2015-2016 NSRC Project Summary
NSRC Theme One: Sustaining Productive Forest Communities

1) **Title:** Identifying Factors Affecting Regional Patterns of Sugar Maple Regeneration in the Northern Forest

2) **Lead Principal Investigator:**

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3) **Project Goals and Objectives:**

This research aims to identify the importance of past management and acid deposition histories, browse pressure from white-tailed deer (O*docoileus virginianus*), and competition with American beech on dynamics of sugar maple regeneration across a gradient of stands and sites throughout the Northern Forest. Further, the goal of this research is to provide forest managers and landowners with updated guidelines for securing successful sugar maple regeneration across the range of Northern Forest climatic and site conditions

Specific objectives include:

1. quantifying the influence of site and forest conditions, atmospheric deposition, herbivore density, and management history on sugar maple regeneration dynamics; and
2. developing guidelines and recommendations for addressing the critical factors limiting sugar maple regeneration in a given region based on information gained from this research.

Project Timeline:

Project activities	***Sept.-Nov 2015***	***Dec 2015-Feb 2016***	***Mar.-August 2016***
Compile long-term datasets			
Random forest analyses			
Draft peer-reviewed manuscript on factors influencing recruitment			
Present research findings at NESAF			
Final Report			

Project Progress:
To date, research is on track with the above timeline. Data has been compiled from the USDA Forest Service Forest Inventory and Analysis, the Vermont Monitoring Cooperative's North American Maple Project, and Oak Ridge National Laboratory's DAYMET climate summaries and random forest analysis has been completed. In March, preliminary results were presented to forestry practitioners and scientists as a poster and talk at the New England SAF meeting in Sturbridge MA and a manuscript is being drafted for peer-review. Final results will be presented to managers and other stakeholders at the 2016 Vermont Monitoring Cooperative Conference.

4) Project Methods
For this project, long-term data (Vermont Monitoring Cooperative) and regional data from Maine, New Hampshire, Vermont, and eastern New York (USDA Forest Service FIA and Oak Ridge National Laboratory DAYMET) were analyzed using non-parametric random forest classification (Brieman 2001) in the statistical software R. Random forest classification identified the variables statistically influential to presence of sugar maple regeneration.

5) **Project Accomplishments To Date**
To date, results have been presented at the New England SAF 2016 winter meeting in Sturbridge MA. Additionally, results are being drafted into a publication for peer-review. Preliminary random forest models integrated 57 initial variables either measured at the plot or calculated from plot measurements and were able to explain 33% of the regional variability in sugar maple regeneration over the past two decades. The most important variable for predicting sugar maple regeneration was presence of other seedlings, which likely reflects the importance of canopy disturbance in driving recruitment. Other important variables included management history and beech density and size (TPH and BA). Future work will integrate more refined characterizations of site conditions both in terms of climate and soils, as well as greater detail regarding prevailing management regime.

6) Project Relevance for the Northern Forest Region
Sugar maple is an economically, ecologically, and socially valuable component of northern hardwood forests in the northeastern United States. However, small-scale studies throughout the

northeast suggest sugar maple reproduction may be in extreme decline. Research across the range of sugar maple attributes this regeneration failure to a variety of climatic and site specific drivers, including deer herbivory, competition from American beech, sensitivity to soil moisture and temperature, increased acidification, and imbalances in soil nutrients. However, considering regeneration failure only at the local level creates knowledge gaps for effectively managing future sugar maple forests at the landscape scale. Knowledge of factors influencing successful establishment of sugar maple will assist forestry practitioners in sustainable management of sugar maple throughout the northern forest.

7) Project Products and Outcomes

- Presentation of results at the New England SAF 2016 winter meeting- Completed
- Peer-reviewed publication on factors influencing sugar maple regeneration in the Northern Forest- In preparation for Forest Science

8) Upcoming Events or Announcements

- Presentation of final results at Vermont Monitoring Cooperative Annual Meeting in December

9) Proposed Future Steps

- Integrate additional datasets from long-term silviculture experiments in New York and New Hampshire to further explore influence of management regime, deer browse, and site conditions on recruitment dynamics

10) Additional Information

References

Breiman, L. 2001. Random forests. Machine learning 45: 5-32.