Northeastern States Research Cooperative

USFS FY2021 Award

Projects Starting 2022

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2022 PROJECTS BY PRIORITY ISSUE

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BIODIVERSITY & CONNECTIVITY

Effects of Timber Harvesting on the Wetland Ecology of Northeastern Lowland Forests

Christina Murphy, University of Maine, USGS

The Northern Forest is a working forest that provides benefits, including timber production, from a range of ecological community types broadly classified as lowlands and uplands. Northern Forest lowlands, including forested swamps and seeps, contain regionally important commercial tree species such as northern white cedar, balsam fir, and red spruce. Though widely harvested, impacts of forestry operations on these ecosystems are poorly understood. Yet, demand is strong for products such as softwood pulp, stud wood, and shingles from tree species common in seasonally wetted lowlands. These intermittent waters are increasingly recognized for supporting water quality, biodiversity, and critical wildlife habitat and may encounter increased regulation as the jurisdictional definition of “Waters of the United States” is revised.

NSRC researchers will quantify ecological impacts in these lowlands and develop standardized measurement methods for assessing wetland habitats to help guide planners and forest managers. Researchers will develop a better understanding of intermittent wetland habitats and ecological processes associated with northern white cedar forests. They will compare wetland processes related to decomposition and insect populations across timber harvesting treatments and develop standard quantification methods for aquatic leaf litter processing, wood decomposition, and insect biodiversity in seasonally wetted lowlands that can be applied throughout the Northern Forest.

To aid forestry practitioners in lowland forest management planning, researchers will share tradeoffs in wetland ecosystem condition and biodiversity associated with tree harvesting methods. By understanding these ecosystems and how they respond to harvest, this study will inform sustainable management and prepare stakeholders for questions regarding ecological tradeoffs in management of intermittent waters throughout Northern Forest lowlands.

BIODIVERSITY & CONNECTIVITY

Quantifying Changes in Forest Condition, Connectivity and Resilience in the Northeast Using Geospatial and Remotely Sensed Data

Melissa Clark, The Nature Conservancy

To ensure the long-term sustainability of the Northern Forest, land managers, agencies, and conservationists need a way to measure and monitor forest condition and connectivity for wildlife movement, assess how it is distributed across the region, and estimate the impact of forest management practices. Where are forests improving or degrading? What is the prevalent condition? Where are the most climate-resilient sites? How do individual management decisions affect the connectivity of the landscape for wildlife?

NSRC researchers will use newly available remotely sensed time-series information covering 30 years to assess and evaluate forest condition and forest connectivity based on human impacts on wildlife, climatic gradients, and forest condition to project spatial patterns of species movement in response to climate change. Guided by a steering committee of agency and NGO scientists and tapping USDA Forest Service experts on key topics, researchers will translate the comprehensive spatial information into a user-friendly decision support tool for decision makers and other concerned audiences.

Results from the tool will allow users to quantify the condition of the forest at any location and run scenarios to estimate the impact of various management practices or types of land conversion implemented at specific places. Design of the decision support tool will be tested with focus groups to ensure its utility in providing useful information for making informed decisions about the individual and cumulative impact of conservation and management activities on the Northern Forest.

BIODIVERSITY & CONNECTIVITY

Wildlife in the WUI: Investigating Forest Characteristics and Impacts on Mammalian Diversity in the Wildland-urban Interface

Daniel Bogan, Siena College

Across the United States, housing development in forests has created a vast and rapidly expanding wildland-urban interface (WUI), where housing is intermixed with or adjacent to forests. As of 2010, 28% of forest in the Northern Forest region was found in these areas, with 8% of the region's forest becoming WUI since 1990, a 40% increase in the amount of forest in WUI in those two decades. Housing development pressure will likely continue and may accelerate due to relocation to rural areas in response to COVID-19. It is important to learn from past trends to understand how future decisions will impact the region's biological diversity.

Researchers will develop methods to inform land use policies and practices, identify opportunities to conserve wildlife diversity, and anticipate human-wildlife interactions. Researchers will compare forest structure and composition inside and outside the WUI across the Northern Forest landscape. They will quantify impacts of housing development on forest stand diversity, biomass, regeneration, standing dead trees, and downed woody material, with implications for wildlife habitat suitability. They will then investigate impacts of the WUI on diversity, distribution and behavior of mammals such as fisher, coyote, red and gray fox, white-tailed deer, and small species. They will generate a model to select field study sites for non-invasive camera traps, live-capture/recapture of small mammals, and vegetation sampling.

This study aims to better understand the state of the Northern Forest and measure impacts from housing development on native biological diversity. The findings will provide new information to guide decision makers when updating open space planning while balancing sustainable housing development.

Implementing Forest Adaptation Options for Northern Forest Ecosystems

Anthony D'Amato, University of Vermont

Climate change and increasing prevalence of non-native invasive insects and diseases are some of the most significant challenges facing forest managers in sustaining ecosystems across the Northern Forest region. This project will increase the application of adaptation strategies to enhance forest resilience to climate change and invasive pest and disease impacts, while also sustaining critical ecosystem services, including wildlife habitat, carbon storage, and local forest-based economies.

NSRC researchers will evaluate outcomes and effectiveness of already implemented adaptation strategies and partner with resource managers to produce site-tailored recommendations on best practices for anticipated impacts of climate change and invasive species. This project uses a network of adaptation experiments and demonstrations in Maine, New Hampshire, New York, and Vermont on more than 30 sites to better understand the ability of forest adaptation strategies to address emerging forest health and climate change impacts. Researchers will measure forest structural, compositional, and functional outcomes of these strategies at these sites to document forest management approaches that provide the greatest adaptation potential for northern hardwood, mixedwood, and spruce-fir ecosystems. Through partnerships with federal, state, Tribal, private, and NGO forestry stakeholders, researchers will develop outreach materials, such as pamphlets, webpages, webinars, and workshops that identify site-tailored, best adaptation practices for these key forest types in northern New England and New York.

Short-term benefits for the Northern Forest include management guidance and a broadened community of practice for operationalizing forest adaptation strategies to address emerging threats. Long-term benefits include the ability to sustain ecological and economic benefits of critically important forest ecosystems despite changing climate and disturbances.

Oak at the Edge: Investigating the Importance of Fire as a Tool in Oak Range Expansion

Matthew Vadaboncouer, University of New Hampshire

Northern red oak is one of the most valuable tree species for wildlife and timber in the Northeast. Forest managers need to better understand regeneration ecology of oak as climate change expands its potential range into the Northern Forest and beyond. Even where it is currently abundant, red oak regeneration has proven challenging to forest managers seeking to maintain its dominance. NSRC researchers will investigate whether fire plays a unique role in promoting oak establishment and recruitment near its northern range limit and provide critical silvicultural information specific to its management in the Northern Forest.

Through a combination of tree-ring analysis, regeneration studies in silvicultural prescribed burns, and controlled mesocosm (potted seedling) experiments, researchers will expand our understanding of how fire influences oak regeneration and how it can best be used silviculturally to meet this goal. The lack of previous studies on fire's role in oak regeneration specifically in the Northeast makes this project scientifically novel and necessary to inform future management.

Researchers will also investigate how soil is transformed by fire and may benefit oak regeneration. Researchers will reach out to stakeholders at many stages of the project with immediate educational benefits through field work with community scientists, prescribed fire demonstration, and active collaborations with local forest groups. The project will provide fundamental information on oak regeneration and the use of prescribed fire as a tool to help create more resilient and climate-ready forests and will help others to adopt and accept this approach in ways that are supported by data.

INDIGENOUS FOREST KNOWLEDGE FUND

Building Stewardship Capacity: Protecting the Brown Ash of the Northern Forest

John Daigle, University of Maine

This project's goal is to advance the use of practices that will help sustain brown ash on the Northern Forest landscape. Brown ash has cultural significance to local indigenous tribes and is threatened by the Emerald Ash Borer (EAB). Researchers will work in tandem with tribal partners to identify adaptive management strategies that can be supported by the Wabanaki to slow the spread of EAB and promote ash regeneration.

The project will inform landowners about the cultural significance of ash to Tribal communities. Long term, the project aims to improve relationships among landowners and Tribal communities as it relates to sustaining Tribal culture and enrolling more landowners in monitoring programs. The project will develop Best Management Practices for brown ash conservation in Maine using scientific and traditional knowledge.

Through a partnership with the Wabanaki Youth in Science Program (WaYS), the project will engage a Tribal youth with an interest in the forestry profession to assist in the field work of this project and educate youth on local conservation.

INDIGENOUS FOREST KNOWLEDGE FUND

Monitoring Moose and Other Culturally Important Wildlife on Penobscot Indian Nation Lands Using Remote Cameras

Benjamin Simpson, Penobscot Indian Nation

The Penobscot Indian Nation (PIN) manages over 129,000 acres of land in Maine. The proper management and conservation of wildlife are top priorities for tribal members so that these cultural resources are available for future generations. Moose are specifically important game species for the PIN. The recent declines in moose populations due to winter ticks has caused concern amongst the tribe.

The goal of this study is to monitor moose and other wildlife populations through remote cameras while engaging tribal youth members with wildlife conservation on PIN lands.

Using AMMonitor and the standardized camera method, the study will obtain information on the annual impacts of winter ticks on moose and identify hotspots on PIN lands where infestations are severe.

INDIGENOUS FOREST KNOWLEDGE FUND

Supporting Abenaki Stewardship of the Ecologically Rare and Culturally Important Atlantic White Cedar Swamp Ecosystem

Heidi Asbjornsen, University of New Hampshire

Atlantic White Cedar (AWC) swamp ecosystems occur along the coast from southern Maine to central Florida but about 80% of their historic coverage has been wiped out or converted due to human activities. AWC ecosystems were extensively used for traditional products (e.g., canoes, baskets) and as sacred areas to support cultural and spiritual practices. The Bradford Bog, one of the most northern and well-preserved communities of AWC, is still activity utilized for traditional purposes by the Abenaki, who have expressed concern over the lack of AWC regeneration and declining health.

NSRC researchers will assess AWC natural regeneration and stand dynamics and establish long term monitoring plots that will be maintained by the Abenaki using integrated Indigenous-Western research methods to assess ecosystem health. The study will result in an eco-cultural stewardship plan to ensure the conservation, restoration, and sustainable use of this important ecosystem.

This project will support the education and mentorship of a young Abenaki member in forest ecology, ecosystem management, and Indigenous knowledge and communication.

Eastern White Pine Health Monitoring through Remote Sensing Assessment of Foliar Traits

Parinaz Rahimzadeh, University of Maine

Eastern white pine, an economically and ecologically important tree species in Northeastern forests, has been impacted by shifts in habitat and disturbances over the past two centuries and has become prone to several pests, pathogens, and dieback. In recent years, white pine needle damage has been a significant threat and is expected to become more severe. Remote sensing tools using aerial and satellite imagery assist field and aerial monitoring efforts by providing observations across large regions over time. Recent findings show that severe needle damage is successfully detected using fine-resolution satellite imagery, but detection of light and moderate defoliation faces challenges.

Leaf traits including nitrogen, chlorophyll, leaf mass per area, and leaf area index are essential indicators of the health of vegetation communities. NSRC researchers will characterize white pine foliar traits by using models at leaf scale from remote sensing data. They will estimate key trait indicators for white pine susceptibility to needle damage and upscale and map damage using satellite imagery. They will produce a foliar traits databank and thresholds for discriminating infested and healthy white pines, a remote sensing-based workflow for mapping needle damage susceptibility using leaf traits as a proxy, and damage maps generated from satellite imagery.

In addition to characterizing biochemical and biophysical traits of healthy and infected white pines in the Northeast, this project complements aerial detection survey and traditional remote sensing change detection techniques, benefiting stakeholders. The Maine Forest Service and USDA Forest Service can use the tools as part of short- and long-term efforts to monitor and mitigate negative impacts of the damage.

Invasive Pest Effects on Tree Demographics Across the Northeastern US

Jeff Garnas, University of New Hampshire

Nonnative pests and diseases have dramatic negative effects on forests especially in the Northern Forest region, as the Northeast has the greatest density of invasive forest pest and pathogens in the country. Consequences of these invasions on host trees are well established, but the ways in which introduction of these organisms influences long-term structure, composition, and biomass storage capacity of affected forests are less well understood.

NSRC researchers will examine trends over time and more recent effects on tree demographics in forests impacted by dominant forest pests introduced into northeastern North America over the past 140 years. Researchers will estimate carbon storage capacity and sequestration rates for forests within the region in light of established and currently spreading invasives. They will examine how biological, ecological, and demographic traits of host trees and invasive pests interact to determine rates of change and potential for the ultimate return to pre-invasion biomass and productivity. They will model outcomes in cases of multiple, overlapping non-native insects and diseases and in the context of a changing climate.

Researchers will use USDA Forest Inventory and Analysis data from several remeasurement cycles across forests containing significant components of host trees impacted by seven of the most damaging forest insects and pathogens. This work has the strong potential to guide management strategies focused not simply on mitigating impacts but also on shifting forests toward more favorable outcomes in the face of climate change.

Jumping Worm Invasion and Impact in the Northern Forest

Tim Mccay, Colgate University

Jumping worms are invasive earthworms from Asia that are invading and impacting ecosystems worldwide, including portions of the Northern Forest. Evidence is emerging that these species are damaging biodiversity, ecosystem services, forest regeneration, water quality, and recreational value in other regions. The vulnerability of specific areas within the Northern Forest to these earthworms and the magnitude of the threat they represent are unknown.

NSRC researchers will use an interdisciplinary, three-pronged approach to better understand this threat and lay the foundation for lessening impacts. First, they will conduct training seminars and develop protocols to leverage a network of professional resource managers, citizen naturalists, and gardeners to detect, report, and monitor the distribution and phenology of jumping worms in the region. Second, they will examine the environmental conditions associated with jumping worm presence and expansion to develop a model of vulnerability to jumping worm invasion in the region. Finally, they will study the impact of jumping worms on biodiversity, nutrient cycling, water quality, and regeneration at select forested sites representing an invasion gradient.

This project will provide a greater understanding of the Northern Forest ecosystem, especially the forest floor, and its vulnerability to invasive threats. Improved knowledge of the biology of jumping worm species that threaten the Northeast will assist global efforts to understand and control these species, especially in northern latitudes. Finally, this project will provide training to students at a variety of institutions and improve connections among natural resource managers and members of the interested public within the Northern Forest region.

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

Jay Wason, University of Maine

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. NSRC researchers will determine how tree regeneration in the Northern Forest will respond to extreme drought, heat, and midwinter warming events to better inform forest management.

Researchers will conduct 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.

Researchers will collaborate with forest landowner partners at six locations in Maine and engage a broad scope of stakeholders. They will 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.

Investigating the Role of Mycorrhizal Fungi in New England Forest Management

Caitlin Hicks Pries, Dartmouth College

Mycorrhizae—fungi that live on plant roots—are essential to tree growth and provide nutrients and water in exchange for sugars. Mycorrhizal fungi enhance soil carbon storage and tree pathogen resistance. New England forests are dominated by arbuscular mycorrhizae (AM) and ectomycorrhizae (EcM), depending on tree species present. Forests dominated by EcM or AM differ in seedling survival, nutrient availability, and how soil stores carbon. As climate change and invasive pests shift tree species in New England forests, mycorrhizae will also change. With loss of ash trees from emerald ash borer and decline of sugar maple, the Northern Forest will lose two AM-associated trees, and the Northern Forest may become more dominated by EcM, with cascading effects on the ecosystem services New England forests provide.

NSRC researchers will examine how the legacy of dominant mycorrhizal associations affects how forests regenerate, cycle nutrients, and sequester carbon following timber harvesting. In this field experiment, researchers will investigate how changes in soil fungal communities and nutrient availability affect planted and naturally-regenerated seedling survival and growth in AM- and EcM-dominated forest stands after logging. They will investigate how timber harvesting differently affects long-term soil carbon storage in EcM- vs AM-dominated forest stands.

This project will establish a site for long-term monitoring of forest regeneration and carbon storage and data will be publicly available through the Northeastern Forest Regeneration Network. Outcomes will help guide foresters and land managers as they consider how tree mycorrhizal associations could impact forest regeneration, nutrient retention, and long-term carbon storage in their management planning.

RECREATION AND TOURISM

Trail Forks and Merges: Exploring Social Impacts from Recreational Mountain Biking in Northern Forest Communities

Kimberly Coleman, Suny Plattsburgh

Nation-wide, mountain biking is growing in popularity. This trend is mirrored in the Northern Forest and has intensified during the COVID-19 pandemic. For many rural communities, the growth of mountain biking represents an opportunity to build a new economy centered on forest-based recreation. However, questions remain about the impact mountain biking has on forests and forest-dependent communities.

NSRC researchers will explore the social impacts of mountain biking on the Northern Forest. They will investigate social impacts already identified and discussed in science literature and on social media. They will determine what social impacts of mountain biking are currently being experienced by communities in the Northern Forest and how the social impacts are similar or different to what is discussed beyond this region. They will then assess how these comparisons inform management and expectations of trends within the region. The research team will conduct a systematic literature review, social media analysis, content analysis of regional news stories, and community surveys to illuminate social impacts at the global, national, regional, and local levels, respectively.

Results of this study will shed light on a range of social impacts from mountain biking that are affecting Northern Forest communities now and into the future. These results will be of immediate practical use to land managers and communities considering enhancing mountain biking as a recreational and economic opportunity and will help inform decision-making about planning and managing forest-based recreation in the region.

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