2016 Project Abstract
For the Period Ending June 30, 2019

PROJECT TITLE: Restoration of Elk to Northeastern Minnesota
PROJECT MANAGER: James D. Forester
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FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: M.L. 2016, Chp. 186, Sec. 2, Subd. 03l

APPROPRIATION AMOUNT: $300,000
AMOUNT SPENT: $300,000
AMOUNT REMAINING: $ 300,000

Sound bite of Project Outcomes and Results
This study examined the feasibility of restoring elk to northeastern Minnesota. It provides information for determining where elk restoration will be successful, should it occur. Results show that habitat suitability and landowner support are not limiting factors for restoring elk to northeastern Minnesota.

Overall Project Outcome and Results
Elk historically occupied most of Minnesota prior to the early 1900s, but now only 3 small groups occur in northwestern Minnesota. These groups are managed at low levels to reduce human-elk conflict. Forested areas of the state could avoid some conflict and see ecological and economic benefits from returning elk to the landscape. Evidence from other states indicates elk restoration can be successful, but success is dependent on forest management and public support for elk by local communities. This study examined the feasibility of restoring elk to 3 study areas in northeastern Minnesota. It provides information that will be useful for determining where elk restoration will be successful, should it occur, including information about social acceptance and habitat suitability. It resulted in 2 reports (McCann et al. 2019 and Walberg et al. 2019).

To assess landowner and local resident attitudes toward restoring elk to northeastern Minnesota, we surveyed 4,500 private landowners and 4,000 local residents. Eighty percent of landowners and 81% of local residents within the study areas strongly supported restoring elk to northeastern Minnesota. Landowner support for restoration was highest on the Cloquet Valley study area and lowest on the Fond du Lac study area. Local resident support was highest in southern St. Louis County, followed by Duluth, northern Pine County, and Carlton County.

To evaluate elk habitat suitability and to provide additional assessment of social support for restoring elk to northeastern Minnesota, we measured elk forage in the field and utilized GIS data to map habitat and social suitability. Our results show that habitat suitability and landowner support are not limiting factors for restoring elk to northeastern Minnesota. We sampled 186 field plots and found that mean summer forage at field plots exceeded amounts elk prefer and winter forage matched amounts where elk occur in Wisconsin. Estimates of how many elk are likely to be supported (5 to 8 elk/6 mi2) were similar to elk densities in Wisconsin and Michigan. Estimates of biological carrying capacity ranged from 287 on the Fond du Lac study area to 551 elk on the Cloquet Valley study area. Each of the 3 study areas: (1) had large amounts of habitat with suitability scores similar to where elk occur in Wisconsin; (2) a majority of land in public ownership; and (3) and relatively low human-elk conflict risk. Considering factors we assessed to be equally important did not result in statistically different study area rankings (on average, all 3 study areas were about the same) but some study areas ranked better than others when we weighted factors (considered some factor to be more important than others).

Project Results Use and Dissemination

Schrage delivered 16 presentations about this project to multiple groups, including: Rocky Mountain Elk Foundation banquets in Duluth and Prior Lake, the Minnesota Sharp-tailed Grouse Society in Hinckley, the Winton Historical Society, staff from the MNDNR's Northwest Region, the Minnesota Soil and Water Conservation District Forestry Association, the Breckinridge Chapter of the Izaak Walton League, Rocky Mountain Elk Foundation members in the Twin Cities, the Moose Lake Covenant Church Outdoor Expo, the annual meeting of the Minnesota Division of the Izaak Walton League, the Minnesota Forest Resources Partnership, St. Louis County Leaseholders, Northwoods Audubon, MNDNR Region 2 Assistant Wildlife Managers, a joint meeting of Minnesota Forest Industries and MNDNR Forestry, and at a meeting of the St. Louis County Committee of the Whole. McCann and PhD student Eric Walberg delivered presentations about the project at the joint meeting of the State Chapters of The Wildlife Society and Society of American Foresters in Duluth, MN. Fulton and McCann delivered presentations about the project at the Western Association of Fish and Wildlife Agencies' Biennial Deer & Elk Workshop in Marfa, TX. This project was featured in the Duluth News Tribune, Pioneer Press, Brainerd Dispatch, the Minnesota Deer Hunters Association publication of "Whitetales", and Outdoor News. Educational displays about elk and this project were set up and staffed by tribal, Rocky Mountain Elk Foundation, University of Minnesota, and volunteer staff at the Carlton County and Minnesota State Fairs. Additionally, Schrage and other tribal personnel staffed booths that highlighted this project at the Minnesota State Fair and a second at the Cloquet Forestry Center's 50th anniversary celebration of their Conservation Education Day event, and Schrage and McCann ran an informational booth for the project at the Outdoor News Deer and Turkey Classic show. We held multiple project meetings that included MNDNR staff. We developed an internet presence, including a website (http://elk.umn.edu) and Facebook page (https://www.facebook.com/NE.MN.elk).

Environment and Natural Resources Trust Fund (ENRTF)
M.L. 2016 Work Plan Final Report

Date of Report: 16 August 2019

Final Report

Date of Work Plan Approval: June 7, 2016

Project Completion Date: 30 June 2019

PROJECT TITLE: Restoration of Elk to Northeastern Minnesota

Project Manager: James D Forester

Organization: University of Minnesota

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Location: Carlton, Pine, and St. Louis Counties

Total ENRTF Project Budget:		
	ENRTF Appropriation:	**$300,000**
	Amount Spent:	**$300,000**
	Balance:	**$0**

Legal Citation: M.L. 2016, Chp. 186, Sec. 2, Subd. 03l

Appropriation Language:
$300,000 the second year is from the trust fund to the Board of Regents of the University of Minnesota in cooperation with the Fond du Lac Band and Rocky Mountain Elk Foundation to determine the habitat suitability and levels of public support for restoring elk to northeastern Minnesota. This appropriation is available until June 30, 2019, by which time the project must be completed and final products delivered.

I. PROJECT TITLE: Restoration of Elk to Northeastern Minnesota

II. PROJECT STATEMENT:

Elk historically occupied most of Minnesota prior to the early 1900's. Although two small populations were re-established in northwest MN, they are currently managed at low levels to reduce human-wildlife conflict. Forested areas of the state, however, could avoid some of these conflicts and see significant ecological and economic benefits from returning elk to the landscape. Re-establishing this keystone herbivore will help restore the state's traditional wildlife heritage, diversify the large mammal community, increase tourism from wildlife viewers, and eventually provide additional hunting opportunities. Finally, a landscape actively managed for elk will benefit other species adapted to young forests and brushlands. Evidence from other eastern states indicates elk restoration can be successful, but success is dependent on active forest management and public support for elk by local communities.

This research will determine areas of suitable habitat and levels of public support for restoring elk to Northeastern Minnesota. Research will be conducted in an area already identified as having local public interest and abundant public forest land (i.e., southern St Louis, Carlton, and northern Pine counties; Figure 1). The research team will build upon existing eastern elk restoration research to address two research goals:

1) Identify the amount of public support for a restored elk population by surveying citizens in and around the prospective restoration sites.

2) Determine where suitable habitat exists and how many elk it could sustain. Combine the public support and habitat suitability maps to identify areas likely to support a restored elk population.

Despite potential economic and ecological benefits, care must be taken to determine if suitable habitat exists for elk and if the public will support having elk on the landscape. Our initial interaction with county governments and conservation groups indicates there is great interest in exploring elk restoration; however, we will conduct a quantitative survey of public attitudes to determine levels of tolerance for elk across the study area. To identify locations of suitable habitat, we will compile existing data on land use and land cover and collect field data on forage availability. We will use these data in conjunction with a synthesis of existing elk research in the Midwest to map how habitat suitability varies across the study area. Finally, we will combine the public support and habitat suitability maps to identify areas most likely to support a successful restoration. This study will provide critical information to wildlife managers and local governments allowing them to make an informed decision regarding habitat suitability and public support for the next steps in elk restoration.

III. OVERALL PROJECT STATUS UPDATES:

Project Status as of 2 December 2016:

We are well into the initial planning stages of this project. We have met as a group to lay the initial ground work for the survey effort and have hired a graduate student to work on the survey portion of this project; a postdoctoral job advertisement is currently being drafted. The first major decisions for this project are to identify where the most suitable restoration locations are. Key to this is determining the minimum area that should be considered, and what ecological characteristics the area should include. Because Wisconsin used a core elk range of 288 mi^2 for their Clam Lake herd and 320 mi^2 for the Black River herd, we are initially looking for areas within the larger region of southern St. Louis, Carlton and northern Pine Counties that are >300 mi^2 to focus our analysis on. Based on the general habitat requirements of elk, the focal areas should include a large core of public land, and should represent a mosaic of brushland and forests. We are working with local area DNR wildlife staff and county and tribal land managers to identify candidate focal areas. Once this is complete, we will fine-tune our survey effort to target the general public across the study area as well as land owners in and around the identified focal areas. We have begun collecting relevant GIS land-cover and land-use maps to guide

our efforts and have started the development of a simulation model that will help us estimate how restored elk are likely to use each of the landscapes.

Project Status as of 30 June 2017:
Both activities are now well underway. We worked with State and County land managers to identify three study areas that are centered on large tracts of public land and have begun to survey these areas to assess the availability of potential elk forage and cover. Across the region we have conducted two focus group sessions with local landowners and are using this interaction to refine the survey questions. A draft survey instrument has been developed and is being refined with input from University of Minnesota, Fond du Lac, and MN DNR study team members; the survey will be deployed later this summer. We have also developed a web presence with a Facebook page (https://www.facebook.com/NE.MN.elk) and website (http://elk.umn.edu).

Project Status as of 31 January 2018:
Progress continues for both research activities. Following input from University of Minnesota researchers, Fond du Lac wildlife resource management staff, and Minnesota DNR staff, we have nearly finalized the landowner and resident surveys (activity 1); the surveys will be sent out in early February 2018 using a sampling design that was completed in late 2017. Habitat sampling (Activity 2) was completed at 112 locations on our 3 ecological study areas (centered on Cloquet Valley, Fond du Lac, and Nemadji State Forests), and preliminary analyses were conducted. Planning is underway for additional habitat sampling that is to take place within the 3 ecological study areas during summer 2018.

We held 3 project meetings with staff from the DNR that included discussion of study design for Activities 1 and 2, and preliminary results for Activity 2. Dissemination included multiple presentations to DNR staff and the public, including displays at the Carlton County and Minnesota State Fairs. Media coverage included articles featured in multiple outlets, including the Duluth News Tribune and the Minnesota Deer Hunters Association publication of “Whitetales”.

Project Status as of 30 June 2018:
A resident survey and a landowner survey (Activity 1) were finalized and sent out in February. Three rounds of follow-up surveys were then sent out to residents and landowners that did not respond to the initial surveys. To date, return rates for the resident survey and landowner survey are 42.9% and 58.5%.

Eighty-six landowners were contacted, and access was granted for vegetation sampling on 76 parcels of private land (activity 2). A method for sampling vegetation on private lands and rights-of-way was also devised. A four-person field-crew was hired and trained, and has begun data collection.

We held one project meeting that included discussion of preliminary results for Activity 1 and study design for Season 2 of Activity 2. Schrage and McCann ran an informational booth for the project at the Outdoor News Deer and Turkey Classic show, and Schrage gave a presentation at the annual meeting of the Minnesota Division of the Izaak Walton League. Additional outreach and dissemination efforts continue through a website and a Facebook page.

Amendment Request (Amendment Approved by LCCMR 2/26/2019):

We need to retroactively move $925 from “Equipment/Tools/Supplies” to “Service Contracts” because the postage costs were included in the mailing services fees (i.e., we did not buy stamps separately).

Due to cost savings on travel and equipment, and would like to move the balances ($1,154 from equipment; $1,649 from travel) to Personnel to cover increases in costs in graduate student salary and fringe.

Project Status as of 31 January 2019:
Data entry from surveys of landowners and the general public has been completed and success rates have been quantified. The general public survey had a 45.8% response rate and the landowner survey had a 59.6% response rate. We completed habitat sampling, which resulted in a total of 217 sampling locations across the two summers that we sampled. Data were validated and organized, and preliminary habitat analysis were completed. Analysis of survey and habitat data is ongoing, and we are developing methods for combining results from Activity 1 to those from Activity 2 to develop a suitability map that incorporates public perceptions and habitat requirements. Schrage gave multiple presentations on elk restoration, staffed two booths that highlighted this project, and attended a one-day elk workshop in Wisconsin. Outreach and dissemination efforts continue through a website and a Facebook page with a number of followers that has grown to 198.

Overall Project Outcomes and Results:
Elk historically occupied most of Minnesota prior to the early 1900s, but now only three small groups occur in northwestern Minnesota. These groups are managed at low levels to reduce human-elk conflict. Forested areas of the state could avoid some conflict and see ecological and economic benefits from returning elk to the landscape. Evidence from other states indicates elk restoration can be successful, but success is dependent on forest management and public support for elk by local communities. This study examined the feasibility of restoring elk to three study areas in northeastern Minnesota. It provides information that will be useful for determining where elk restoration will be successful, should it occur, including information about social acceptance and habitat suitability. It resulted in two reports (McCann et al. 2019 and Walberg et al. 2019).

To assess landowner and local resident attitudes toward restoring elk to northeastern Minnesota, we surveyed 4,500 private landowners and 4,000 local residents. Eighty percent of landowners and 81% of local residents within the study areas strongly supported restoring elk to northeastern Minnesota. Landowner support for restoration was highest on the Cloquet Valley study area and lowest on the Fond du Lac study area. Local resident support was highest in southern St. Louis County, followed by Duluth, northern Pine County, and Carlton County.

To evaluate elk habitat suitability and to provide additional assessment of social support for restoring elk to northeastern Minnesota, we measured elk forage in the field and utilized GIS data to map habitat and social suitability. Our results show that habitat suitability and landowner support are not limiting factors for restoring elk to northeastern Minnesota. We sampled 186 field plots and found that average summer forage at field plots exceeded amounts elk prefer and winter forage matched amounts where elk occur in Wisconsin. Estimates of how many elk are likely to be supported (5 to 8 elk/6 mi^2) were similar to elk densities in Wisconsin and Michigan. Estimates of biological carrying capacity ranged from 287 on the Fond du Lac study area to 551 elk on the Cloquet Valley study area. Each of the 3 study areas: (1) had large amounts of habitat with suitability scores similar to where elk occur in Wisconsin; (2) a majority of land in public ownership; and (3) and relatively low human-elk conflict risk. Considering factors we assessed to be equally important did not result in statistically different study area rankings (on average, all 3 study areas were about the same) but some study areas ranked better than others when we weighted factors (considered some factor to be more important than others).

IV. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1: Assessing public attitudes towards elk restoration.
Description: Understanding the public's attitudes and acceptance of elk and their potential impacts are key components of assessing the viability of elk restoration. Long-term management of elk will require an adaptive impact approach in which management objectives and strategies are guided by the preferences of the impacted public. To address this need, we propose conducting surveys and workshops with local citizens.

Three important groups include: private landowners in the potential restoration zone, hunters and the larger conservation community, and the general public residing in or near the potential restoration zone. The

completed target sample size for each study group will provide error estimates within 4%. We will contact potential respondents in each target population using current best practices for multi-modal survey contact designs and probability-based sampling approaches. Probability-based samples are essential to allowing generalization of results back to the populations of interest. Initial contacts will be made using address-based sampling designs and mailed paper surveys. Subsequent contacts will be made via e-mail when possible with provision of a web-based response.

We will use county property records to identify and randomly select landowners for inclusion in the study and augment county contact information with available e-mail addresses to allow for direct electronic contact of respondents with e-mail addresses. We will use Address Based Sampling (ABS) utilizing the US Postal Service's Computerized Delivery Sequence File (or 9-1-1 response) addresses to randomly select individual households for participation in the study. This ABS approach provides 100% coverage of owner-occupied and rental residential addresses and will be augmented with e-mail contact information so that follow-up contacts can be electronic and data collection web-based. We will use the Minnesota Department of Natural Resource's Electronic License System data to randomly select hunters and other conservationists for participation in the study. Up to 30% of individuals in the ELS provide an e-mail contact, and we will append additional e-mail addresses using commercially available services so that an e-mail contact and web-based survey option can be provided to those respondents who prefer electronic contact. This probability-based sampling and multi-modal administration strategy will help to minimize sampling, non-coverage and response biases.

The primary objectives of the surveys will be to understand citizens': 1) attitudes toward elk and elk restoration; 2) acceptance and tolerance of potential elk impacts; 3) preference for management objectives concerning elk restoration including elk population size and geographical distribution; and 4) preferences for management strategies to address potential conflicts with elk. Our approach for gathering social survey data will be guided by numerous studies assessing the social aspects of wildlife restoration. Based on our findings, we will develop a spatially explicit map of expected tolerance levels for a restored elk population.

We will also conduct a minimum of 6 local workshops and webinars after the social survey data have been collected and analyzed so we can better understand the public perceptions of the social survey data and ecological research from Activity 2 and facilitate discussion among the attendees about the research findings. The primary objectives of the workshops are to disseminate research findings and facilitate dialogue concerning the implications of the findings. We will also develop a website and use traditional and social media outlets to distribute information about the project to the public.

Summary Budget Information for Activity 1:

ENRTF Budget: $141,607
Amount Spent: $141,607
Balance: $ 0

Outcome	Completion Date
1. *Design, implement and analyze data for 3 survey groups (based on up to 12,182 mailed surveys; this is the most effective method for a statistically valid survey).*	December 2017
2. Complete social acceptance map for the study area.	May 2018
3. *Complete 6 public workshops / webinars (25-50 attendees expected at each).*	May 2019
4. *Develop website and use traditional and social media outlets to distribute information and receive comments about the social and ecological survey results.*	June 2019

Activity Status as of 2 December 2016:
We have conducted an initial planning meeting that included representatives from the MN DNR and have identified a graduate student, Eric Walberg, to work on this project. Eric is already involved with the survey on

the NW elk population, and has begun developing a survey to deploy in this study area. We are currently deciding on the appropriate survey questions to ask and how best to identify the different target groups.

Activity Status as of 30 June 2017:
During the past 6 months we have conducted three project design meetings that included participation from University of Minnesota researchers, Fond du Lac wildlife resource management staff, and Minnesota DNR researchers and managers. We have refined the study areas, target study population for the surveys, and sampling protocols. A draft survey instrument has been developed and is being refined with input from University of Minnesota, Fond du Lac, and MN DNR study team members. To assist with survey design and pretesting, focus groups were conducted in early June with landowners in northeast Minnesota. The focus groups provided a productive discussion with local landowners that helped develop the survey and more effectively identify the benefits and/or concerns local residents and landowners might have about restoring a local elk population.

Our outreach and dissemination efforts have included creating a website and Facebook page, along with scheduling focus groups of landowners in northeast Minnesota. The website was created to provide information about elk in Minnesota and restoration efforts in the eastern United States, along with providing summaries of the research projects to be conducted. The Facebook page was created to provide instantaneous communication with interested citizens with relevant updates about the research projects.

Activity Status as of 31 January 2018:
In late 2017 and early 2018 we worked toward finalizing the questions and sampling designs for landowner and local resident questionnaires using input from University of Minnesota researchers, Fond du Lac wildlife resource management staff, and DNR study team members. Questions were informed by focus group meetings with landowners in northeastern Minnesota that we held in June 2017. Questionnaire topics include, (1) landowner property characteristics, (2) knowledge about elk, (3) attitudes about elk restoration, (4) elk restoration objective prioritization, (5) risk perceptions of restoring elk, (6) comparative impacts of deer and elk, (7) value of restoring elk, (8) trust in elk managers, (9) elk-related recreation, (10) outdoor activities and organization membership, and (11) demographic characteristics. In early February we will send questionnaires to 4,500 landowners and an additional 4,000 local residents in northeastern Minnesota. We will survey landowners using parcel ownership information obtained from county tax records. We will survey local residents after obtaining contact information for households obtained from a third-party vendor.

Activity Status as of 30 June 2018:
Starting in early February, we contacted 4,500 landowners and 4,000 local residents in northeastern Minnesota to complete a survey questionnaire about the potential for elk restoration. We randomly sample landowners with three study areas using parcel ownership information obtained from county tax records as the sampling frame. We have contacted a stratified random sample of local residents within four study areas using contact information for households obtained from a third-party vendor. The three study areas for the landowner survey include: (1) Cloquet Valley State Forest in St. Louis County, (2) Fond du Lac Indian reservation in St. Louis and Carlton Counties, and (3) Nemadji State Forest in Pine County. The four study areas for the survey of local residents include: (1) St. Louis County south of the St. Louis River, (2) Carlton County, (3) Pine County north of Minnesota Highway 48, and (4) Duluth and the surrounding suburbs.

We have contacted landowners and the general public four times to complete a survey questionnaire. We are continuing to receive survey responses and data entry is ongoing. Of the 4,000 recipients of the general public survey, we have had 1,496 responses and 509 invalid contacts (bad addresses, deceased individuals, etc.) resulting in a 42.9% response rate. Of the 4,500 recipients of the landowner survey, we have had 2,514 responses and 204 invalid contacts resulting in a 58.5% response rate.

Activity Status as of 31 January 2019:

Data entry from surveys of landowners and the general public have been completed. Of the 4,000 recipients of the general public survey, we received 1,574 responses and 566 invalid contacts (bad addresses, deceased individuals, etc.) resulting in a 45.8% response rate. Of the 4,500 recipients of the landowner survey, we received 2,550 responses and 222 invalid contacts resulting in a 59.6% response rate. We are currently analyzing the data and writing a draft report. We have also prepared data for combining results from Activity 1 to those from Activity 2 in order to develop a suitability map that incorporates both public perceptions and habitat requirements.

Final Report Summary:
We surveyed 4,500 private landowners and 4,000 local residents in northeastern Minnesota to describe landowner and local resident attitudes toward potentially restoring an elk population to northeastern Minnesota. Eighty percent of landowners and 81% of local residents within the study areas strongly supported restoring elk to northeastern Minnesota. Landowner support for restoration in northeastern Minnesota was highest on the Cloquet Valley study area and lowest on the Fond du Lac study area, and a majority of landowners (76%) were supportive of restoring elk within five miles of their property. Local resident support was highest in southern St. Louis County, followed by Duluth, northern Pine County, and Carlton County.

Hunters were more supportive of restoring elk than non-hunters and this was true for landowners (81% vs 75%) and local residents (80% vs 75%). Among landowners, non-farmers were more supportive of restoring elk than were farmers (82% vs 73%) and timber producing landowners were less supportive of restoring elk than were non-producers (76% vs 81%). Respondents believed that the most likely outcomes from restoring an elk population were providing opportunities to view elk, restoring a native wildlife species, and providing opportunities to hunt elk. The least likely outcomes were believed to be negative impacts on other wildlife, increased risk of disease transmission to livestock and wildlife, and damage to trees and forest vegetation.

The most important management objectives for landowners were: (1) minimizing impacts to existing wildlife, (2) restoration of a native species, and (3) minimizing impacts to deer populations and deer hunting. The most important management objectives for local residents were: (1) minimizing impacts to existing wildlife populations, (2) restoration of a native species, and (3) maximizing sustainable elk population size.

Landowners and local residents believed that there would potentially be moderate to high potential benefits from restoring elk, and that restoring elk would pose little to moderate threat to the economic well-being (e.g., agriculture, personal property) and health/safety (vehicle collisions) of the respondents and other individuals in the local community. Respondents perceived that having elk within the study areas would pose moderate threat to other wildlife in the area (disease) and to trees and forest vegetation.

Landowners and local residents had moderate knowledge of elk in Minnesota, with hunters having moderate knowledge and non-hunters having low knowledge. A majority of landowners and local residents agreed with these statements: (1) “it is important that Minnesota someday have an abundant elk population within the study areas” (64% of landowners and 69% of local residents); “whether or not I would get to see an elk, it is important to me that they could exist within the study areas” (70% of landowners and 76% of local residents); and “it is important to establish elk populations within the study areas so future generations can enjoy them” (73% of landowners and 79% of local residents). A majority of landowners (61%) and local residents (64%) indicated that they would likely make a trip to view, photograph or hear elk within the study areas in Minnesota. About one-quarter of landowners (24%) and but fewer than 1 in 5 local residents (16%) indicated that they plan to apply for a Minnesota elk hunting license in the future. In general, landowners were more likely than local residents to have applied for or have drawn an elk license or apply for one in the future.

ACTIVITY 2: Ecological aspects of elk restoration
Description:

Whether a restored elk population will thrive at a given site will depend on a variety of factors. Here, we will focus our efforts on determining: 1) human land-use patterns; 2) the distribution of current land-cover types (including forest age structures and the specific agricultural uses); 3) expected future changes to land cover; 4) the diversity and abundance of forage within each cover type; and 5) locations of captive cervid operations. We will consider risk of agricultural damage and other potential human conflicts as well as expected elk movement patterns and population growth. Finally, we will use the existing 2013-2014 MN land-cover dataset to identify prospective sites; field surveys of forage availability will be conducted in all of these areas to estimate the distribution of food resources (both quality and amount) within each land-cover type. We will combine these data with existing information on elk habitat use to develop a habitat suitability map and estimate the carrying capacity of potential relocation sites. This map will be integrated with the final product of Activity 1 to produce an elk suitability map for the region.

Compilation of existing spatial data: In Year 1, we will collect existing data about recent land use (e.g., locations of agriculture, timber harvest, and captive cervid operations) and land cover from state and county agencies. Future use of public lands will be considered by discussing forest management plans with agency representatives; when possible (i.e., where spatially explicit plans of timber harvest are available) we will include expected land-cover change into our projections of suitability. Land cover will be validated in Years 2 and 3 by visiting 250 sites across the study area.

Forage availability: We will identify 120 sites distributed among the primary land-cover types within the study area. During the summer of Year 2 (June-August) we will visit each site to estimate plant species abundance and biomass for all functional groups (herbaceous plants, grasses, and low woody vegetation). For a subset of the sites we will collect and dry plant biomass to refine biomass allometric equations for the study area. The forage diversity and abundance estimates will be extrapolated across the study area, and these maps crossvalidated and then ground-truthed by visiting 50 sites in the summer of Year 3.

Restoration Suitability: We will synthesize current and previous research on elk from Wisconsin, Ontario, Michigan, and western Minnesota to develop Habitat Suitability estimates for the study area. These data will consist of resource selection patterns and population growth rates through time. Based on our data that quantify the distribution of resources and previous research on elk physiology and behavior, we will develop approximate carrying capacities for a variety of potential release sites within the study area. We will combine the Ecological and Social maps to identify areas where restoration efforts are more likely to succeed. Our final feasibility report will summarize the strengths and weaknesses for different release sites with the goal to provide managers with the information they need to decide if an elk restoration is feasible, and if so where it will have the greatest likelihood of success in the study area.

Summary Budget Information for Activity 2

ENRTF Budget: $ 158,393
Amount Spent: $ 158,393
Balance: $ 0

Outcome	Completion Date
1. Identify primary elk study areas using existing data.	*May 2017*
2. Complete forage surveys (visit 120 sites distributed among primary land-cover types to estimate quality and abundance of common elk forage species).	*September 2017*
3. Ground truth land-cover and forage availability maps (visit 250 sites to confirm cover types).	*August 2018*
4. Complete ecological carrying capacity map and population estimation.	*December 2018*
5. Complete final suitability map and feasibility report.	*June 2019*

Activity Status as of 2 December 2016:

Forester and Schrage have begun collecting GIS layers for this project and discussing potential study areas with MN DNR staff as well as county and tribal land managers. They have also created an initial draft of a simulation model that will be used to explore potential spread of elk given landscape patterns and resource selection; this model will contribute to the population estimation efforts over the next two years.

Activity Status as of 30 June 2017:
Three ecological study areas have been identified, all centered on large tracts of public land (the Cloquet Valley, Fond du Lac, and Nemadji State Forests). Forester and Mark Ditmer (hired as a postdoc on this project) refined the vegetation sampling protocol and generated stratified random sample points for all relevant land-cover types throughout the three study areas. In early June, we trained a four-person field crew on vegetation sampling methods. This crew began collecting vegetation and cover data in mid June and will have finished data collection by the end of August.

Activity Status as of 31 January 2018:
Our four-person field crew collected vegetation and land cover data from 112 locations in the 3 ecological study areas (tracts of public land centered on the Cloquet Valley, Fond du Lac, and Nemadji State Forests). We conducted preliminary analyses that (1) estimated forage biomass at each of the sampling locations, and (2) compared forage biomass between cover types. We also compiled and assessed publicly-available spatial data that will be used for future analysis. Nick McCann was hired as a Postdoctoral Associate, replacing Mark Ditmer. McCann will work with Forester, Schrage, Fulton, and Walberg to help complete this project. Planning is underway for fieldwork that is to take place in summer 2018. Fieldwork in 2018 will focus on sampling private lands within the 3 study areas.

Activity Status as of 30 June 2018:
Vegetation sampling is occurring primarily on private lands in 2019. Sampling on private lands, in addition to public lands that were sampled in 2018, will provide an understanding of what type of food is available to elk that is more complete. Using a random-stratified approach, we selected private land parcels to sample from the pool of landowners that said it was OK to contact them on the landowner survey conducted for Activity 1. We then emailed and called 86 landowners to determine if they would allow us on their land for research, and we were granted access to 76 parcels. We also devised a protocol for sampling in rights-of-way (e.g., roadsides and areas adjacent to transmission lines) and contacted foresters and land managers to acquire GIS data that depicts recent land use (e.g., timber harvest). We hired and trained a four-person field crew for vegetation sampling, which began in early June and will end in late August.

Activity Status as of 31 January 2019:
We completed vegetation sampling in August 2018, resulting in data from a total 186 sampled plots across both years (63 in the Cloquet Valley study area; 69 in the Fond du Lac; and 54 in the Nemadji). Additional vegetation sampling was completed along roadsides and other right of ways at 31 locations (8 in the Cloquet Valley study area; 13 in the Fond du Lac; and 10 in the Nemadji), resulting in a total of 217 sampling locations across the two summers that we sampled. Data were validated and organized, and preliminary habitat analysis were completed. Additionally, we are evaluating methods by which to combine results from the human dimensions surveys with habitat analyses. Analysis is ongoing.

Final Report Summary:
We used multiple methods to evaluate and map elk habitat suitability and social support. We measured potential summer (leaf-on) and winter (leaf-off) forage in the field and combined forage data with remotely sensed data to estimate the number of elk likely to be supported by each study area. We mapped habitat suitability index scores and a resource selection function, each developed in Wisconsin. Data from roads, feedlots, row crops, and hay and pasture fields enabled us to create a risk map for human-elk conflict, and data from mail-in questionnaires enabled us to map support for elk restoration by landowners and local residents. We ranked study areas and tested the influence of considering some factors as being more important than

others. Our results show that habitat suitability and landowner support are not limiting factors for restoring elk to northeastern Minnesota.

By sampling 186 field plots, we found that mean summer forage at field plots exceeded amounts elk prefer and winter forage matched amounts where elk occur in Wisconsin. Public land had more winter forage than private land, forested shrub wetlands had more winter forage than grasslands, and grasslands had more summer forage than coniferous forests and mixed forests. Estimates of how many elk are likely to be supported (5 to 8 elk/6 mi^2) indicate that northeastern Minnesota can support densities similar to Wisconsin and Michigan. Estimates of biological carrying capacity ranged from 287 on the Fond du Lac study area to 551 elk on the Cloquet Valley study area.

Each of the 3 study areas had large amounts of habitat with suitability scores similar to where elk occur in Wisconsin. The Cloquet Valley study area contained about 4-times more suitable habitat than the Black River Herd's core area in Wisconsin, while the Nemadji study area contained about 2-times more, and the Fond du Lac study area contained about the same amount. Resource selection function maps showed the greatest amount of summer elk habitat on the Nemadji study area. When we excluded the influence of wolf territories in selection calculations (because we lacked recent wolf data from the Nemadji study area), the Nemadji study area had higher selection scores than the Cloquet Valley and Fond du Lac study areas. Aspen was more abundant in the Cloquet Valley study area than in the other study areas, while grassland was distributed similarly across the study areas. Public land made up the majority of all 3 study areas and was most abundant on the Cloquet Valley study area than in the other study areas.

Most landowners and local residents supported elk restoration, and support was similar across study areas. Overall, 82% of landowners (people who owned ≥ 4 ha of land) inside the 3 study area boundaries and 86% local residents (owned < 4 ha of land) with addresses inside the 3 study area boundaries expressed favorable attitudes toward elk restoration. Using questionnaire responses from 2,585 landowners and 1,521 local residents from inside and outside the study areas, we mapped social acceptance scores and found landowner and local resident acceptance was high.

Human-elk conflict risk was low on the 3 study areas, but increased from north to south, with the Nemadji study area having mean risk 5-times greater than for the Cloquet Valley study area. Low conflict risk in all directions adjacent to the Cloquet Valley study area may enable elk population expansion without eroding public support. The same is true to the west, north, and east of the Fond du Lac study area, but areas outside the Nemadji study area (in all directions within the state), had higher risk of human-elk conflict.

Considering the factors that we assessed to be equally important (i.e., evenly weighing them) did not result in statistically different study area rankings (on average, all 3 study areas were about the same). Some study areas ranked better than others, however, when we weighted factors (considered some factor to be more important than others). The Cloquet Valley study area ranked best most often (after weightings), followed by the Nemadji study area and the Fond du Lac study area.

V. DISSEMINATION:

Description: The workshops in Activity 1 will provide a direct outlet to share our findings with the public. A fact sheet that summarizes our findings will be distributed to LCCMR members and land managers at the state and federal level; this will also be made available on the UMN Department of Fisheries, Wildlife, and Conservation Biology website. Results will be presented at state and national wildlife and ecology conferences (e.g., both state and national conferences of The Wildlife Society, the Society for Conservation Biology). Any publications resulting from this project will be made available through the FWCB website or Open Access journal websites.

We also expect that there will be a large amount of informal dissemination because we will be working closely with researchers and managers from the Department of Natural Resources, county governments, and the Fond

du Lac Band of Lake Superior Chippewa. These researchers will take the results of our study into consideration as they make management decisions and will work with us to ensure that our data products reach a broad audience within their agencies.

Status as of 2 December 2016**:**
We are including the MN DNR, county, and tribal land managers in our planning efforts, but do not yet have any results to disseminate.

Status as of 30 June 2017**:**
Schrage, Forester, and Fulton worked closely with University, DNR Area Wildlife staff, and county and tribal land managers to finalize the three proposed focal study areas; this was completed in March, 2017. Schrage gave two presentations on the project at Rocky Mountain Elk Foundation banquets in Duluth and Prior Lake; another elk project presentation was given to the Minnesota Sharp-tailed Grouse Society in Hinckley. Forester, Schrage, and Fulton were interviewed about the elk project for an Outdoor News article that was published on 15 June. We have also developed an internet presence, including a website (http://elk.umn.edu) and Facebook page (https://www.facebook.com/NE.MN.elk).

Status as of 31 January 2018**:**
We held 3 project meetings that included discussion of preliminary results with staff from the DNR. Schrage gave presentations describing this project and elk restoration to the Winton Historical Society, staff from the DNR's Northwest Region, and the Minnesota Soil and Water Conservation District Forestry Association. In addition, educational displays about elk and the idea of elk restoration in northeast Minnesota were set up and staffed by tribal, Rocky Mountain Elk Foundation, University of Minnesota, and volunteer staff at the Carlton County and Minnesota State Fairs.

The number of followers of the elk project's Facebook site has grown to 156. In fall 2017 this project was featured in the Duluth News Tribune, Pioneer Press, Brainerd Dispatch, and the Minnesota Deer Hunters Association publication of "Whitetales".

Status as of 30 June 2018**:**
Schrage and McCann ran an informational booth for the project at the Outdoor News Deer and Turkey Classic show. Schrage gave a presentation at the annual meeting of the Minnesota Division of the Izaak Walton League. Additional outreach and dissemination efforts continue through a website and a Facebook page that we created to keep citizens informed of our research. The website was created to provide information about elk in Minnesota and restoration efforts in the eastern United States, along with providing summaries of the research projects to be conducted. The Facebook page was created to provide instantaneous communication with interested citizens with relevant updates about the research projects.

Status as of 31 January 2019**:**
Schrage gave presentations on elk restoration to the Breckinridge Chapter of the Izaak Walton League, Rocky Mountain Elk Foundation members in the Twin Cities, and at the Moose Lake Covenant Church Outdoor Expo. Schrage and other tribal personnel staffed two booths that highlighted this project, one at the Minnesota State Fair and a second at the Cloquet Forestry Center's 50th anniversary celebration of their Conservation Education Day event. Outreach and dissemination efforts continue through a website and a Facebook page that we created to keep citizens informed of our research. The number of followers of the project's Facebook site has grown to 198.

Final Report Summary:
Schrage delivered 16 presentations about this project to multiple groups, including: Rocky Mountain Elk Foundation banquets in Duluth and Prior Lake, the Minnesota Sharp-tailed Grouse Society in Hinckley, the Winton Historical Society, staff from the MNDNR's Northwest Region, the Minnesota Soil and Water

Conservation District Forestry Association, the Breckinridge Chapter of the Izaak Walton League, Rocky Mountain Elk Foundation members in the Twin Cities, the Moose Lake Covenant Church Outdoor Expo, the annual meeting of the Minnesota Division of the Izaak Walton League, the Minnesota Forest Resources Partnership, St. Louis County Leaseholders, Northwoods Audubon, MNDNR Region 2 Assistant Wildlife Managers, a joint meeting of Minnesota Forest Industries and MNDNR Forestry, and at a meeting of the St. Louis County Committee of the Whole. McCann and Walberg delivered presentations about the project at the joint meeting of the State Chapters of The Wildlife Society and Society of American Foresters in Duluth, MN. Fulton and McCann delivered presentations about the project at the Western Association of Fish and Wildlife Agencies' Biennial Deer & Elk Workshop in Marfa, TX. This project was featured in the Duluth News Tribune, Pioneer Press, Brainerd Dispatch, the Minnesota Deer Hunters Association publication of "Whitetales", and Outdoor News. Educational displays about elk and this project were set up and staffed by tribal, Rocky Mountain Elk Foundation, University of Minnesota, and volunteer staff at the Carlton County and Minnesota State Fairs. Additionally, Schrage and other tribal personnel staffed booths that highlighted this project at the Minnesota State Fair and a second at the Cloquet Forestry Center's 50th anniversary celebration of their Conservation Education Day event, and Schrage and McCann ran an informational booth for the project at the Outdoor News Deer and Turkey Classic show. We held multiple project meetings that included MNDNR staff. We developed an internet presence, including a website (http://elk.umn.edu) and Facebook page (https://www.facebook.com/NE.MN.elk). Detailed final reports for each Activity were produced and will be provided to MN DNR and other management agencies.

VI. PROJECT BUDGET SUMMARY:

A. ENRTF Budget Overview:

Budget Category	$ Amount	Overview Explanation
Personnel:	$ 281,029	1 project manager at 8%FTE for 3y; 1 postdoc at 100% FTE for 2y; 1 PhD student at 50% FTE for 2 y; 1 lab technician at 8% FTE for 3 y; 2 undergraduate research assistants at 15%FTE for 1y; 4 undergraduate research assistants at 17% FTE for 2y.
Professional/Technical/Service Contracts:	$4,579	Mailing services for survey
Equipment/Tools/Supplies	$3,033	Sample bags, tablets and GPS for data entry, drying oven, and postage
Travel Expenses in MN:	$11,359	Travel to study area by project management staff and technicians 3 months/yr for 2 years; partial room and board for field crew.
Other:	$0	
TOTAL ENRTF BUDGET:	**$300,000**	

Explanation of Use of Classified Staff: NA

Explanation of Capital Expenditures Greater Than $5,000: NA

Number of Full-time Equivalents (FTE) Directly Funded with this ENRTF Appropriation: 4.9

Number of Full-time Equivalents (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation: 0

B. Other Funds:

Source of Funds	$ Amount Proposed	$ Amount Spent	Use of Other Funds
Non-state			

Fond du Lac Band	$15,000	$15,000	internal funding to support survey materials Survey materials (envelopes, paper, printing costs, etc: 12182 surveys $1.25 each)
Fond du Lac Band	$26,400	$26,400	Pending - external funding to support field effort (room and board for field crew, equipment, postage)
Rocky Mountain Elk Foundation	$15,000	$15,000	funding to support survey incentive ($3 / completed survey)
United States Geological Survey	$32,000	$32,000	Salary for Fulton (10% match over two years)
Fond du Lac Band	$27,799	$27,799	Salary for Schrage (10% match)
Fond du Lac Band	$8,736	$8,736	Salary for Howes (3% match)
Fond du Lac Band	$10,500	$10,500	Travel for Schrage and FDL employees for elk research
State			
UMN research funds from Forester	$3,158	$3,158	
UMN foregone Indirect Cost Recovery funding	$137,023	$137,023	52% of direct costs, excluding graduate fringe
TOTAL OTHER FUNDS:	**$275,616**	**$275,616**	

VII. PROJECT STRATEGY:

A. Project Partners:

A research team will be led by scientists from the University of Minnesota Department of Fisheries, Wildlife, and Conservation Biology (Dr. James Forester) and MN Cooperative Fish & Wildlife Research Unit (Dr. David Fulton) and the Fond du Lac Resource Management Division (Mike Schrage and Tom Howes). Forester will oversee the ecological portion of the project while Fulton will take the lead on the public attitude and acceptance survey. We will support a PhD level graduate student and a postdoctoral research associate on this project (advised by Forester and Fulton) and will receive support from the Fond du Lac Band and the Rocky Mountain Elk Foundation. Carlton, St. Louis, and Pine Counties, and the Minnesota Department of Natural Resources are not receiving funding, but are supporting this application and will provide data on forest management and land use. Other local and statewide conservation organizations have written letters of support for conducting this initial feasibility study.

B. Project Impact and Long-term Strategy:

If this study demonstrates there is sufficient public support and suitable habitat, then the next steps in the process for restoring elk to Northeastern Minnesota can be taken. Further, we will develop a research framework that could be applied to other areas of the state where citizens are interested in exploring the feasibility of elk restoration. The proposed work builds on moose research by the MNDNR in NW Minnesota to examine how this species is responding to a variety of landscapes. This study will directly address questions of management concern and will also advance managers' understanding of (1) the strength of public support for an elk restoration in NE Minnesota; (2) where a reintroduced elk population would be most likely to thrive based on the landscape-scale distribution of forage and land cover; and (3) where areas of social support and high-quality elk habitat overlap. Our ongoing collaborations with state, tribal, and federal agencies will ensure that the research results are broadly disseminated and that they will be used to help determine if elk restoration in this area is feasable in the future.

C. Funding History:

Funding Source and Use of Funds	Funding Timeframe	$ Amount
Mike Schrage and Tom Howes from the Fond du Lac Band have	2014-2015	$14,632

given 20 presentations to local county governments and the public on this topic to build initial support for this plan. In addition, Mike has attended 2 Eastern Elk Workshops and traveled to Michigan and Wisconsin to better understand the issues and logistics with restoring elk populations. Funding has come from internal Fond du Lac Band funding sources to cover time and travel expenses.		
		$
		$

IX. VISUAL COMPONENT or MAP(S):

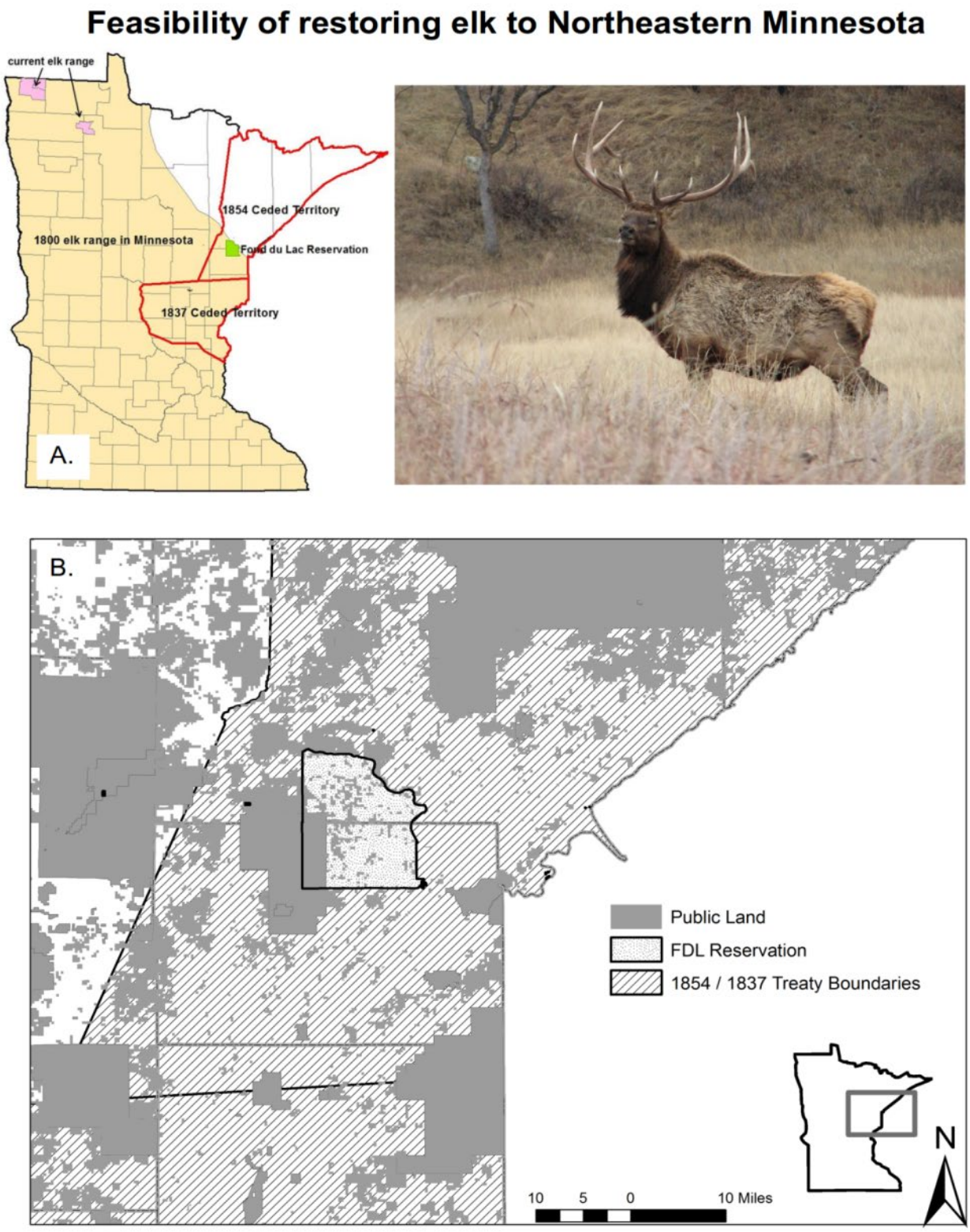

Figure 1: A. Historic and current range of elk in Minnesota. **B.** The proposed study area in Northeastern MN. A combination of public opinion surveys and workshops along with GIS mapping, air photos, and field surveys of habitat characteristics will identify areas with sufficient public support and suitable habitat for restoring an elk population.

X. RESEARCH ADDENDUM: NA

XI. REPORTING REQUIREMENTS:

Periodic work plan status update reports will be submitted no later than 2 December 2016, 30 June 2017, 31 January 2018, 30 June 2018, and 31 January 2019. A final report and associated products will be submitted between June 30 and August 15, 2019.

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

Project Title: Restoration of Elk to Northeastern Minnesota
Legal Citation: M.L. 2016, Chp. 186, Sec. 2, Subd 03l
Project Manager: James D Forester
Organization: University of Minnesota
M.L. 2016 ENRTF Appropriation: $300,000
Project Length and Completion Date: 3 Years, June 30, 2019
Date of Report: 2019-08-16

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Revised Activity 1 Budget 02/26/2019	Amount Spent	Activity 1 Balance	Revised Activity 2 Budget 02/26/2019	Amount Spent	Activity 2 Balance	TOTAL BUDGET	TOTAL BALANCE
BUDGET ITEM								
Personnel (Wages and Benefits)	$137,028	$137,028	$0	$144,001	$144,001	$0	$281,029	$0
Faculty (Forester) - 8%FTE = 1mo summer salary per year over 3yr ($25,519) plus 33.8% fringe ($8,625): will manage project, and take lead on supervise the collection and analysis of elk habitat data (total = $34,144).								
Postdoctoral scholar $22/hr 100% FTE for two years (annually: $45,760 salary, $9,793 fringe; total = $111,106): Will lead field and GIS data collection and analysis efforts, and create final combined suitability map.								
PhD student $21/hr 50% FTE for two years (annually: $21,723 salary, $18,848 fringe and tuition, total = $79,941): Will lead stakeholder engagement survey efforts.								
Undergraduate lab assistants – 3-4 students, working a total of 624h over 1 yr, $15/h: will complete survey mailing and aid graduate students with data entry of survey results (total 30% FTE for 1 yr = $9,360)								
Undergraduate field and lab assistants – 3-4 students, 40h/wk, 10 wks over 2 yr, $15/h: will aid graduate student and postdoc with data collection and entry. (total 70% FTE /yr for 2 years = $43,600)								
Professional/Technical/Service Contracts	$4,579	$4,579	$0				$4,579	$0
Mailing services and postage for surveys (UMN mailing service)								
Equipment/Tools/Supplies	0	$0	$0	$3,033	$3,033	$0	$3,033	$0

field equipment (cloth sample bags 323 x $1.50)								
Tablets for data entry (1 x $250)								
Handheld GPS units (1 x $530)								
Compasses (standard sighting compasses 2 x $45)								
Drying oven (for drying vegetation biomass samples) $2832								
Travel expenses in Minnesota				$11,359	$11,359	$0	$11,359	$0
Travel to study area by project management staff and technicians 3 months/yr for 2 years (1 fleet truck @$818/month, $0.37/mi, 9000 miles/ yr)								
Room and board for field crew (2 yr of summer field sessions, 3 months/yr, 6 crew members at a time, rent @ $1,500/mo, board@$1,240/mo) -- Fond du Lac Band will cover $15,000 of these costs								
COLUMN TOTAL	**$141,607**	**$141,607**	**$0**	**$158,393**	**$158,393**	**$0**	**$300,000**	**$0**