Date of Report: December 4, 2015

Date of Next Status Update Report: January 1, 2017

Date of Work Plan Approval:

Project Completion Date: June 30, 2019

Does this submission include an amendment request? **No**

PROJECT TITLE: Evaluation of Forest Tree Retention Guidelines Pertaining to Wildlife

Project Manager: Gerald Niemi

Organization: Natural Resources Research Institute, University of Minnesota Duluth

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Location: Statewide

Total ENRTF Project Budget:		
	ENRTF Appropriation:	**$232,000**
	Amount Spent:	**$0**
	Balance:	**$232,000**

Legal Citation: M.L. 2016, Chp. xx, Sec. xx, Subd. xx

Appropriation Language:

I. PROJECT TITLE: Evaluation of Forest Tree Retention Guidelines Pertaining to Wildlife

II. PROJECT STATEMENT:

We propose to examine and quantify the benefits of tree retention after logging on Minnesota's wildlife. The primary goal of forest management is increasingly focused on maintenance of biodiversity, compared to a historic emphasis on timber production alone. In 1998, the Minnesota Forest Resources Council (MFRC) established Minnesota's Forest Management Guidelines (http://mn.gov/frc/documents/council/site-level/MFRC_Forest_Mangement_Field_Guides_2014.pdf), which were intended to reduce the potential for negative environmental impacts resulting from forest harvesting and management activities on all forest lands in the state. Recommendations to retain trees during harvesting were considered key to sustaining wildlife species of greatest conservation concern (http://www.dnr.state.mn.us/cwcs/index.html), including many mammals, birds, and amphibians. Applications of guidelines during harvesting operations are voluntary, but if implemented, can mitigate impacts to wildlife habitat and help maintain healthy populations into the future. It is important to measure and assess the effectiveness of the retention guidelines to maximize the intended benefit to Minnesota's wildlife.

The current guidelines recommend that 6-12 trees per acre or 5 percent of the harvest area in 0.25 acre patches or greater be left uncut. The spatial structures of retained trees and their characteristics influence local habitat suitability for wildlife species and long-term forest structure including tree regeneration and native plant communities. Given this, spatial configurations of leave trees likely have important impacts on forest wildlife diversity, but there have been no experimental tests to determine the configurations that provide the greatest benefit to wildlife. Tree retention guidelines are grounded in best available scientific judgment, but there is little data available to quantify the long-term impacts or influence of the spatial configuration of "leave trees" on wildlife diversity. Evaluating these impacts will provide valuable information on which configurations are most beneficial for mitigating the impacts of forest harvesting to wildlife.

We will use monitoring data on leave tree retention collected by the Minnesota Department of Natural Resources (MNDNR) over the last decade to identify sites for this project. The MNDNR has monitored over 1000 harvest sites from 2000-2015 to determine the percentage of harvest sites that have implemented the recommended leave tree guidelines. We will use an experimental design that will allow us to assess differences in species diversity and composition between sites with contrasting (clumped or scattered) leave tree configurations. The study design is retrospective, covering a wide range of site conditions across the state and a post-harvest period of 3-15 years to determine the influence of leave trees over time. This approach will address common limitations of existing leave tree studies including insufficient sample size and duration of response.

We will utilize currently available high resolution LiDAR ("Light Detection and Ranging") data, an active remote sensing technology that uses laser light to detect and measure surface features, along with other high resolution imagery. This technology will be used to measure and quantify leave tree configuration and habitat characteristics of 60 harvest sites across the state. We will then conduct wildlife surveys, using a variety of sampling techniques and technologies to assess bird, mammal, and herptile diversity at leave tree sites. These data will allow us to assess the influence of spatial configurations of leave trees, time since harvest, habitat characteristics and landscape context.

The goals of this proposed project are to:
1)   Quantify wildlife communities of birds, mammals, and herptiles, in relation to tree retention configuration following harvest; and
2)   Improve ecological benefits of Minnesota's Forest Management Guidelines.

Project results will be summarized and presented to the MFRC for evaluation, and a summary report will be made available on NRRI's website and the MFRC website. The MFRC will use the information to either validate

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the existing leave tree guidelines, or propose alternative guidelines that mitigate impacts on forest bird, mammal, and herptile species. The overall desired outcome of this project is to ensure that recommended tree retention guidelines are effective at mitigating harvest-related impacts on wildlife in the state. Ultimately, the information from our research will be transferred to loggers and resource managers during guideline training sessions.

III. OVERALL PROJECT STATUS UPDATES:

Project Status as of January 1, 2017:

Project Status as of July 1, 2017:

Project Status as of January 1, 2018:

Project Status as of July 1, 2018:

Project Status as of January 1, 2019:

Overall Project Outcomes and Results:

IV. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1: Measure leave tree configuration and quantify habitat characteristics of 60 harvest sites with LiDAR.

Description:

We will compile monitoring data for over 1000 harvest sites collected by MNDNR Forestry department over the period 2000-2015. The DNR randomly selected these sites from all forest harvests, providing a representative sample of leave tree conditions throughout the state. We will use this data as a coarse filter to select sites that will be surveyed for wildlife. Utilizing the DNR monitoring data allows us to cover a range of leave tree configurations across the state for a post-harvest period of 3-15 years. For the site selection process, sites will be evaluated based on cover type, time since harvest, size, location, and be separated into two implementation categories: 1) clumped leave tree configuration, or 2) scattered leave tree configuration. A random-stratified design, with respect to time since harvest, will be used to select 60 sites. We will use area-restricted sampling, selecting sites in Cook, Lake, St. Louis, Koochiching, Itasca, Aitkin, Hubbard, Cass, and Beltrami Counties to minimize travel costs. The approach will allow for robust comparisons of the effect of leave tree configuration across a wide range of site conditions. Public and private lands were included in the monitoring data. Private landowners will be identified from previously collected information or county tax records, and then contacted to obtain permission to access the site.

After sites have been selected, we will use available LiDAR and high resolution imagery data to quantify habitat characteristics and spatial configurations of leave trees at each of the sites. LiDAR are capable of characterizing three-dimensional habitat structures that are significant to species with differing habitat preferences at scales that are comparable to, and often supersede, standard habitat ground measurements. Indeed, LiDAR has demonstrated ability in the assessment of three-dimensional vegetation structural characteristics that are important for wildlife, and have been employed to evaluate habitat for birds and mammals with predictive capabilities comparable to, or greater than, that of ground measurements. Potential variables to be used in the statistical modeling of wildlife habitat, based on LiDAR data, include canopy cover, canopy height, shrub cover, sub-canopy cover, leave tree structure, coarse woody debris, elevation, topographic index, and slope, among others.

Summary Budget Information for Activity 1:   ENRTF Budget: $ 91,150
                                                 Amount Spent: $ 0
                                                      Balance: $ 91,150

Outcome	Completion Date
1. Identify 60 sample sites.	October 2016
2. Quantify habitat characteristics and spatial configurations of 60 harvest sites.	September 2018

Activity Status as of January 1, 2017:

Activity Status as of July 1, 2017:

Activity Status as of January 1, 2018:

Activity Status as of July 1, 2018:

Activity Status as of January 1, 2019:

Final Report Summary:

ACTIVITY 2: Quantify effects of leave tree configurations on bird, small mammal, and amphibian communities. Description:

We will measure bird, small mammal, and amphibian diversity by conducting systematic counts at 60 harvest sites during the late spring and summer for 2 field seasons. Funding for this project will be used to measure bird, mammal, and herptile diversity at harvest sites. We will use a variety of wildlife survey techniques and technologies depending on site specific characteristics to obtain comprehensive information about wildlife communities at harvest sites. Avian survey techniques include point counts and digital audio recorders. Track stations, and camera traps will be used to survey mammals. Survey methods for herptiles include digital audio recorders and surveys of coarse woody debris. Together these methods will provide a comprehensive estimate of wildlife biodiversity in leave tree sites.

Wildlife survey methodology overview:
1. Point counts: Breeding birds
2. Digital Audio Recorders: Breeding birds and frogs
3. Camera traps: Mammals
4. Track plates: Mammals
5. Coarse woody debris surveys: Herptiles

The expected outcome of wildlife surveys will be to quantify presence/ absence and relative abundance of birds, mammals, and herptiles. Spatial pattern metrics of leave trees (Activity 1), harvest size, and time since harvest will be related to field data. The deliverable from this activity will be the synthesis of these data to create a summary report on the effects of leave tree guideline implementation on biodiversity. These recommendations will be separate for each taxa (birds, mammals, and herptiles) because it is possible that there will be species-specific responses within each taxa. These analyses will allow us to assess the impact of tree retention levels and harvest size on the long-term abundance and diversity of Minnesota's wildlife. Findings will be presented to the Minnesota Forest Resources Council and recommendations will be made for modifications to the Forest Management Guidelines.

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Summary Budget Information for Activity 2:   ENRTF Budget: **$ 140,850**
                                                    Amount Spent: **$ 0**
                                                    Balance: **$ 140,850**

Outcome	Completion Date
1. Quantify bird, small mammal, and amphibian abundance and diversity at 60 research sites.	September 2018
2. Evaluate effects of leave tree configurations on species abundance and diversity.	April 2019
3. Develop recommendations and present findings to the Minnesota Forest Resources Council.	June 2019

Activity Status as of January 1, 2017:

Activity Status as of July 1, 2017:

Activity Status as of January 1, 2018:

Activity Status as of July 1, 2018:

Activity Status as of January 1, 2019:

Final Report Summary:

V. DISSEMINATION:
Description:
Project results will be summarized and presented to the MFRC for evaluation, and a summary report made available on NRRI's website and on the MFRC website. In his role as Site-level Program Manager at the MFRC, R. Slesak will use the information to either validate the existing leave tree guidelines, or propose alternative guidelines that mitigate impacts on forest bird, herptile and mammal species.

Ultimately, the information will be transferred to loggers and resource managers during guideline training sessions, as these groups are the primary users of Minnesota's Forest Management Guidelines. In addition to the above, manuscripts detailing project results will be written and submitted for publication in peer-reviewed journals.

Status as of January 1, 2017:

Status as of July 1, 2017:

Status as of January 1, 2018:

Status as of July 1, 2018:

Status as of January 1, 2019:

Final Report Summary:

VI. PROJECT BUDGET SUMMARY:
A. ENRTF Budget Overview:

Budget Category	$ Amount	Overview Explanation

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Personnel:	$ 217,674	1 project manager at 0.3% FTE each year for 3 years ($2,000); 2 co-investigators, 1 at 27.3% FTE each year for 3 years ($53,726), and 1 at 30% FTE each year for 3 years ($51,200); 1 research associate at 10% FTE each year for 3 years ($33,700); 1 post-doctoral researcher at 50% FTE for year 1 ($31,100); 2 field technicians at 20% FTE each year for 3 years ($35,348); 1 undergraduate research assistant at 25% FTE for year 2 ($6,900); 1 administrative support staff at 2% FTE each year for 3 years ($3,700).
Equipment/Tools/Supplies:	$ 1,250	Sherman traps
Travel Expenses in MN:	$ 13,076	Mileage ($9,807); lodging ($3,269)
TOTAL ENRTF BUDGET:	$ 232,000	

Explanation of Use of Classified Staff: N/A

Explanation of Capital Expenditures Greater Than $5,000: N/A

Number of Full-time Equivalents (FTE) Directly Funded with this ENRTF Appropriation: 4.3 FTEs

Number of Full-time Equivalents (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation: N/A

B. Other Funds:

Source of Funds	$ Amount Proposed	$ Amount Spent	Use of Other Funds
State			
Gerald Niemi, project manager (cash support)	As needed	-	If awarded, NRRI will contribute time and effort as needed for successful completion of the project without requesting further funds from LCCMR.
Foregone F&A funding of 52% TDC	$ 120,640	$ 0	Indirect costs on personnel, travel, and supplies related to work on the sponsored project
Robert Slesak, MN Forest Resources Council (in-kind support)	$ 35,000	$ 0	Salary and fringe of 0.1 FTE each year for 3 years for effort spent on project activities.
TOTAL OTHER FUNDS:	$ 155,640	$	

VII. PROJECT STRATEGY:

A. Project Partners: The project team includes Dr. Gerald Niemi, Dr. Alexis Grinde, and Annie Bracey and Ed Zlonis from the Natural Resources Research Institute, Dr. Michael Falkowski at the University of Minnesota, and Dr. Rob Slesak from the MN Forest Resources Council. Cooperators will include the DNR Division of Forestry and Division of Fish & Wildlife who we will work closely with to incorporate the findings into operational practice on state lands.

B. Project Impact and Long-term Strategy:
This proposal is a part of a larger strategy to assess the effectiveness of Minnesota's Forest Management Guidelines. Findings will be incorporated into Minnesota's Forest Management Guidelines, and

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recommendations widely implemented across the state by DNR, US Forest Service, Counties, industry, and other forestry partners.

C. Funding History: N/A

VIII. FEE TITLE ACQUISITION/CONSERVATION EASEMENT/RESTORATION REQUIREMENTS:

A. Parcel List: N/A

B. Acquisition/Restoration Information: N/A

IX. VISUAL COMPONENT or MAP(S): See attached

X. RESEARCH ADDENDUM: N/A

XI. REPORTING REQUIREMENTS:
Periodic work plan status update reports will be submitted no later than January 1, 2017; July 1, 2017; January 1, 2018; July 1, 2018; and January 1, 2019. A final report and associated products will be submitted between June 30 and August 15, 2019.

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Environment and Natural Resources Trust Fund
M.L. 2016 Project Budget

Project Title: Evaluation of Forest Tree Retention Guidelines Pertaining to Wildlife
Legal Citation: M.L. 2016, Chp. xx, Sec. xx, Subd. xx
Project Manager: Gerald Niemi
**Organization:** Natural Resources Research Institute, University of Minnesota Duluth
M.L. 2016 ENRTF Appropriation: $232,000
Project Length and Completion Date: 3 years, June 30, 2019
Date of Report: 12/04/2015

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Activity 1 Budget	Amount Spent	Activity 1 Balance	Activity 2 Budget	Amount Spent	Activity 2 Balance	TOTAL BUDGET	TOTAL BALANCE
BUDGET ITEM	Measure leave tree configuration and quantify habitat characteristics of 60 harvest sites with LiDAR			Quantify effects of leave tree configurations on bird, small mammal, and amphibian communities				
Personnel (Wages and Benefits)	$91,150	$0	$91,150	$126,524	$0	$126,524	$217,674	$217,674
Gerald Niemi, Project Manager: $2,000 (66.3% salary, 33.7% benefits); 0.3% FTE each year for 3 years								
Alexis Grinde, Co-Investigator: $53,726 (82.4% salary, 17.6% benefits); ~27.3% FTE each year for 3 years								
Ed Zlonis, Co-Investigator: $51,200 (66.3% salary, 33.7% benefits); 30% FTE each year for 3 years								
Michael Falkowski, Research Associate: $33,700 (66.3% salary, 33.7% benefits); 10% FTE each year for 3 years								
1 Post-doctoral Reseacher: $31,100 (77.6% salary, 22.4% benefits); 50% FTE for year 1								
2 Field Technicians: $35,348 (92.1% salary, 7.9% benefits); 20% FTE each year for 3 years								
Undergraduate Research Assistant: $6,900 (100% salary, 0% benefits); 25% FTE for year 2								
Kim Rewinkel, Administrative support: $3,700 (72.6% salary, 27.4% benefits); 2% FTE each year for 3 years								
Equipment/Tools/Supplies								
50 Sherman traps ($25 each) for small mammal monitoring				$1,250	$0	$1,250	$1,250	$1,250
Travel expenses in Minnesota								
Travel for fieldwork, including mileage (75%) and lodging (25%) for researchers, field technicians, and graduate and undergraduate students. Mileage costs are associated with rental of a field vehicle through the University of Minnesota motorpool for four field sessions each year for 3 years. Travel reimbursement will follow University of Minnesota protocols				$13,076	$0	$13,076	$13,076	$13,076
COLUMN TOTAL	$91,150	$0	$91,150	$140,850	$0	$140,850	$232,000	$232,000

Spatial configurations of trees retained after harvest have important impacts on Minnesota's forest wildlife.
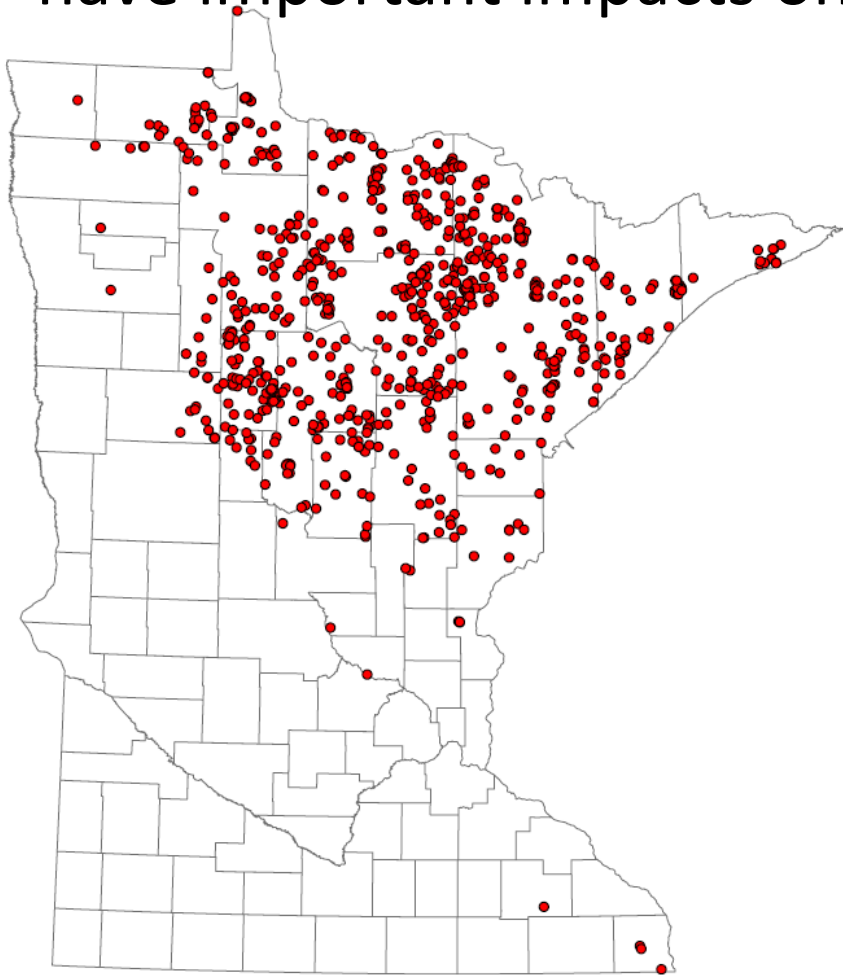
Harvest sites monitored by the MNDNR from 1999 – 2011.

a.)

b.)

MNFRC guidelines provide two options for meeting the leave tree recommendations: a.) scattered individual trees, or b.) clumps.

02/19/2018   Subd. 03q - DRAFT

02/19/2016