



Environment and Natural Resources Trust Fund

M.L. 2025 Approved Work Plan

General Information

ID Number: 2025-309

Staff Lead: Mike Campana

Date this document submitted to LCCMR: June 11, 2025

Project Title: Recruitment and Fecundity of Minnesota Moose

Project Budget: \$2,007,000

Project Manager Information

Name: Michelle Carstensen

Organization: MN DNR - Fish and Wildlife Division

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Project Reporting

Date Work Plan Approved by LCCMR: June 24, 2025

Reporting Schedule: March 1 / September 1 of each year.

Project Completion: June 30, 2031

Final Report Due Date: August 14, 2031

Legal Information

Legal Citation: M.L. 2025, First Special Session, Chp. 1, Art. 2, Sec. 2, Subd. 03gg

Appropriation Language: \$2,007,000 the first year is from the trust fund to the commissioner of natural resources for state and Tribal biologists to work collaboratively to estimate survival and fecundity of yearling and 2-year-old moose in northeast Minnesota to inform future management efforts. Of this amount, \$841,000 is for an agreement with the 1854 Treaty Authority. This appropriation is available until June 30, 2031, by which time the project must be completed and final products delivered.

Appropriation End Date: June 30, 2031

Narrative

Project Summary: Through a co-stewardship research project, state and tribal biologists will work collaboratively to estimate survival and fecundity of yearling and 2-year-old moose in northeast Minnesota to inform future management efforts.

Describe the opportunity or problem your proposal seeks to address. Include any relevant background information.

Mooz, the Ojibwe term for moose or “twig eater”, are vital to Indigenous rights-holders and stakeholders within the 1854 Ceded Territory in which three Ojibwe tribes have reserved rights to hunt, fish, and gather in what is now known as Minnesota. The population of moose in northeast Minnesota is half of what it was 20 years ago. Climate change may be the ultimate driver for the moose population decline; however, mechanisms driving the moose decline in Minnesota include winter ticks (*Dermacentor albipictus*), infection by brainworm (*Parelaphostrongylus tenuis*) with resultant paralysis and nutritional deficiency, and wolf (*Canis lupus*) predation. Recent studies to understand the factors affecting moose populations have collected data on adult and neonatal moose (see graphic). The proposed research project focuses on moose that would give birth at 2-years and 3-years old, when moose begin producing calves. Pilot research by the Grand Portage Band of Chippewa has indicated that moose can be captured and collared safely and successfully during their first winter (at 8-9 months old) and monitored for survival, habitat use, and causes of mortality. We propose to expand this work to the rest of core moose range in northeastern Minnesota (see map in graphic).

What is your proposed solution to the problem or opportunity discussed above? Introduce us to the work you are seeking funding to do. You will be asked to expand on this proposed solution in Activities & Milestones.

Using a co-stewardship framework with State and Tribal project leads, we will investigate recruitment of young moose (1 to 3-year-olds) into the breeding population by determining survival rates and age of first reproduction. Results will help identify habitat and wildlife management strategies that can be used to restore the moose population in Minnesota.

- 1: We will deploy GPS collars on 8- to 9-month-old moose across northeastern Minnesota moose range to measure survival rates, cause-specific mortality, and habitat use over a five-year period.
- 2: We will use non-invasive sampling techniques (fecal pellet collection) to determine age of first pregnancy for collared female moose.
- 3: We will use GPS collar data and aerial thermal surveys to determine parturition rates (percentage of moose giving birth), fecundity (number of calves born), and calf survival for 2 and 3-year-old female moose.

What are the specific project outcomes as they relate to the public purpose of protection, conservation, preservation, and enhancement of the state’s natural resources?

To identify how yearling and 2-year-old moose contribute to restoring the moose population in Minnesota, we need survival rates, birth rates, and habitat use of these age classes. Results from this study will identify when female moose begin calving, indicate habitats that are related to survival and reproduction of yearling and 2-year-old moose (and their calves), identify cause-specific mortality, and identify how best to manage the species that affect moose (deer, wolves, and black bears). Further, if pregnancy rates vary across moose range, this may identify areas where forest management could potentially have the greatest positive impact on moose reproduction.

Project Location

What is the best scale for describing where your work will take place?

Region(s): NE

What is the best scale to describe the area impacted by your work?

Statewide

When will the work impact occur?

In the Future

Activities and Milestones

Activity 1: Estimate survival and recruitment rates of moose from 8 months to 3.3 years old across northeast Minnesota.

Activity Budget: \$1,586,067

Activity Description:

1854 Treaty Authority will contract with a helicopter capture company to capture and collar 80 eight-month-old moose (20 males, 60 females) each January for three years. Capture effort will be dispersed throughout core moose range (see graphic). DNR and 1854 Treaty Authority will collect biological samples at capture to assess overall health, parasite exposure (especially winter ticks), and morphological measurements to estimate body mass. GPS collars will be equipped with mortality sensors and will send mortality notifications via satellite. DNR and 1854 Treaty Authority will monitor all collared moose for survival from capture to 3.3 years old and investigate mortalities to determine cause of death. Both agencies will work together to include survival and recruitment rates in moose population models to increase accuracy of population trend estimates and identify how various management strategies may impact population performance. UMN will use GPS locations from collared moose to calculate home range size and habitat use on an annual and seasonal basis and assess if young moose use the forest differently than previous information on adult moose, which may help to direct forest management enhancements for younger moose. (DNR = \$766,067 and 1854TA = \$820,000 of Activity 1)

Activity Milestones:

Description	Approximate Completion Date
Capture and collar 8-month-old female and male moose (Jan-March 2026, 2027, and 2028)	March 31, 2028
Evaluate health of moose at capture	March 31, 2028
Monitor moose movement and survival	September 30, 2030
Investigate mortalities through field necropsy or carcass extraction	September 30, 2030
Determine cause of death, parasite loads, and other health issues	September 30, 2030
Update vital rates in moose models, analyze all data	September 30, 2030
Assess home range size and habitat use on an annual and seasonal basis	September 30, 2030
Interpret results and begin manuscripts	December 31, 2030

Activity 2: Determine pregnancy rates for 1.5 and 2.5-year old moose

Activity Budget: \$35,325

Activity Description:

1854 Treaty Authority and DNR will use a non-invasive field technique to determine pregnancy rate of females and determine age of first reproduction. Fecal pellets will be collected from collared females during winter. 1854 Treaty Authority will send fecal samples to the Smithsonian Conservation Biology Institute (Fort Royal, VA) for progesterone analyses to determine pregnancy status. 1854 Treaty Authority will confirm fecal collections were obtained from the collared moose, by requesting a DNA match be performed at the University of Minnesota-Duluth using a reference sample from each moose's original capture. Pregnancy is an important vital rate that serves as an indicator of adequate nutritional condition in moose; thus, improving our ability to determine if forage availability or quality may be limiting population growth in northeast Minnesota. (DNR = \$15,125 and 1854TA = \$20,200 of Activity 2 budget)

Activity Milestones:

Description	Approximate Completion Date
Collect feces from collared females during each winter to determine yearling pregnancy rate	March 31, 2030

Determine fecal progesterone levels to indicate pregnancy	March 31, 2030
Match DNA samples to verify individual moose	March 31, 2030
Update vital rates in moose models, analyze data	August 31, 2030

Activity 3: Determine fecundity of 2 and 3-year-old female moose and calf survival

Activity Budget: \$385,608

Activity Description:

All collared female moose that were pregnant (determined in Activity 2) will be monitored by DNR, 1854 Treaty Authority, and University of Minnesota-Duluth for movements indicative of calving in May. This would be the first set of calves produced by these cows, at 2 or 3 years of age. Abrupt changes in movement/behavior patterns predict the occurrence of calving. However, these techniques alone cannot determine the number of calves produced by each pregnant female. DNR will use aerial thermal flights as a non-invasive method to confirm calving has occurred and determine the number of calves produced by each female moose. Given this technique is novel, DNR will plan to fly all female moose surviving to 2 and 3 years of age to reduce uncertainty in our fecundity estimates. All females that successfully produced at least one calf will have a secondary aerial thermal flight after leaf-off to estimate calf survival rates. (DNR = \$385,608 of Activity 3 budget)

Activity Milestones:

Description	Approximate Completion Date
Intensely monitor females for calving movements	June 30, 2030
Conduct aerial thermal flights to determine fecundity	June 30, 2030
Analyze fecundity data	August 31, 2030
Conduct aerial thermal flights to determine calf survival	December 31, 2030
Analyze calf survival data	December 31, 2030
Interpret results and begin manuscripts	December 31, 2030

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Morgan Swingen	1854 Treaty Authority	Co-Project Manager; project leadership and fiscal management in a co-stewardship framework with DNR; lead moose capture and collaring operations, coordinate field work, respond to moose mortalities, and assist with manuscripts	Yes
Dr. Ron Moen	University of Minnesota - Duluth	Advise on project design, administer graduate student, model moose population, and assist with manuscripts	Yes
Dr. Seth Moore	Grand Portage Band of Lake Superior Chippewa	Advise on project design and data collection, assist with manuscripts, and provide in-kind research effort.	No
Dr. Janine Brown	Smithsonian Conservation Biology Institute	Analyze fecal samples for progesterone to determine pregnancy status of moose	Yes
Dr. Arno Wuenschmann	Minnesota Veterinary Diagnostic Laboratory	Train project team on field necropsy techniques, perform all diagnostics from biological samples of moose collected both at capture and death	Yes
Dr. Sergey Berg	University of St. Thomas	Provide consultation of moose model parameters and statistical methods	No
Dr. Michelle Verant	National Park Service	Provide wildlife veterinary consultation for moose capture operations	No
Tom Irvine	National Parks of Lake Superior Foundation	Hosting the moose biologist position to support field work for the project	Yes

Dissemination

Describe your plans for dissemination, presentation, documentation, or sharing of data, results, samples, physical collections, and other products and how they will follow ENRTF Acknowledgement Requirements and Guidelines.

Prior to the first moose captures, press releases and social media platforms will be utilized to announce the start of the study and clearly describe its goals and outcomes. Local and state media will be invited to a "media day" during moose captures to interview project staff and observe operations. A webpage will be co-created and housed by 1854 Treaty Authority to provide ongoing project updates through the life of the study. Project leads will provide written and oral updates through scientific meetings (local, regional, and national platforms), conservation organizations, tribal networks, and invited public venues. Technical reports will be provided to internal and external partners. Posters with project highlights will be available at the DNR building at the MN State Fair and county fairs within core moose range. At the end of the study, the findings will be summarized into several scientific publications in peer-reviewed journals, including the Journal of Wildlife Management, Wildlife Society Bulletin, Alces, and others. The Environment and Natural Resources Trust Fund will be acknowledged through use of the trust fund logo or attribution language on project print and electronic media, publications, signage, and other communications per the ENRTF Acknowledgment Guidelines.

Long-Term Implementation and Funding

Describe how the results will be implemented and how any ongoing effort will be funded. If not already addressed as part of the project, how will findings, results, and products developed be implemented after project completion? If additional work is needed, how will this work be funded?

Data we collect on survival and reproduction of young moose will be directly applied to management questions, such as effective types and areas for habitat management and management of parasites and predators. In addition to informing management, we will pursue additional funding (Tribal Wildlife Grants, GLRI, internal DNR funding, America the Beautiful Challenge) to recollar moose at the end of this project. Known-age moose are valuable to inform ongoing population modeling work. Funding for this project could be used as match in other proposals, and recollaring known moose would greatly decrease time and cost required when additional funding is received.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
Personnel								
2 DNR Field Staff (DNR Cost)		On-call pay for weekend and holiday support for a maximum of 2 DNR staff to monitor moose for mortality events and conduct timely investigations			40%	0.9		\$59,193
							Sub Total	\$59,193
Contracts and Services								
Minnesota DNR Enforcement Division	Internal services or fees (uncommon)	Aviation support for moose captures (\$360/hr for locating moose, 40 hours each year, 3 years = \$43,200) and thermal imaging flights (\$425/hr for locating calves in May and Dec each year, 80 hours annually, 3 years = \$102,000) (DNR cost)				0		\$145,200
HeliWild LLC	Service Contract	A helicopter capture company will capture and collar 80 moose per year for 3 years, at \$1,300/moose (1854 TA cost)				0		\$312,000
Smithsonian Conservation Biology Institute	Service Contract	Provide laboratory services for pregnancy testing via fecal progesterone (\$25/sample, 300 samples over 4 years (1854TA cost). Smithsonian Institute, while outside of Minnesota, is the only lab in the US that offers this type of biological testing for wildlife samples.		X		0		\$7,500
University of Minnesota-Duluth	Service Contract	Conduct genetic testing of fecal samples (\$42.50/each, 300 samples over 4 years) to ensure the correct collared moose was tested for pregnancy status (1854TA cost)				0		\$12,750
University of Minnesota, Veterinary Diagnostic Lab	Service Contract	Conduct necropsies of collared moose to determine cause of death and pathogen or parasite exposures (\$250/each, 40 moose/year, 5 years) (DNR cost)				0		\$50,000
University of Minnesota, Clinical Pathology Laboratory	Service Contract	Analyze serum chemistries and blood profiles of moose at capture to determine their health status (\$200/each, 80 moose/year, 3 years) (DNR cost)				0		\$48,000

University of Minnesota-Duluth:	Subaward	PhD student for fieldwork, data analyses, manuscript preparation (\$191,206, 5 years); 5% faculty support (\$29,602, 5 years); travel expenses (fleet usage and meals/hotel) at \$26,800 for 5 years), and snowmobile/ATV rental fees at \$36,000 for 5 years.				5.25		\$283,608
National Parks of Lake Superior Foundation	Subaward	The National Parks of Lake Superior Foundation will host a moose field biologist position to support capture operations, coordinate mortality investigations, assist technicians and grad student with field work, monitor moose movement data (50% FTE moose field biologist; \$33,011/yr +\$13,666 fridge per year for 5 years).				2.5		\$233,385
							Sub Total	\$1,092,443
Equipment, Tools, and Supplies								
	Equipment	GPS collars for 80 moose/year at \$1,880/each for 20 males and \$2,200/each for 60 females, for 3 years (1854TA cost)	Monitoring movements of moose for survival, calving, and investigating cause of death					\$508,800
	Equipment	Data subscription and transmission fees for 240 collars (DNR cost)	GPS collar fees: activation fee of \$30/each = \$7,200; data fees of \$24/collar and transmission fees of \$284.70/year for an estimate of 80, 140, 200, 160, 120 active collars over 5 years, respectively = \$160,055					\$167,255
	Tools and Supplies	Capture supplies, immobilization drugs, and biological sampling supplies (DNR cost)	Chemically immobilize moose during capture operations, uniquely mark individuals, collect samples to assess health and genetics					\$26,986
	Tools and Supplies	Necropsy supplies, fecal collection materials (DNR cost)	Supplies to conduct field necropsies in remote locations and collect biological samples to determine cause of death and health status of individual moose, sampling materials for fecal collections to determine pregnancy and genetic matches					\$22,500
							Sub Total	\$725,541
Capital Expenditures								

							Sub Total	-
Acquisitions and Stewardship								
							Sub Total	-
Travel In Minnesota								
	Miles/ Meals/ Lodging	Fleet costs for project team (1 vehicle at 18,000, 5 years and 1 at 10,000 miles for 4.5 years @ \$0.67/mi) (DNR cost)	Travel to conduct moose capture operations, respond to mortalities and collect biological samples or transport carcasses to the laboratory					\$90,450
	Miles/ Meals/ Lodging	Lodging and meals for project team during field deployments (DNR cost)	Project team will be deployed during moose capture operations and mortality responses that will require overnight lodging and meal reimbursements					\$24,000
							Sub Total	\$114,450
Travel Outside Minnesota								
							Sub Total	-
Printing and Publication								
							Sub Total	-
Other Expenses								
		Direct and Necessary Costs (only applies to DNR portion of the funding)	HR Support (\$2,167), Safety Support (\$304), Financial Support (\$4,384), Communication Support (\$1,528), IT Support (\$5,852), and Planning Support (\$1,137).					\$15,373
							Sub Total	\$15,373
							Grand Total	\$2,007,000

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
Contracts and Services - Smithsonian Conservation Biology Institute	Service Contract	Provide laboratory services for pregnancy testing via fecal progesterone (\$25/sample, 300 samples over 4 years (1854TA cost). Smithsonian Institute, while outside of Minnesota, is the only lab in the US that offers this type of biological testing for wildlife samples.	Provide laboratory services for pregnancy testing via fecal progesterone (\$25/sample, 300 samples over 4 years (1854TA cost). Smithsonian Institute, while outside of Minnesota, is the only lab in the US that offers this type of biological testing for wildlife samples.

Non ENRTF Funds

Category	Specific Source	Use	Status	\$ Amount
State				
In-Kind	Game and Fish Fund	Minnesota DNR Wildlife Health Program: Dr. Michelle Carstensen, project management, fieldwork, data analysis, writing, outreach, supervising graduate student; 60 mos, 50% effort	Secured	\$262,500
In-Kind	Game and Fish Fund	Minnesota DNR staff support for capture operations and on-call mortalities responses, 8-12 staff, 60 mos, 5% effort	Secured	\$150,000
			State Sub Total	\$412,500
Non-State				
In-Kind	Tribal	1854 Treaty Authority: Morgan Swingen, project management, fieldwork, data analysis, writing, outreach, supervising technicians & graduate student; 60 mos, 20% effort; 2 technicians to support fecal collections and mortality responses over winter (\$186,062 salary and \$20,100 in fleet)	Secured	\$299,912
In-Kind	Natural Resources Research Institute	University of Minnesota-Duluth, Natural Resources Research Institute: Unrecovered indirect costs (55% of total direct costs) for faculty and student support and administrative services	Secured	\$140,724
In-Kind	Tribal	Grand Portage Band of Lake Superior Chippewa: Dr. Seth Moore, project management, field work; 60 mos, 5% effort (\$35,000), matching moose capture and monitoring project on reservation lands and ceded territories of 10 juvenile/year (\$102,000 in collar fees, \$39,000 in capture costs, \$15,000 for immobilization drugs, and \$67,500 in tribal staff effort for monitoring and mortality investigations; 3 years); 50% FTE moose field biologist (50% FTE moose field biologist; \$33,011/yr + \$13,666 fridge, 5 years = \$233,385).	Secured	\$491,885
			Non State Sub Total	\$932,521
			Funds Total	\$1,345,021

Total Project Cost: \$3,352,021

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: [6c2d3ac9-559.pdf](#)

Alternate Text for Visual Component

This visual highlights the knowledge gap of information related to survival, pregnancy, fecundity, and causes of mortality for moose between 8 months of age and 3 years old. A map displays northeast Minnesota and highlights core moose range where this study will take place....

Supplemental Attachments

Capital Project Questionnaire, Budget Supplements, Support Letter, Photos, Media, Other

Title	File
1854 Treaty Authority Authorization Letter	c188d1c2-114.pdf
Grand Portage Commitment Letter	0c0f2731-5c3.pdf
NRRI Letter of Support	fa6cb516-fca.pdf
2025-309 Research Addendum revised_final	18136ff8-04a.pdf

Difference between Proposal and Work Plan

Describe changes from Proposal to Work Plan Stage

In order to meet the reduced funding, we removed the hiring of 2 natural resource technicians (6-month positions) to support fecal collections, capture operations and mortality responses and their associated needs for travel. Instead, 1854 Treaty Authority will utilize in-kind resources to provide additional field support to ensure project needs are met. We removed the serologic testing for *P. Tenuis* with the University of TN from the project. We increased slightly the expected costs for female collars, following recent conversation with collar companies about battery life, and capture supplies due to increasing costs for immobilization drugs. Lastly, we reduced the Moose Field Biologist support from 100% to 50% FTE by recruiting the National Parks of Lake Superior Foundation to host the position, with the remaining 50% of that position coming from in-kind support from the Grand Portage Band. Within each budget item, we indicated whether it was a DNR or 1854TA cost; thus, the total appropriation to DNR would be \$1,165,950 and to 1854 Treaty Authority \$841,050.

Additional Acknowledgements and Conditions:

The following are acknowledgements and conditions beyond those already included in the above workplan:

Do you understand and acknowledge the ENRTF repayment requirements if the use of capital equipment changes?

N/A

Do you understand that travel expenses are only approved if they follow the "Commissioner's Plan" promulgated by the Commissioner of Management of Budget or, for University of Minnesota projects, the University of Minnesota plan?

Yes, I understand the Commissioner's Plan applies.

Does your project have potential for royalties, copyrights, patents, sale of products and assets, or revenue generation?

No

Do you understand and acknowledge IP and revenue-return and sharing requirements in 116P.10?

N/A

Do you wish to request reinvestment of any revenues into your project instead of returning revenue to the ENRTF?

N/A

Does your project include original, hypothesis-driven research?

Yes

Does the organization have a fiscal agent for this project?

No

Does your project include the pre-design, design, construction, or renovation of a building, trail, campground, or other fixed capital asset costing \$10,000 or more or large-scale stream or wetland restoration?

No

Do you propose using an appropriation from the Environment and Natural Resources Trust Fund to conduct a project that provides children's services (as defined in Minnesota Statutes section 299C.61 Subd.7 as "the provision of care, treatment, education, training, instruction, or recreation to children")?

No

Provide the name(s) and organization(s) of additional individuals assisting in the completion of this project:

Morgan Swingen (1854 Treaty Authority), Seth Moore (Grand Portage Band of Lake Superior Chippewa), Ron Moen (University of MN-Duluth)

Do you understand that a named service contract does not constitute a funder-designated subrecipient or approval of a sole-source contract? In other words, a service contract entity is only approved if it has been selected according to the contracting rules identified in state law and policy for organizations that receive ENRTF funds through direct appropriations, or in the DNR's reimbursement manual for non-state organizations. These rules may include competitive bidding and prevailing wage requirements

Yes, I understand