Environment and Natural Resources Trust Fund (ENRTF)
M.L. 2015 Work Plan

Date of Report: October 14, 2014

Date of Next Status Update Report: January 1, 2016

Date of Work Plan Approval:

Project Completion Date: June 30, 2017

Does this submission include an amendment request? _No_

PROJECT TITLE: Genetic and Camera Techniques to Estimate Carnivore Populations

Project Manager: Ron Moen

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Location: Aitkin, Beltrami, Carlton, Cook, Itasca, Koochiching, Lake, St. Louis, statewide

Total ENRTF Project Budget:		
	ENRTF Appropriation:	**$200,000**
	Amount Spent:	**$0**
	Balance:	**$200,000**

Legal Citation: M.L. 2015, Chp. 76, Sec. 2, Subd. 03l

Appropriation Language:
$200,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota – Duluth for the Natural Resources Research Institute to use genetic sampling and remote cameras to improve monitoring of distributions and estimate population sizes of carnivore species.

I. PROJECT TITLE: Genetic and Camera Techniques to Estimate Carnivore Populations

II. PROJECT STATEMENT:

Minnesota has 17 carnivore species which are more common, and 3 other species which are very rare or only occasional visitors. The carnivore species in Minnesota range in size from the tiny least weasel to the black bear. Species with high harvest levels such as bobcat, fisher, marten, and coyote are tracked well, while there is much less known about species with lower harvest levels such as badgers. Some carnivore species such as the coyote, mink, black bear, and raccoon are common throughout much or all of Minnesota. Other species are either at the extreme edge of their distribution or are only known from historical accounts or recent occasional reports. Relatively little is known about these rarer species.

Current methods for monitoring carnivores are the summer scent station survey, a winter track survey, and population modelling from harvest data. While these methods are useful, other techniques have been developed for monitoring carnivores over the past 20 years that could be tested in Minnesota. Namely, the development of genetic DNA analysis and increasing use of trail cameras make it possible to improve existing methods of monitoring distribution and numbers of carnivores. Trail cameras would also provide a mechanism for significant public involvement with future development of a citizen science component.

There are many reasons why it would be beneficial to increase monitoring of carnivores and improve understanding of current distributions. One benefit of increased carnivore monitoring would be an independent estimate of wolf populations in Minnesota. Wolves were removed from U.S. Endangered Species Act protection in January 2012, and species management was transferred to the DNR. Regulated hunting and trapping seasons for wolves were held in 2012, 2013, and 2014. In December 2014 a court ruling placed wolves back under Endangered Species Act protection. This ruling is currently being appealed. Regardless of the outcome of the appeal, future wolf management will require accurate population estimates. An accurate estimate of wolf numbers will also be useful for considering effects wolves might be having on other species (e.g., moose and deer). Independent estimates using either camera trap or genetic mark-recapture testing could help wolf management.

Additionally, wildlife diseases are also of growing concern, especially in urban areas where there is an increased potential for transmission of diseases to humans and domestic animals. Some of the diseases that can be transmitted from wildlife to humans or companion animals include canine distemper, canine heartworm, sarcoptic mange, leptospirosis, erlichiosis, and canine parvovirus. Other diseases also affect humans and domestic animals. These diseases could be of increasing concern in the future, in part because generalist carnivore species such as coyotes, raccoons, and skunks appear to thrive in urban areas.

The specific goals of this proposal for carnivore populations in Minnesota are to:

1. Develop a remote camera based protocol for occupancy modelling and for independent estimates of census population size if applicable to a species.
2. Develop a genetic sample collection and analysis protocol to estimate genetic effective population size for carnivore species. We will also make genetic mark-recapture estimates of census population size when applicable to a species.
3. Review historical trends in distribution and abundance of Minnesota carnivores from museum records and DNR data.

III. OVERALL PROJECT STATUS UPDATES:

Project Status as of December 31, 2015:
Project Status as of June 30, 2016:
Project Status as of December 31, 2016:

Project Status as of June 30, 2017:
Overall Project Outcomes and Results:

IV. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1: Determine Population Sizes of Carnivores
Description: Activity 1 will be divided into three steps.

First, we will develop a protocol for field collection of samples for DNA extraction and analysis from several carnivore species, in addition to using samples already available for some species. The protocol will identify three different groups of carnivores which break down somewhat into small, medium, and large body sizes. We will vary detection methods for each group to account for differences in average home-range size.

The second step in determining the population sizes of carnivores will be to conduct genetic surveys in a non-invasive manner. This method is especially effective at monitoring species that are difficult or expensive to monitor using other methods such as radio-telemetry. Studies involving non-invasive genetic sampling usually acquire DNA from hair or scat (feces) that are collected systematically or opportunistically throughout a study area. This genetic material can be used to determine the species, gender, and individual identity of its source. We will collect both scat and hair samples throughout the study area.

Samples collected will be analyzed genetically and then statistical analyses will enable us to estimate genetic effective and census population sizes. The genetic effective population size is an important measure of the amount of genetic variation in a species, as species with large census population sizes may still have low genetic variation. In addition, genetic data sampled throughout species' ranges in the state will allow us to infer patterns of migration and dispersal by tracking the spread of genetic variants.

Genetic and camera-based estimates of population size will provide complementary information about the status of each species in Minnesota. Pictures of carnivores will enable us to estimate population size and perform occupancy modeling. Museum records, harvest records, DNA data, and other reports will be used to estimate species distributions and abundances across time, providing a comprehensive picture of MN carnivore species population sizes and trends from a genetic and organismal perspective.

Summary Budget Information for Activity 1:

ENRTF Budget:	**$ 200,000**
Amount Spent:	**$ 0**
Balance:	**$ 200,000**

Outcome	Completion Date
1. Genetic estimate of wolf population size from mark-recapture in Year 1	December 31, 2016
2. Population size estimate from mark-recapture completed for selected carnivores	March 15, 2017
3. Genetic effective population size and dispersal events identified for selected carnivores	March 15, 2017
4. Report summarizing census and genetic effective population size estimates and trends	June 30, 2017

Activity Status as of December 31, 2015:
Activity Status as of June 30, 2016:
Activity Status as of December 31, 2016:
Activity Status as of June 30, 2017:

Final Report Summary:

V. DISSEMINATION:

Description: We will create a website to distribute information to the public, but this will be done after the project starts. The website will be modelled after other websites we maintain (e.g., www.nrri.umn.edu/moose).

In addition, we will also prepare and submit papers for publication in peer-reviewed journals, and present our results at regional and national scientific meetings (using other funds for travel outside of Minnesota). All genetic data will be submitted to the Dryad Digital Repository (http://datadryad.org/), a freely accessible non-profit database, upon publication.

We will also probably have periodic contact with print and broadcast media, given the nature of the project.

Status as of December 31, 2015:
Status as of June 30, 2016:
Status as of December 31, 2016:
Status as of June 30, 2017:

Final Report Summary:

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

Budget Category	$ Amount	Overview Explanation
Personnel:	$ 149,225	1 project manager (66.4% salary, 33.6% benefits) at 6% FTE each year for 2 years; 1 co-investigator (66.4% salary, 33.6% benefits) at 8% FTE for 2 years; 1 field and lab technician (63.2% salary, 36.8% benefits)at 25% FTE each year for 2 years; 1 graduate research assistant (AY-84.3% salary, 15.7% benefits, and $17.32/hr tuition reimbursement cost; SUM-76.9% salary, 23.1% benefits, no tuition costs) at 50% FTE (academic year)and 50% FTE (summer) each year for 2 years; and 1 undergraduate research assistant (100% salary, 0% benefits)at 50% FTE each year for 2 years. Allocation of effort among personnel categories are estimates that may be adjusted to best meet project objectives.
Professional/Technical/Service Contracts:	$ 0	n/a
Equipment/Tools/Supplies:	$ 33,850	Trail cameras, genetic analysis supplies, and field supplies such as batteries, mosquito repellent, and flagging
Capital Expenditures over $5,000:	$ 0	n/a
Fee Title Acquisition:	$ 0	n/a
Easement Acquisition:	$ 0	n/a
Professional Services for Acquisition:	$ 0	n/a
Printing:	$ 0	n/a
Travel Expenses in MN:	$ 16,925	In-state travel to/from field sites to deploy and maintain cameras and collect material for genetic analysis
Other:	$ 0	n/a
TOTAL ENRTF BUDGET:	**$ 200,000**	

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: 4.6 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
Non-state			
Ron Moen salary/fringe (cost-share)	$ 6,450	$ 0	
State			
J. Strasburg salary/fringe (cost-share)	$ 6,450	$ 0	
Foregone by UMN ICR funding	$ 88,600	$ 0	52% indirect costs (excluding graduate fringe)
TOTAL OTHER FUNDS:	**$ 101,500**	**$ 0**	

VII. PROJECT STRATEGY:

A. Project Partners:

Other individuals will assist or provide advice on parts of this project.

Dr. John Erb (MN DNR) will provide input and some samples, with an intent to make long-term use of techniques developed in this proposal for DNR management purposes.

Dr. Steve Windels (Voyageurs National Park) will cooperate on the trail camera project and genetic sampling. He already has cameras deployed to test a mark-recapture method of estimating presence and abundance of carnivores in Voyageurs.

B. Project Impact and Long-term Strategy:

Our long term strategy is to develop the ability to do genetic analysis of wildlife populations in Minnesota with in-house expertise. Specific applications will vary from an independent estimate of wolf population size to pro-active preparation for future wildlife issues. For example, wildlife diseases and parasites may become important if they are transmitted to humans or companion animals like dogs and cats.

We envision this as a project to develop techniques that we will initially focus on carnivore species in northeastern Minnesota. As techniques are successfully developed, we will expand to other parts of the state. Over the long-term, a genetic approach should decrease uncertainty in population estimates and even enable analysis of trends over time.

C. Funding History:

Funding Source and Use of Funds	Funding Timeframe	$ Amount
We have been developing the genetics and the field sampling components of this project over the past 2 years. Wolf scat and tissue samples from DNR wolf collar program are being analyzed genetically by an M.S. student co-advised by	2011 to Present	$10,000 estimated.

Strasburg and Moen, and we have hundreds of thousands of trail camera images that can be used as a resource from past research.		
ENRTF – M.L. 2013, Ch. 52, Sec. 2, Subd. 04g. This project on moose browsing habitat is totally unrelated to the Carnivore project in this work plan.	July 1, 2013 – June 30, 2016	$ 200,000
		$ 200,000

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):

X. RESEARCH ADDENDUM:

See attached Research addendum.

XI. REPORTING REQUIREMENTS:

Periodic work plan status update reports will be submitted no later than December 31, 2015, June 30 2016, and December 2016. A final report and associated products will be submitted between June 30 and August 15, 2017.

Environment and Natural Resources Trust Fund
M.L. 2015 Project Budget

Project Title: Genetic and Camera Techniques to Estimate Carnivore Populations
Legal Citation: M.L. 2015, Chp. 76, Sec. 2, Subd. 03l
Project Manager: Ron Moen
Organization: Natural Resources Research Institute, University of Minnesota Duluth
M.L. 2015 ENRTF Appropriation: $ 200,000
Project Length and Completion Date: 2 years, June 30, 2017
Date of Report: October 15, 2014

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Activity 1 Budget	Amount Spent	Activity 1 Balance	TOTAL BUDGET	TOTAL BALANCE
BUDGET ITEM	**Determine Population Sizes of Carnivores.**				
Personnel (Wages and Benefits) Overall	$149,225	$0	$149,225	$149,225	$149,225
Project Manager: (66.4% salary, 33.6% benefits); 6% FTE each year for 2 years. Est. total $10,945					
Co-Investigator: (66.4% salary, 33.6% benefits); 8% FTE each year for 2 years. Est. total $10,985					
Field & Lab Technician: $32,000 (63.2% salary, 36.8% benefits); 25% FTE each year for 2 years. Est. total $19,945					
Graduate Research Assistant: $46,000 (84.3% salary, 15.7% benefits, and $17.32/hr tuition reimbursement cost; summer-76.9% salary, 23.1% benefits, no tuition costs); Academic Year-50% FTE, Summer-50% FTE each year for 2 years. Est. total $83,880					
Undergraduate Research Assistant: $20,800 (100% salary, 0% benefits); Academic Year-50% FTE, and Summer-50% FTE each year for 2 years. Est. total $23,470					
Equipment/Tools/Supplies					
Trail cameras (20 estimated @ $339 each), purchased in year 1	$6,770	$0	$6,770	$6,770	$6,770
Genetic analysis supplies ($12,694 per year)	$25,388	$0	$25,388	$25,388	$25,388
Field supplies ($846 per year) (Batteries, mosquito repellent, flagging, etc.)	$1,692	$0	$1,692	$1,692	$1,692
Travel expenses in Minnesota					
In-state travel to/from field sites ($10,000 per year). Cameras will need to be deployed and maintained at sites in NE Minnesota and material will be collected for genetic analysis, requiring the use of University vehicles. Some trips will involve longer-distance travel and require overnight expenses (camping or motel) and food expenses.	$16,925	$0	$16,925	$16,925	$16,925
COLUMN TOTAL	**$200,000**	**$0**	**$200,000**	**$200,000**	**$200,000**