

Environment and Natural Resources Trust Fund
2014 Request for Proposals (RFP)

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Project Title:

Improving Wildlife Habitat Analysis with Value-Added LiDAR

Category: A. Foundational Natural Resource Data and Information

Total Project Budget: \$ 230,428

Proposed Project Time Period for the Funding Requested: 2 Years, July 2014 - June 2016

Other Non-State Funds: \$ 0

Summary:

We will process LiDAR with high resolution aerial photography in northeast Minnesota to provide current landscape-scale habitat measurements. The product will fundamentally improve habitat management for all forest wildlife species

Name: Ron Moen

Sponsoring Organization: U of MN - NRRI

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Duluth MN 55811

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Email: rmoen@d.umn.edu

Web Address: www.d.umn.edu/~rmoen

Location

Region: Northeast

County Name: Cook, Lake, St. Louis

City / Township:

MP: 0613-2-210-proposa

Budget: 0613-2-210-bud

Qual: 0613-2-210-qualifi

Map: 0613-2-210-map-4

Resolution:

List:

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge
Base			
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency
_____ Capacity Readiness	_____ Leverage	_____ Employment	_____ TOTAL



PROJECT TITLE: Improving Wildlife Habitat Analysis with Value-Added LiDAR

I. PROJECT STATEMENT

Funding sources (including ENRTF and the Outdoor Heritage Fund) and the MN DNR invest millions of dollars on wildlife research and habitat management in forest ecosystems. Effective wildlife management decisions require landscape-scale vegetation data be available.

Yet there are two major problems with existing landscape-scale vegetation data (Fig. 1):

- 1. Available landscape scale GIS coverages are derived from satellite imagery taken in the 1990's**
- 2. This Landsat satellite imagery has a resolution of about 30 x 30 m**

In effect, biologists and managers must use 15 year old vegetation data to address current wildlife habitat problems critical to the state of Minnesota (e.g., the moose population decline, or American marten status).

A cynical view would be that significant results in research projects and good management recommendations arise in spite of, and not because of, currently available landscape cover type products. Light Detection and Ranging (LiDAR) can solve this problem. LiDAR provides high-resolution data on 3-D physical structure over large spatial extents (Fig. 1). Vegetation structure is critical to wildlife use of different habitats, and LiDAR makes it possible to measure habitat quality across broad spatial scales.

Creating a coverage of 3-D vegetation structure would improve research and management on essentially all forest wildlife and tree species. In this proposal we will:

- 1. Merge LiDAR and High Resolution Aerial Photographs (HRAP) to make a GIS coverage.**
- 2. Use the LiDAR/HRAP output to answer wildlife habitat management questions and ecological questions using case studies from existing research projects.**
- 3. Provide LiDAR/HRAP output on a server for Internet download.**

The benefit of creating this LiDAR/HRAP is that resource managers and scientists will be able to access habitat data at the resolution with which animals perceive their habitat. This creates the potential for a fundamental change in how we manage natural resources.

New LiDAR imagery does **not** need to be collected. Basic LiDAR data (e.g., tree locations, building locations, bare earth elevation) are available via the Geospatial Information Office. Basic LiDAR data is hard to use and interpret without technical skills beyond most GIS users and does not exploit all LiDAR capabilities

We will use data from ENRTF and Outdoor Heritage Fund (OHF) projects to illustrate the value of the LiDAR/HRAP approach. Smaller scale sampling in each of these projects can be extended to the landscape-scale with LiDAR/HRAP. Partners with projects distributed across NE MN include:

1. Overstory and understory characteristics at moose bed sites, thermal properties of moose habitats, and time spent in browsing habitat in an ongoing ENRTF project to Moen.
2. Tree species compositions and thermal characteristics of the landscape is being measured using dataloggers at 102 sites in and near the BWCA in an ongoing ENRTF project to Frelich.
3. In an MN DNR American marten radiotelemetry project, tree species, cover, and canopy were measured at rest sites and reproductive den sites. LiDAR/HRAP can extend these measurements across home ranges.
4. Bird distribution and abundance data has been collected for over 20 years at plots in Superior National Forest by Niemi and more recently as part of the ENRTF funded Breeding Bird Atlas Project.
5. Moose habitat restoration is an OHF-funded project with MDHA as the project manager. LiDAR/HRAP can be used to determine habitat quality to moose of the area surrounding potential restoration sites.



Environment and Natural Resources Trust Fund (ENRTF)

2014 Main Proposal

Project Title: Improving Wildlife Habitat Analysis with Value-Added LiDAR

Each of these projects has a common characteristic: hundreds to millions of GPS locations that identify a point from which data have been collected or animal locations have been obtained. LiDAR/HRAP allows us to use this data to its full potential. The end result of the project will be access to high resolution habitat data that managers and scientists can use to benefit Minnesota’s wildlife and plant resources.

II. DESCRIPTION OF PROJECT ACTIVITIES

Activity 1: Improve Wildlife Habitat Management and Ecological Research in NE MN using LiDAR and High Resolution Aerial Photography **Budget: \$230,428**

We will develop methods for automating LiDAR and HRAP processing beyond the pilot study scale. Covering 3 counties is a large scale project (e.g., 40 TB of disk space) that is computationally intensive. We will create a single coverage across NE MN across different ownerships. Conifer and deciduous shrubs and trees, tree density, and tree heights will be identified. We will make the LiDAR/HRAP product available for internet download.

Outcome	Completion Date
1. Produce LiDAR/HRAP for Cook and Lake Counties.	6/30/2015
2. Implement Internet download capability of LiDAR/HRAP.	6/30/2015
3. Update habitat management recommendations for forest wildlife including moose, American marten, and birds and research on tree species using LiDAR/HRAP.	6/30/2016
4. Produce LiDAR/HRAP for St. Louis County.	6/30/2016
5. Provide technical assistance for other agencies and scientists throughout this project.	6/30/2016

III. PROJECT STRATEGY

A. Project Team/Partners

Dr. Ron Moen (NRRI-UMD) is project manager and will use LiDAR/HRAP for two ENRTF moose projects and one OHF moose habitat restoration project.

Dr. George Host (NRRI-UMD) will oversee GIS data acquisition and advise on processing and interpretation.

Dr. Kirk Stueve (NRRI-UMD) will implement LiDAR/HRAP processing, supervise student employees, and monitor quality control.

Dr. Lee Frelich (UM-TC) will use LiDAR/HRAP for ENRTF project “Change and Resilience in Boreal Forests.”

Dr. Gerald Niemi (NRRI-UMD) will use LiDAR/HRAP output to analyze data collected over the past 20 years on breeding bird census plots and the ENRTF funded Breeding Bird Atlas Project.

Minnesota DNR. We are working on projects with the MN DNR (e.g., American marten with Dr. John Erb, Furbearer biologist). Other MN DNR projects will also find the LiDAR/HRAP output useful.

Minnesota Deer Hunters Association (MDHA). MDHA is project manager for the moose habitat restoration project funded by the Outdoor Heritage Fund and will work with us on interpreting restoration site quality.

B. Timeline Requirements

This project would require 24 months of ENRTF funding from 7/1/2014 to 6/30/2016. We are ready to begin this project with LiDAR/HRAP data at NRRI, a fiber optic internet connection, and preliminary work to determine feasibility of the processing protocol.

C. Long-Term Strategy and Future Funding Needs

Several scientists and managers want to apply LiDAR/HRAP to improve analysis of habitat characteristics for different wildlife species. With future funding we could reuse the framework developed in this proposal to extend the LiDAR/HRAP output to other forested regions of Minnesota. We expect this product to be useful for the next 7 to 10 years, after which it would be desirable to fly LiDAR again. When LiDAR is flown again it would be possible to repeat the processing protocol to detect change that has occurred.

2014 Detailed Project Budget

Project Title: Improving Wildlife Habitat Analysis with Value-Added LiDAR

IV. TOTAL ENRTF REQUEST BUDGET 2 years

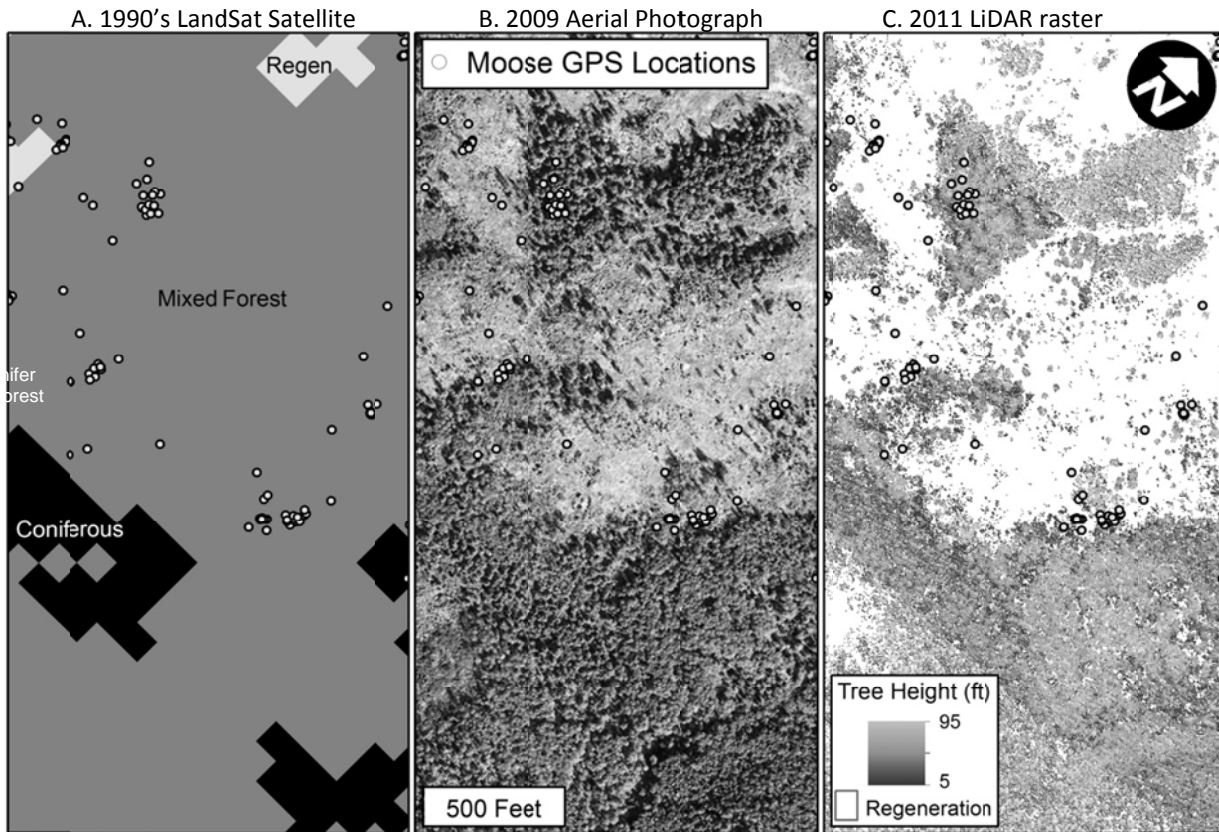
<u>BUDGET ITEM</u>	<u>AMOUNT</u>
Personnel:	
Moen, PI; analyze, write, manage, outreach; 2.53% fte; 75% salary/24% fringe, 24 mo. (\$4996)	\$ 228,224
Host, Co-PI; GIS lab mgmt, data availability; 1.75% fte; 75% salary/25% fringe, 24 mo. (\$5007)	
Stueve, PD; Design, analysis, write, supervise; 40% fte; 83% salary/17% fringe, 24 mo. (\$60,850)	
TBD, GRA; Process LiDAR, manage database, website access; 30% fte; 55% salary/45% fringe AY, 24 mo. (\$45,180)	
TBD, URA; Process LiDAR, create batch files; 25% fte AY, 85% fte SUM; 100% salary / 24 mo. (\$17,916)	
TBD, Technician; manage database, program internet access, process LiDAR; 100% fte; 73% salary/27% fringe, 24 mo. (\$94,275)	
	\$ -
Travel:	
Duluth to Twin Cities and other locations in Minnesota to meet with collaborators. Estimated at \$0.565/mi and 3,900 miles. 13 trips Duluth to Twin Cities, or more trips if collaborators are closer.	\$ 2,204
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND \$ REQUEST =	\$ 230,428

V. OTHER FUNDS

<u>SOURCE OF FUNDS</u>	<u>AMOUNT</u>	<u>Status</u>
Other Non-State \$ Being Applied to Project During Project Period:	\$ -	
Other State \$ Being Applied to Project During Project Period:		
4 computers built for processing LiDAR/HRAP (i7, 32 GB RAM, 2 x 512GB SSD, 2 x 4 TB HD)	\$ 5,000	Secured
Salary/Fringe for Host and Meyseburg (NRRRI GIS Lab Manager)	\$ 12,000	Secured
In-kind Services During Project Period:		
Continued data collection on several research projects (Moen, Frelich, Niemi, Erb) will be directly incorporated into the use of LiDAR/HRAP output.		
Remaining \$ from Current ENRTF Appropriation (if applicable):		
Critical Habitat for Moose to R. Moen. M.L. 2010, Chapter 362, Sec 2, Subd 3k. Finished and spent out on 6/30/2013.		
Moose habitat Restoration to R. Moen. M.L. 2013, Chapter XX, Sec. XX, Subd XX. Begins 7/1/2013.	\$ 200,000	Secured
Funding History: Moen and Stueve have been exploring use of the LiDAR/HRAP over the last several months and will continue to do so in the future.	\$ -	

Improving Wildlife Habitat Analysis with Value-Added LiDAR

Figure 1. Each panel displays the same area. Cover types in much of Panel D (vs. Panel A) have changed over the past 15 years and illustrate why this project is required now. The LiDAR image (Panel C) shows detail impossible to acquire from satellite imagery, and when merged with aerial photography in Panel B will give unequalled resolution of habitat characteristics across large areas as LiDAR/HRAP output (Panel E).



D. Land Cover change 1995 - 2009



Black areas in Panel D would be incorrect if we use the 1990's Landsat imagery (Panel A) today because of changes in habitat.

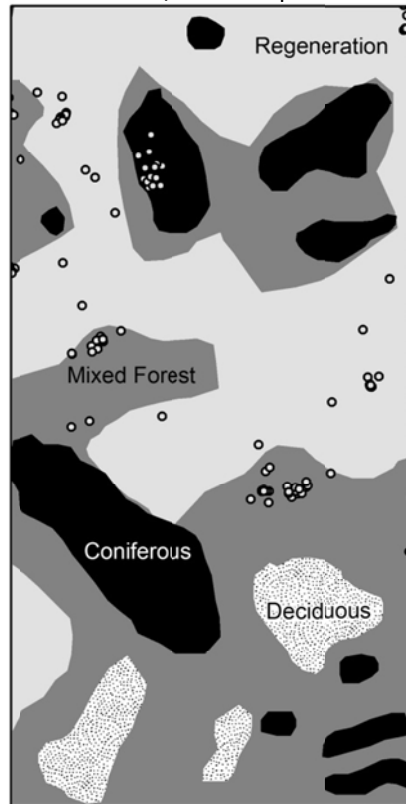


Panel E shows LiDAR/HRAP output and how moose are using forest edges. Tree density, tree height, and other data are also available at each moose location.



LiDAR/HRAP output will also be used to measure habitat quality for American marten, several bird species, and trees in this project.

E. LiDAR/HRAP output



Improving Wildlife Habitat Analysis with Value-Added LiDAR

2014 LCCMR Project Manager Qualifications and Organization Description

Ronald A. Moen, Natural Resources Research Institute, University of Minnesota Duluth

Key Qualifications

Dr. Moen is a research associate at the Natural Resources Research Institute, adjunct assistant professor in the Department of Biology at the University of Minnesota Duluth, with appointments in the graduate programs of Integrated Biological Science (Duluth campus) and Conservation Biology (Twin Cities campus).

Education

University of Minnesota, Wildlife Conservation, Ph.D. 1995

University of Minnesota, Wildlife, M.S. 1988

Cornell University, Biological Sciences, B.S. 1984

Selected Grants

2013. National Park Service / CESU. Climate Change Adaptation Planning for Northern Forest Ecosystems in the Great Lakes National Parks. R. Moen, L. Frelich., S. Windels. \$400,000.

2013. Environment and Natural Resources Trust Fund. Moose habitat restoration in northeastern Minnesota. R. Moen. \$200,000.

2010. Environmental Protection Agency Great Lakes Restoration Initiative. Restoring moose foraging habitat in Lake Superior Uplands. R. Moen. \$198,000.

2010. Environment and Natural Resources Trust Fund. Identifying critical habitats for moose in northeastern Minnesota. R. Moen, M. Lenarz, M. Schrage, A. Edwards, and M. Johnson. \$510,000.

2009. U.S. Fish and Wildlife Service. Seth Moore, Andrew Edwards, and R.A. Moen. Mooz (Moose) habitat use in a changing climate. \$199,999.

2009. U.S. Geological Survey. Steve Windels, Michael E. Nelson, and R.A. Moen. Investigate effects of climate change and other factors on population viability of moose in Voyageurs National Park. \$307,700.

Selected Publications

McGraw, A.M., R.A. Moen, and L. Overland. 2012. Effective Temperature of Cover Types Found in Moose Home Ranges in Northeast Minnesota. *Alces* 48:45-52.

Moen, R.A., S.K. Windels, and B. Hansen. 2012. Suitability of Voyageurs National Park as Canada lynx habitat. *Natural Areas Journal* 32:348-355.

Moen, R.A., M.E. Nelson, and A. Edwards. 2011. Radiotelemetry locations, home ranges, and aerial surveys in Minnesota. *Alces* 47:101-112.

McGraw, A.M., R.A. Moen, and M. Schrage. 2011. Characteristics of post-parturition areas of moose in northeast Minnesota. *Alces* 47:113-124.

Burdett, C.L., R.A. Moen, G.J. Niemi, and L.D. Mech. 2007. Defining Canada lynx space use and movements with GPS telemetry. *Journal of Mammalogy* 88:457-467.

Moen, R.A., J. Pastor, and Y. Cohen. 1997. Accuracy of GPS telemetry collar locations with differential correction. *Journal of Wildlife Management* 61:530-539.

The **Natural Resources Research Institute** is a part of the University of Minnesota Duluth. NRRI's mission is to promote private sector employment based on natural resources in an environmentally sensitive manner. NRRI scientists have extensive experience in applied ecological research on terrestrial and aquatic systems.