United States Department of Agriculture

Final Report

Title:	Response of forests to changes in native disturbance regimes, species pools, and ecosystem processes

Sponsoring Agency	NIFA	**Project Status**	COMPLETE
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Accession No.	218267	**Project No.**	IND011533MS
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Performing Department

Forestry & Natural Resources

Non-Technical Summary

Human populations have had a profound impact on native ecosystems. These impacts include direct actions such as land use conversions and building of structures and roads. However, some of the most problematic effects of human activities are indirect, including the introduction of exotic species and alterations to endemic disturbance regimes. These effects are often synergistic in nature and may create a cascading series of changes that lead to ecological degradation. In addition, differing management scenarios may reduce or enhance desired ecosystem services, including carbon storage. This research project will continue to examine, in detail, several of these human-induced changes and their impacts on forest ecosystems. Invasion of exotic species constitutes one of the most problematic drivers of ecological change and degradation. In forests and other biomes, exotic species have eliminated or excluded native species, altered soil conditions, homogenized species composition, reduced biological diversity, and suppressed forest regeneration. Further, invasive species alter the productivity and sustainability of forest ecosystems, which directly impacts the economic viability of forest land. Alterations to native disturbance regimes have also led to ecological change. For example, fire suppression across most of eastern North America has led to the loss of fire-dependent forest types, the homogenization of species composition, and the loss of important habitat. Land management agencies have sought to restore native fire regimes. Across much of the eastern United States, fire suppression has led to the loss of oak species, which are viewed as foundation species due to their ecological importance. Over the next five years, this program will examine environmental conditions and competitive interactions that influence the successful establishment of oak species. Chronic browsing by over abundant deer populations has led to the loss of species, the homogenization of forest communities, and the failure of forest regeneration. The contemporary landscape across much of the eastern United States has created conditions that favor continued overabundance of deer. Research is needed to determine how the interactions of deer and invasive plants influence forest composition and structure. Over the next five years, this research program will continue to focus on the effects of over abundant deer populations. However, the scope of this inquiry will be expanded to examine the relationship between deer herbivory and the invasion of non-native plants. Forests are view a critical carbon sink in regional and global carbon budgets. However, the effects of human activities, including forest management, on carbon storage are not well understood. Across the central United States, less intensive forest management has allowed forests to develop towards old-growth structure. How the carbon budget of old-growth forests differ from those of younger forests is not well understood. Over the next five years, this program will examine carbon storage in old-growth and managed forests across the Midwest.

Accomplishments

Major goals of the project

The primary objective of this project is to improve understanding of how human-induced changes to native disturbance regimes and species pools have altered the distributions, interactions, and coexistence of species through changes in ecological processes. More specifically, my research will focus on how invasion by exotic species (insects, disease, and plants) combine with changes in native disturbance regimes resulting from the actions of humans (such as fire suppression, deer herbivory, and forest management) to influence the composition, diversity and structure of forest ecosystems in the

eastern United States. Potential mechanisms and impacts will be addressed at multiple spatial and temporal scales within the forests of Midwest and the forests of the southern Appalachian Mountains. Additional studies that address one or more of these objectives may be added if opportunity and funding permits. The proposed program for the next five years is comprised of continuing studies that have extended beyond a five year time frame and new studies that further address core research questions. Specific objectives for the next five years include: 1. Determine the spatial dynamics of exotic plant invasions and evaluate the relative influence of invasion duration and exotic plant density on the composition, diversity, and structure of forest communities. 2. Examine how human-induced changes to native disturbance regimes have influenced the composition, function and spatial interactions of forest plant populations and communities. 3. Examine how above and below ground carbon storage of Midwest forests differ with disturbance history.

What was accomplished under these goals?

We were able to address all three of our objectives with completed projects that produced research papers, multiple outreach presentations, and material for undergraduate and graduate level courses. With regard to practical applications our work provided guidance on how best to apply invasive species treatments to minimize negative impacts to other ecosystem components and how to best to use forest management to regenerate desired tree species. Over the final year of the project, we also produced a MS graduate who obtained employment with a state forest management agency.

What opportunities for training and professional development has the project provided?

As mentioned previously, we produced a successful MS graduate in the the final year, in addtion to the multiple students previous produced by the project. The PI also participated in a training session to teach undergraduates about the challenges and control of invasive plant species.

How have the results been disseminated to communities of interest?

We have dissiminated our results through research publications and outreach presentations. These presentations included professional organizations, landowner groups, and a tour for Indiana state legislators.

What do you plan to do during the next reporting period to accomplish the goals?

{Nothing to report}

Participants

Actual FTE's for this Reporting Period

Role	Non-Students or faculty	Students with Staffing Roles			Computed Total by Role
		Undergraduate	Graduate	Post-Doctorate	
Scientist	0.5	0	1	0	1.5
Professional	1.4	0	0	0	1.4
Technical	0	0	0	0	0
Administrative	0	0	0	0	0
Other	0.4	0	0	0	0.4
Computed Total	2.3	0	1	0	3.3

Student Count by Classification of Instructional Programs (CIP) Code

Undergraduate	Graduate	Post-Doctorate	CIP Code
	2		03.01 Natural Resources Conservation and Research.

Target Audience

Our target audiences were the scientifc community, agency and NGO land managers, private landowners and interested citizens.

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Products

Type	Status	Year Published	NIFA Support Acknowledged
Journal Articles	Published	2018	YES

Citation

Frank, G.S. M.R. Saunders, and M. A. Jenkins. 2018. Short term vegetation responses to invasive shrub control techniques for Amur honeysuckle (Lonicera maackii [Rupr.] Herder). Forests 9(10), 607; https://doi.org/10.3390/f9100607

Type	Status	Year Published	NIFA Support Acknowledged
Journal Articles	Published	2018	YES

Citation

Frank, G.S. C.H. Nakatsu, and M. A. Jenkins. 2010. Soil chemistry and microbial community functional responses to invasive shrub removal in mixed hardwood forests. Applied Soil Ecology 131: 75-88.

Type	Status	Year Published	NIFA Support Acknowledged
Journal Articles	Published	2018	YES

Citation

Swaim, J.T, D.C Dey, M.R. Saunders, D.R. Weigel, C.D. Thornton, J.M. Kabrick, and M.A. Jenkins. 2018. Overstory species response to clearcut harvest across environmental gradients in hardwood forests. Forest Ecology and Management 428: 66-80.

Type	Status	Year Published	NIFA Support Acknowledged
Theses/Dissertations	Published	2018	YES

Citation

Mulroy, M. L. 2018. Forest Ecosystem response to hemlock woolly adelgid (Adelges tsugae) in the southern Appalachian Mountains

Other Products

{Nothing to report}

Changes/Problems

{Nothing to report}