



# Environment and Natural Resources Trust Fund

M.L. 2023 Approved Work Plan

## General Information

**ID Number:** 2023-183

**Staff Lead:** Corrie Layfield

**Date this document submitted to LCCMR:** May 30, 2023

**Project Title:** Mapping the Ecology of Urban and Rural Canids

**Project Budget:** \$601,000

## Project Manager Information

**Name:** James Forester

**Organization:** U of MN - College of Food, Agricultural and Natural Resource Sciences

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## Project Reporting

**Date Work Plan Approved by LCCMR:** June 22, 2023

**Reporting Schedule:** April 1 / October 1 of each year.

**Project Completion:** June 30, 2026

**Final Report Due Date:** August 14, 2026

## Legal Information

**Legal Citation:** M.L. 2023, Chp. 60, Art. 2, Sec. 2, Subd. 03I

**Appropriation Language:** \$601,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota to determine how disease prevalence, diet, habitat use, and interspecies interactions of coyotes and foxes change from urban to rural areas along the Mississippi River corridor.

**Appropriation End Date:** June 30, 2026

## Narrative

**Project Summary:** We will determine how disease prevalence, diet, habitat use, and inter-species interactions of coyote and red fox populations change from urban to rural areas along the Mississippi River corridor.

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

Foxes and coyotes are becoming increasingly common in backyards and parks throughout Minnesota. The Twin Cities Coyote and Fox Project (TCCFP), funded by the Environment and Natural Resources Trust Fund in 2019, has begun to uncover how these predators interact with each other and humans in the Metro Area. As part of our community outreach program, we have received dozens of reports of foxes establishing dens close to houses and even under decks. Our results suggest that foxes may be attracted to higher-density human areas as they seek refuge from coyotes (coyotes kill foxes but gravitate towards areas with fewer humans). Unfortunately, foxes and coyotes in the most urban areas of the Metro are frequently spotted with mange—several study animals even died from this disease. Do these animals change how they perceive risk as human densities increase and does this increase disease risks to humans or their pets? Do animals use the Mississippi River as a movement corridor and thus transmit diseases between urban and rural populations? Our current study is producing baseline data on urban canid disease and movement ecology; here we will leverage our experience and expand to include urban and rural areas outside of the Metro.

**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.**

We will expand our current research northwest along the Mississippi River towards St. Cloud, and will ask three overarching questions:

- 1) Are red fox and coyote populations between the Metro and St. Cloud linked by movement along the Mississippi River corridor and do these animals change their movement behavior or diet as they move from urban to rural areas?
- 2) How does the level of human activity (i.e., the level of urbanization) affect the fine-scale behavioral responses of coyotes and foxes to competitors of the same species, predators, and humans?
- 3) Does the prevalence of diseases change between urban and rural canid populations and do diseased animals change their diet or behavior?

Our continued effort to map patterns of habitat use, diet, and disease prevalence of canid populations will help managers reduce human-wildlife conflicts and inform efforts to manage natural areas throughout the state. Further, because many Minnesotans know little of the wildlife that lives near them, we will continue working with the Three Rivers Parks District and a diverse coalition of non-profit organizations to provide outreach and education opportunities. Our research and outreach activities will help influence public perceptions and management of these native wildlife species across Minnesota.

**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?**

This project will increase the understanding of wildlife managers and the general public in Minnesota about how landscape change due to urbanization impacts interactions among coyotes, red foxes, and humans. This research will also determine whether the prevalence of wildlife diseases, like mange and distemper, vary across this wider urban to rural gradient. By better understanding the role that humans play in shaping important aspects of red fox and coyote ecology, we can provide management recommendations to reduce human-wildlife conflict and disease spillover while safely sustaining these wildlife populations in both urban and rural contexts.

## Project Location

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

Region(s): Metro, Central,

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

Statewide

**When will the work impact occur?**

During the Project and In the Future

## Activities and Milestones

### Activity 1: Map areas used by foxes and coyotes to assess habitat needs and reduce conflicts with people and livestock

**Activity Budget:** \$312,245

**Activity Description:**

Preliminary results from our current project suggest that foxes select areas with more human activity, possibly to avoid predation by coyotes; however, we do not know if these observations hold in less urban areas. One of our collared coyotes moved over 50 miles from northern St. Paul to a rural area, and the difference in this animal's behavior in the two landscapes was profound: it went from routinely patrolling neighborhoods to demonstrating an apparent avoidance of human activity centers. How do coyotes and foxes adapt to survive within such a wide gradient of urbanization? Further, are urban and rural populations linked by the Mississippi River corridor (a landscape feature heavily used by our urban study animals)? To answer this, we will map the areas that foxes and coyotes use and identify the habitats that they need to survive. We will place GPS collars on red foxes and coyotes (30 per species distributed from the Metro to St. Cloud) that will collect 2,000 locations/animal over a year. Combined with stable isotope analysis of hair, we will determine whether the diets, space use, or survival rates of foxes and coyotes change across a wide urban-rural gradient.

**Activity Milestones:**

Description	Approximate Completion Date
Identify study sites, acquire equipment, and train staff	September 30, 2023
Capture and process foxes and coyotes – season 1	February 28, 2024
Capture and process foxes and coyotes – season 2	February 28, 2025
Submit hair samples for stable isotope analysis	March 31, 2025
Final report and activity results submitted	June 30, 2026

### Activity 2: Experimentally test how the relationship between coyotes, foxes and humans changes between rural and urban settings

**Activity Budget:** \$156,624

**Activity Description:**

Our goal is to determine how foxes and coyotes perceive risk of interacting with competitors, predators, and humans in urban and rural environments. We predict that foxes will avoid coyotes and tolerate humans in urban environments, but will strongly avoid both in a rural setting. We predict that coyotes will respond negatively to human presence, but may show stronger avoidance in rural areas where they are hunted.

We will use audio playback experiments, deployed in urban and rural areas, to test how wild canids respond to auditory cues in the environment. Animals will trigger a motion-sensitive device to play an audio treatment (e.g., human voices, dogs barking, coyote or fox vocalizations), while recording video of the subject's behavioral responses (e.g., fleeing). By scoring the videos with standardized metrics, we will determine if the frequency of fear or aggression responses to each treatment are different in urban vs. rural landscapes. These experiments will provide context to the movement behaviors observed in Activity 1, and insight into how urbanization can affect interactions between these species. This is a unique opportunity to examine how a subordinate predator (foxes) weighs risks of humans and top predators (coyotes) across an urbanization gradient.

**Activity Milestones:**

Description	Approximate Completion Date
Identify 15 study sites and deploy playback units.	December 31, 2023
Complete first year of experiments.	February 28, 2024
Complete second year of experiments	February 28, 2025
Analyze data and submit manuscript for publication.	June 30, 2026

### Activity 3: Map infectious diseases to assess risk for wildlife, pets, and people

**Activity Budget:** \$132,131

#### Activity Description:

The high occurrence of mange in populations of urban foxes and coyotes is one of the most obvious examples of urban wildlife disease. Other diseases, many of which are transmissible to pets (e.g., canine distemper, heartworm, parvovirus), or pets and humans (e.g., rabies, toxoplasmosis, echinococcosis, leptospirosis, Lyme disease), do not manifest in ways as obvious as mange. When wild carnivores are infected with mange, individuals suffer weight loss and are unable to forage efficiently, causing them to potentially exploit anthropogenic food sources. While collaring study animals for Activity 1, we will collect biological samples (blood and feces) to test for diseases and will also estimate the percent cover of mange on the animal. In this activity, we will: 1) test for the eight aforementioned diseases to determine whether there are significant differences in disease prevalence between urban and rural populations; 2) compare habitat preference of mange infected and non-infected animals; and 3) determine if there is a difference in diet preference (anthropogenic vs. natural resources) between mange infected and non-infected animals. This activity will expand our knowledge about the distribution and prevalence of wildlife diseases and greatly improve our understanding of how mange affects Minnesota's wild canids.

#### Activity Milestones:

Description	Approximate Completion Date
Submit first season disease samples for analysis	February 28, 2024
Submit second season disease samples for analysis	February 28, 2025
Complete disease analysis and produce map of disease prevalence for final report.	June 30, 2026

## Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Meggan Craft	UMN Department of Ecology, Evolution, and Behavior	Co-PI / Provide lead role in integrating disease information with ecological and behavioral information	Yes
John Moriarty	Three Rivers Parks District	Identifying locations to capture and track canids within the Three-Rivers Parks District properties.	No
Steven Hogg	Three Rivers Parks District	Identifying locations to capture and track canids within the Three-Rivers Parks District properties.	No

## 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.**

We will present results at state and national scientific conferences (e.g., annual meetings of The Wildlife Society). We will make scientific publications that result from this project available through University of Minnesota websites, Open Access journal websites, and upon a request. Outreach will include speaking engagements at nature centers (e.g., the Eastman Nature Center operated by the Three Rivers Park District) and at meetings held by organizations that are interested in conservation and management of wildlife (e.g., the Minnesota Trappers Association). Results from this project will also be incorporated into class material the the FWCB Department at UMN. We expect that this research will draw media attention, which will provide additional opportunities to inform the public about findings from this project.

The Minnesota Environment and Natural Resource Trust Fund (ENRTF) 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 Acknowledgement 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?**

This project will expand upon our ongoing research in the Metro area, building toward a long-term dataset of coyote and fox ecology. Graduate and undergraduate students will continue to supervise research activities after this project is completed, and will disseminate results through talks at wildlife conferences and as part of community outreach efforts. The lead PI will apply for NSF research support to expand this project and allow us to examine long-term trends in population dynamics and behavior.

## Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Impacts of Forest Quality on Declining Minnesota Moose	M.L. 2014, Chp. 226, Sec. 2, Subd. 05l	\$300,000
Restoration of Elk to Northeastern Minnesota	M.L. 2016, Chp. 186, Sec. 2, Subd. 03l	\$300,000
Moose Calf Surveys and Monitoring	M.L. 2017, Chp. 96, Sec. 2, Subd. 03j	\$348,000
Understanding Brainworm Transmission to Find Solutions for Minnesota Moose Decline	M.L. 2019, First Special Session, Chp. 4, Art. 2, Sec. 2, Subd. 03f	\$400,000

Mapping Habitat Use and Disease of Urban Carnivores	M.L. 2019, First Special Session, Chp. 4, Art. 2, Sec. 2, Subd. 03g	\$500,000
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## Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
<b>Personnel</b>								
James Forester/Associate Professor/PI		Project management / provide lead in synthesizing ecological and behavioral data			36.5%	0.3		\$54,438
Meggan Craft/Associate Professor/Co-PI		Provide lead role in integrating disease information with ecological and behavioral information			36.5%	0.16		\$37,230
Geoffery Miller / Graduate Student		Lead field effort and analysis of movement data / includes tuition			24.1%	1.5		\$80,163
2 Wildlife technicians		Assisting graduate student with setting and checking traps.			8%	2		\$67,392
4 Undergraduate field assistants		Assist technicians and graduate student checking traps and playback units.			0%	0.38		\$13,608
Postdoc		Manage field crew and animal tracking effort			25.7%	2		\$137,792
							<b>Sub Total</b>	<b>\$390,623</b>
<b>Contracts and Services</b>								
TBD	Professional or Technical Service Contract	Testing of 60 biological samples for 8 diseases at diagnostic laboratories				-		\$22,200
TBD	Professional or Technical Service Contract	Analysis of diet composition at stable isotope laboratory to determine how diets change across study area				-		\$1,800
TBD	Professional or Technical Service Contract	GPS collar data downloads (\$350/collar) to locate animals.				-		\$21,000
							<b>Sub Total</b>	<b>\$45,000</b>
<b>Equipment, Tools, and Supplies</b>								
	Equipment	GPS collars (60 collars @ \$1850/collar)	To track animals in the field					\$111,000



	Tools and Supplies	Equipment for animal capture and managing biological samples, including pharmaceuticals and traps	To capture and collar test animals					\$13,555
	Tools and Supplies	Equipment for automatic behavioral playback research (15 units @ \$710 each)	To record how animals respond to different acoustic threats across the urban to rural gradient.					\$10,650
							<b>Sub Total</b>	<b>\$135,205</b>
<b>Capital Expenditures</b>								
							<b>Sub Total</b>	-
<b>Acquisitions and Stewardship</b>								
							<b>Sub Total</b>	-
<b>Travel In Minnesota</b>								
	Miles/ Meals/ Lodging	49268 miles (daily trap checking over two 6-month seasons by three people)	Setting and checking traps, visits to potential field sites, setting and recovering acoustic playback kits					\$28,822
	Conference Registration Miles/ Meals/ Lodging	Formal presentation by graduate student at state chapter Wildlife Society meeting	Presenting at the Minnesota Chapter of The Wildlife Society will highlight the research in the state and serve and outreach function					\$500
							<b>Sub Total</b>	<b>\$29,322</b>
<b>Travel Outside Minnesota</b>								
	Conference Registration Miles/ Meals/ Lodging	Graduate student participation at professional society to make a formal presentation	Graduate student will make a formal presentation at national level professional society research conference	X				\$850
							<b>Sub Total</b>	<b>\$850</b>
<b>Printing and Publication</b>								
							<b>Sub Total</b>	-
<b>Other Expenses</b>								
							<b>Sub Total</b>	-

							<b>Grand Total</b>	<b>\$601,000</b>
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## Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
<b>Travel Outside Minnesota</b>	Conference Registration Miles/Meals/Lodging	Graduate student participation at professional society to make a formal presentation	It is important to share our results to a national audience. Further, this will provide excellent experience to the graduate student as he finishes his degree.

## Non ENRTF Funds

Category	Specific Source	Use	Status	\$ Amount
<b>State</b>				
Cash	55% MTDC un-recovered indirect costs	Indirect costs are "costs that are incurred for common or joint objectives and, therefore, cannot be identified readily and specifically with a particular sponsored project, an instructional activity, or any other institutional activity."	Secured	\$330,550
Cash	College of Biological Sciences	0.5 FTE, Teaching Assistantship through EEB Program to support graduate student	Secured	\$26,721
			<b>State Sub Total</b>	<b>\$357,271</b>
<b>Non-State</b>				
			<b>Non State Sub Total</b>	-
			<b>Funds Total</b>	<b>\$357,271</b>

## Attachments

### Required Attachments

#### *Visual Component*

File: [e05f7693-b7d.pdf](#)

#### *Alternate Text for Visual Component*

Diseases like mange, rabies, and leptospirosis have serious consequences for coyotes and foxes, but they can also affect pets, livestock, and (in the case of rabies and other zoonotic diseases) humans. Changes in the way these wild canids interact in different urban and rural environments can alter how diseases spread....

### Optional Attachments

#### *Support Letter, Photos, Media, Other*

Title	File
UMN SPA Approval Letter	<a href="#">9391fc9b-87f.pdf</a>
BackgroundCheckForm	<a href="#">647f82da-bca.pdf</a>
Research Addendum_2023-183_approved	<a href="#">868cfb3d-a8b.pdf</a>

## Difference between Proposal and Work Plan

### *Describe changes from Proposal to Work Plan Stage*

The budget has been updated to reflect the approved amount. We have reduced the FTEs of graduate support because we were able to secure external funding for the last 0.5 year. Several other amounts were adjusted to reflect updated rates and costs.

External funding was updated to include 0.5 FTE of graduate support from a teaching assistantship. Title was added to figure.

#### Response to final comment:

Our previous project was able to deploy most of our collars except for some of those intended for grey foxes (which is why we are not focusing on that species in this study). It was hard work to capture the animals we needed because we were learning how to capture the animals the first year and then had difficulties during the pandemic in hiring people to help our postdoc and graduate student. Now, our student (Geoff Miller) has extensive experience capturing these animals and we will be hiring a field crew to help manage the traplines during capture season. If we have difficulties finding enough animals, we will seek additional help from the Minnesota Trappers Association to target more sites.

## 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 agree travel expenses must 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 agree to the UMN Policy.

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

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?**

Yes, Sponsored Projects Administration