identification of trees or stands that are genetically diverse and ideal for use as seed stocks for regeneration or restoration and of pollen sources for assisted pollination to genetically enrich future generations. Results will provide baseline information for the level of sugar maple diversity and serve as the start of a Forest Genetic Resource Monitoring program for the Northern Forest to detect potentially harmful changes to forest adaptability. Genetically-sound harvesting practice is central to sustainable management of forest resources, especially the “genetic resource” that allows population and species-level adaptations to change.

RECREATION AND TOURISM

Influence of Multiple Impacts on User Experience and Decision Making in the Northeastern Forest

Elizabeth Vidon, SUNY

During the COVID-19 pandemic, recreation lands in the Northern Forest have seen a dramatic increase in visitors. While this has clear positive outcomes (revenue for communities, emotional and physical benefits for users), there are also challenges associated with increased use and crowding (ecological degradation, litter, waste, conflict, risk) that, when combined, interfere with user satisfaction and impact overall experience. Most studies to-date have addressed the ways individual impacts (parking or congestion on trails) inform user experience and decision making in forested outdoor recreation landscapes. Few studies have investigated the combined influence of these impacts on user experience and decision making in the context of user density, crowding, displacement, conflict, and risk and safety. This hinders our ability to develop holistic management strategies and crowd mitigation techniques in forested environments.

NSRC researchers will contribute to understanding the ways various impacts work together to inform the whole picture of user experience and decision making. This, in turn, will allow for more comprehensive management and mitigation strategies than management approaches based on a single stressor. This work is widely applicable to forested areas of the northeastern United States and beyond.

For this study, researchers will work in high-use areas of the Adirondack Park that provide outdoor recreational opportunities for health and wellness, receive high visitor volume, and may be at heightened risk because of increased visitation during COVID-19. A combination of field observation, surveys, and interviews will result in an analytical model that Park managers can use to simultaneously assess, and more effectively mitigate, multiple impacts on site and user experience.

Escaping to the Northern Forest: Migration and Community Implications in the Time of COVID

Jessica Carson, University Of New Hampshire

Well into the COVID-19 pandemic, popular press and local anecdotes continue to paint a picture of people fleeing urban spaces to take refuge in amenity-rich, rural regions. Fear of contracting the virus has paired with a new unlinking of employment from geography and a renewed appreciation for outdoor recreation, spurring moves into rural spaces, including the Northern Forest region. However, regional stakeholders have thus far been unable to quantify this migration.

Community and economic development professionals from across the region suggest that understanding how many people have moved into communities and their characteristics will highlight challenges and opportunities for serving movers, supporting locals, and sustaining communities. Beyond this specific wave of migration, identifying factors that "pull" migrants into one part of the region over another helps inform stakeholders' long-term planning for future migration, including in response to climate change, natural disasters, and impending waves of generational retirements.

NSRC researchers will estimate patterns of COVID-era migration into the Northern Forest region, identify the extent of migration, the socio-demographic characteristics of migrants, and the features of communities that have attracted the greatest number of migrants. By using multiple sources of administrative, sales, survey, tax, and interview data, researchers will analyze migration in each county within the Northern Forest, for groups of communities, and for the entire region. Community and economic development stakeholders across four states will serve as informal advisors and will benefit from the research and recommendations emerging from this project.

Town Forest Census: Carbon, COVID, and Capacity-building

Cecilia Danks, University Of Vermont

Town forests play a special role in forest conservation in the Northern Forest region. These publicly managed, accessible forest parcels contribute not only to forest integrity, ecosystem services, and community well-being, but also can serve as models to family forest owners of sustainable forest management and conservation for diverse goals. Acquisition of new town forests often add strategic pieces to regional conservation efforts that counteract the growing fragmentation of the Northern Forest and help sustain the forest products industry. Many communities, however, find that managing these parcels can also bring challenges when trying to accommodate diverse public demands with limited resources. Town forests are identified in the Vermont Forest Action Plan as a priority landscape, and public and private initiatives in recent years have sought to build capacity of communities to meet the challenges.

NSRC project collaborators have identified several needs hampering these efforts: lack of a complete inventory and key contacts for town forests, inadequate public maps and information on town forests, and uneven knowledge of community needs. This research project will help fill these gaps while asking novel questions about impacts of the COVID-19 pandemic and potential for forest carbon markets to help finance stewardship activities.

NSRC researchers with deep knowledge of town forests will provide a complete inventory of community forests in Vermont, a census of Vermont town forests that can be repeated in the future, an updated database with public interface, and an interactive, publicly-available map. These products will enhance efforts to bolster the ability of communities to steward their forest resources to produce benefits that extend beyond their borders.

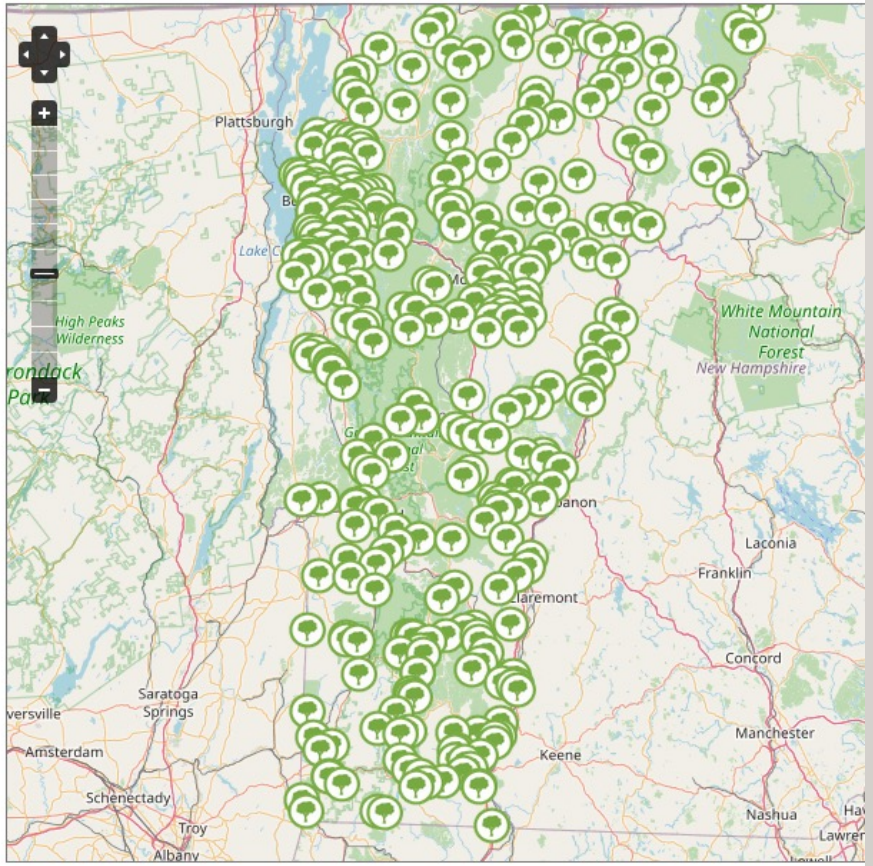

Figure 19: Current online map of Vermont Town Forests, which this research project will help redesign and update

The Northeastern States Research Cooperative is funded by the United States Congress in a collaboration with the USDA Forest Service.

This institution is an equal opportunity provider.

Contact

Vermont: Julianna White,
julianna.white@uvm.edu

Maine: Meg Furgusson,
margaret.fergusson@maine.edu

New Hampshire: Michelle Shattuck,
michelle.shattuck@unh.edu

New York: Mary Beth Malmsheimer,
mmalmshe@esf.edu

The University of Vermont

1865 THE UNIVERSITY OF MAINE

HUBBARD BROOK RESEARCH FOUNDATION

FOREST SERVICE US DEPARTMENT OF AGRICULTURE

NH University of New Hampshire

ESF State University of New York College of Environmental Science and Forestry