Environment and Natural Resources Trust Fund
2016 Request for Proposals (RFP)

Project Title: **ENRTF ID: 025-A**

Causes and Effects of Human-Related Stress on Mammals

Category: A. Foundational Natural Resource Data and Information

Total Project Budget: $ 319,128

Proposed Project Time Period for the Funding Requested: 2.5 years, July 2016 to December 2018

Summary:

Determine what human activities and developments cause stress in bears and their corresponding consequences. Work with the MN DNR to apply knowledge towards reducing stress in mammal species of concern.

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Sponsoring Organization: U of MN

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Location

Region: Central, Metro, NW, NE

County Name: Statewide

City / Township:

Alternate Text for Visual:

Diagram of tools used to identify stressors in bears and some of the species of concern our insights will benefit.

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

PROJECT TITLE: Causes and Effects of Human-Related Stress on Mammals

I. PROJECT STATEMENT –

Measuring and understanding the causes of stress experienced by wildlife is important because high stress loads can reduce reproduction and survivorship. Despite the expanding human footprint which creates stress for wildlife in many forms (e.g. roads and traffic, habitat loss, increased temperatures from climate change, noise from recreational activities), only recent advances in technology have allowed the new field of "conservation physiology" to begin to flourish . **In collaboration with Medtronic, Inc. and the MN Dept. of Natural Resources, we will determine what human activities and developments act as stressors, and the consequences of those stressors on bears.** By gaining this knowledge and collaborating with the MN Dept. of Natural Resources we can develop better **actionable management plans** that can be used to **reduce stress on MN mammals with declining populations such as moose and lynx.** These threatened species face similar stressors as bears. For example, ATV use may cause stress, the DNR can alter areas or dates they can be used on public lands during moose calving.

The goals of this project are to: **1) identify** what human activities and human-modifications to the Minnesota landscape (e.g. roadways, snowmobile use) and conditions (temperature stress) act as stressors to mammals, **2) quantify** the stress response associated with each type of stressor, how frequently the stressor occurs, and the effects of the differing stress loads on the health and reproductive output of individual bears. Based on our findings we will engage MN DNR wildlife managers to create a report to **3) recommend** actionable mitigation strategies to minimize the effects of the most prominent sources of stress for mammal species of concern in Minnesota and be incorporated into MN mammal management.

Our team of researchers is uniquely capable of addressing these important questions. Since 2009, the MN DNR, Univ. of Minnesota Medical School, and Medtronic Inc. have collaborated to pioneer the use implantable cardiac monitors that record and store every heartbeat of bears without negative effects to the animals (over 30 different bears thus far). By linking heart rate data (spikes in heart rate indicate a stress response) with GPS-collars that collect frequent locations of bears we are able to: **1) discern the cause of the stress response, 2) how long the response lasts, 3) how frequently it occurs, and 4) eventually how the individual responds to their stress load (i.e. weight, reproduction)**. We will expand on our current successful research, located primarily in northwestern MN, to add populations that experience differing types and levels of stress. Bears are a great study species for stress research among mammals because they move over wide distances and may encounter numerous potential stressors, and we have already successfully equipped some with biologgers without any harm.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: *Identifying Stressors and Measuring Stress Loads* **Budget: $278,155**

1) During spring ('16 & '17), we will trap bears with baited barrel traps. During the initial handling we will assess physical health (measure weight and fat levels), age, fit a satellite GPS-collar with Iridium communication, and surgically implant a cardiac biologger to record average heart rate at 2-minute intervals. Each winter following capture, we will visit bears at their den to assess the same measures as well as to download heart rate and GPS data.
2) We will sample bears from: (1) the Chippewa National Forest (nearly 2,700 km^2 of continuous forest in north central MN) and (2) Voyageurs National Park. Bears in these regions rarely encounter potential human-caused stressors. (3) Northwestern MN is primarily devoted to agriculture, has an extensive road network, and a limited amount of natural habitat. (4) Camp Ripley National Guard training facility exposes bears to sounds of military training activities including long-range artillery fire

and human recreational activities. (5) Bears living near the urban area of Duluth, MN opportunistically utilize neighborhoods for unsecured garbage. (6) Captive bears are housed at the Wildlife Science Center located in Forest Lake, MN will serve as the control group for this study.

3) Relate heart rate stress responses with bear locations from GPS-collars and identify stressors with GIS cover maps

Outcome	Completion Date
1. Spring'16 & '17 capture, GPS-collar, implant bears w/ heart monitors and assess health/weight	*Aug. 2017*
2. Winter '16 & '17 download GPS-collar and heart rate data. Quantify reproductive output, weight changes and other metrics of body fat composition.	*March 2018*
3. Analyze the corresponding GPS and heart rate data to determine stressors and quantify individual bear stress loads and effects	*July 2018*
4. Publish the results of the analysis in a peer reviewed journal(s)	*Dec. 2018*

Activity 2: *MN DNR manager survey and full-report on recommendations* **Budget: $40,973**

1) Present MN DNR managers with results and survey them about best mitigation strategies for reducing stress in targeted species.
2) Write full report that synthesizes the results for state-wide management action plans.

Outcome	Completion Date
1. Engage MN DNR managers where declining mammal populations are found within MN	*Oct. 2018*
2. Compile MN DNR manager responses and create a report which recommends how and where to implement actionable management plans within the DNR to help conserve these declining populations and species of special concern	*Dec. 2018*

III. PROJECT STRATEGY

A. Project Team/Partners

Our team of collaborators has expertise in the fields of wildlife biology, cardiology and surgery, along with expertise in medical devices. **Dr. Mark Ditmer** is a post-doctoral researcher at the Univ. of Minnesota Dept. of Fisheries, Wildlife, and Conservation Biology and will act as project manager and lead researcher. [Post-doc salary paid for with trust money] The following partners will not receive money from the fund: **Dr. Paul A. Iaizzo** is a Professor of Surgery; Integrative Biology and Physiology at the Univ. of Minnesota. He will conduct field surgery and serve as advisor to a master's student receiving trust funds. **Dr. David Garshelis** is an Adjunct Professor in the Department of Fisheries, Wildlife and Conservation Biology at the Univ. of Minnesota and the Bear Project Leader at the MN Dept. of Natural Resources. He will provide expertise on bear behavior. **Dr. Timothy Laske** is Vice President of Research and Business Development at Medtronic AF Solutions and an Adjunct Associate Professor; Dept. of Surgery at the Univ. of Minnesota. He will provide biomedical engineering expertise and the Medtronic Reveal cardiac biologgers which would otherwise be unavailable.

B. Project Impact and Long-Term Strategy

This project will provide specific management recommendations, considerations for future development projects and information to form better future rules and regulations of activities near imperiled mammal populations in Minnesota. This project will not require additional funding beyond this timeline. We are seeking additional funding through the National Science Foundation to include cortisol sampling as a second stress metric.

C. Timeline Requirements

We require 2 years of field work to obtain enough data from bears spanning the specified areas within the state. The final 6 months of work will be required to engage MN DNR managers and write up recommendations for management actions.

2016 Detailed Project Budget

Project Title: *Understanding the Causes and Effects of Human-Induced Stress on Minnesota Mammals*

IV. TOTAL ENRTF REQUEST BUDGET 2.5 years

BUDGET ITEM *(See "Guidance on Allowable Expenses", p. 13)*	**AMOUNT**
Personnel:	
Postdoctoral Fellow (Mark Ditmer) - 100%FTE = 30 mo salary for entire project ($120,300) + 21.4% fringe ($25,744): will manage the project and take data analysis lead and report writing lead.	$ 146,044
Master's Student - 2 years of summer salary, 6 mo @ $20.28 per hour = salary ($10,827) plus 16.6% health and FICA ($1,797): Trained in Iaizzo lab to conduct summer biologger surgery and assist in the winter den work. Also 1 academic year of funding to become trained in surgery and to pay for all of the extra time spent doing winter den work surgery (salary:$15,959, fringe: $2,649, tuition:13,915, total = $32,523). The remainder of the funds for this student's master's degree will be paid for by Dr. Iaizzo and their research topic will reolve around this project.	$ 45,147
Undergraduate field assistants from the Univ. of Minnesota: 2 assistants per yr. for 3 months a year for 2 yrs., $10/h. Will be responsible for checking traps, collaring bears and assisting master's student. They will gain great field work experience and be engaged in the project throughout its course.	$ 10,400
Equipment/Tools/Supplies:	
40 GPS-Collars from Telonics ($2,100 each) and corresponding satellite time ($5000)	$ 89,000
Field equipment (bait for bear traps, flagging, attractants etc)	$ 1,200
Flight costs associated with locating bear dens prior to winter field work. ($225 an hour X 40 hours for 2 winter seasons)	$ 9,000
Immobilization and anestization drug costs that exceed Dr. Garshelis' budget due to additional bears. Approx $60 per bear during winter handling and $10 per bear for summer handling. This will cover adults and any potential yearlings during winter den visits.	$ 6,000
Travel:	
Summer travel to study area by project management staff and technicians 3 months/yr for 2 years (1 fleet trucks @$779/month, $0.37/mi, 8000 miles/ yr). Due to the additional bears we will need to break into 2 teams during winter work. Additional costs of winter travel to bear dens beyond the costs of Dr. Garshelis' budget (2 fleet trucks @$779/month, $0.37/mi, 500 miles/ yr)	$ 12,337
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	$ 319,128

V. OTHER FUNDS

SOURCE OF FUNDS	**AMOUNT**	**Status**
Other Non-State $ To Be Applied To Project During Project Period:	N/A	N/A
Medtronic Inc. cardiac Reveal XT biologgers. These are provided free of charge for our research purposes due to our working relationship with Dr. Laske. New, each device costs ~$10,000, but we receive re-used ones (previously used for human medical purposes). We have access to an unlimited supply. We plan to implant in ~45 individuals.	$ 450,000	*Secured*
Other State $ To Be Applied To Project During Project Period:		
MN Dept. of Natural Resources bear research budget for Dr. Garshelis. Many of Dr. Garshelis' additional expenses will be due to an increased number of collared bears.	$ 6,000	*Secured*
In-kind Services To Be Applied To Project During Project Period:	N/A	N/A
Funding History:		
Medtronic Inc. cardiac Reveal XT biologgers. These are provided free of charge for our research purposes due to our working relationship with Dr. Laske. See description above. We have implanted without ANY harm to the bears for the past 6 years. ~ 10 per year.	$ 600,000	*Secured*
MN Dept. of Natural Resources bear research budget for Dr. Garshelis. Many of Dr. Garshelis' expenses are related to our current research on the stressors of bears. 2009 - 2014 (6 years @ ~6,000 a year)	$ 36,000	*Secured*
Salary, benefits and fringe for Dr. Ditmer's post-doctoral research. 2 years of pay from Dr. Iaizzo's lab and the MN DNR. ($40,000 per year)	$ 80,000	*Secured*
GPS-Collars from Telonics (5@ $2,100 each), Vectronics (8@ $4,000 each), and Telemetry Solutions (20 @ $1,500 each) and corresponding satellite time ($3000) paid by Medtronic Inc. and the MN DNR	$ 75,500	*Secured*
Remaining $ From Current ENRTF Appropriation:	N/A	N/A

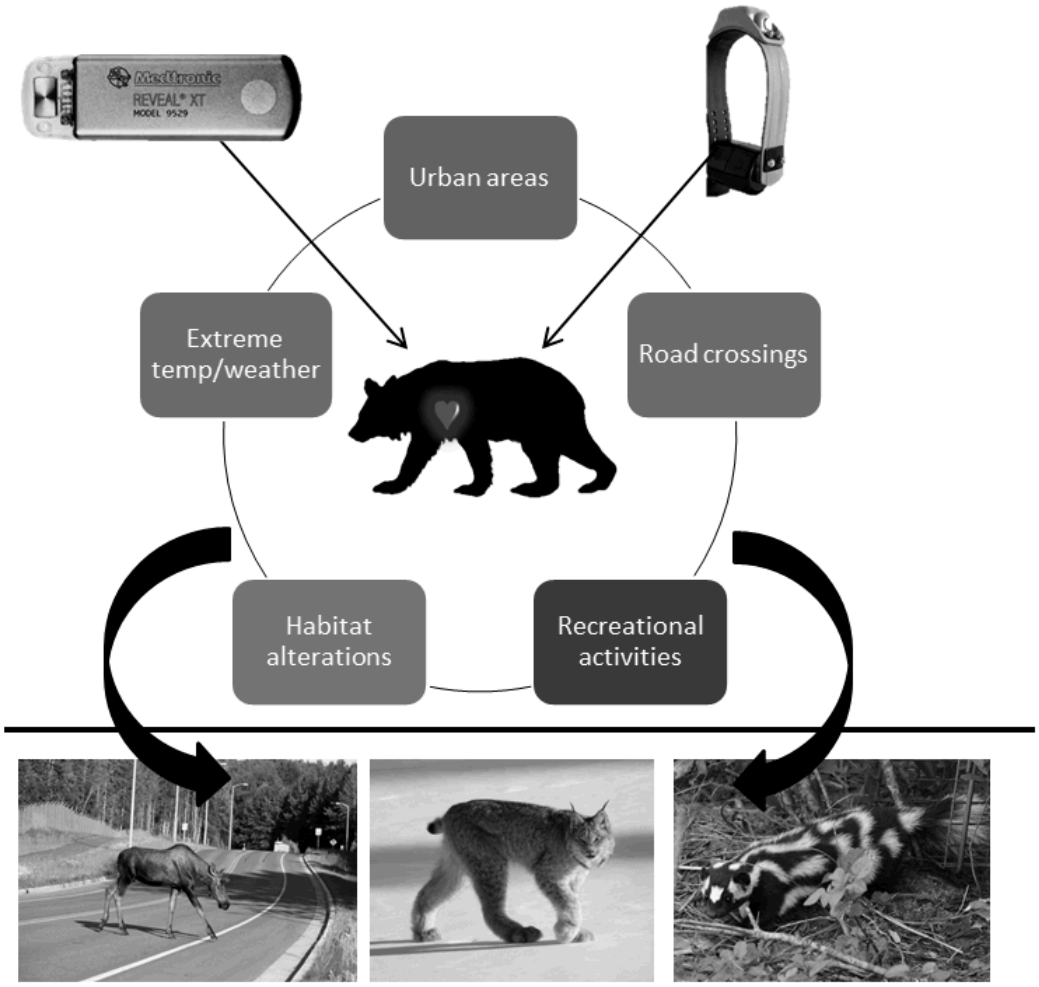

Figure 1). Through the use of cutting-edge cardiac biologger technology provided by Medtronic Inc. and satellite GPS-collars, we can discern what human activities cause a stress response in mammals, how long the stress response lasts, and how frequently they occur. The impact of the overall stress load on the individual can be linked with metrics of health including weight changes and reproductive output. We will use black bears as our study species living in various parts of MN and exposed to different stressors and varying degrees of stress. Since many declining species in MN face similar stressors as bears, we can use this information to work with the MN DNR managers to reduce stress loads in species such as moose, lynx and spotted skunk.

Causes and Effects of Human-Related Stress on Mammals
Project Manager Qualifications

Mark A. Ditmer

I. QUALIFICATIONS

Professional Preparation

Villanova University	Economics	B.S., 2005
Villanova University	Finance	B.A., 2005
Charles Rivers Associates	Analyst – Finance/Litigation	2005−2006
OnLocation, Inc.	Energy Consultant, Modeler	2006−2008
University of Minnesota	Conservation Biology	Ph.D., 2014
University of Minnesota	Wildlife Biology	Post-doc 2014−2015

Expertise Related to the Proposed Research

Ditmer has experience in both the high-stakes corporate world of consulting and field biology/ecology. He has completed a Ph.D dissertation focused on understanding how black bears in Minnesota can thrive in largely human-dominated, agricultural areas. He has extensive experience in rigorous quantitative methods, specifically working with spatial data from GPS-collars as well as physiology data from biologgers. He has successfully published results of his work in several peer-reviewed scientific journals. His research as a postdoctoral research specialist at the University of Minnesota's Dept. Fisheries, Wildlife, and Conservation Biology is primarily focused on how mammals respond both behaviorally and physiologically to human-related stressors.

II. RESPONSIBILITIES

Ditmer will manage and coordinate all research activities within the project. He will act as lead data analyst and work with the experts on the project in physiology (Dr. Iaizzo), bear behavior (Dr. Garshelis), and medical devices (Dr. Laske) to ensure the most rigorous and safe (for both humans and bears) methods and analyses are implemented (Activity 1). He will also be responsible for contacting and meeting with MN DNR managers to determine best practices and ideas for reducing stress in species of concern as well as being the lead author on the resulting report of recommendations (Activity 2).

III. ORGANIZATION DESCRIPTION

The Department of Fisheries, Wildlife, and Conservation Biology (part of the University of Minnesota), has a mission "to foster a high quality natural environment by contributing to the management, protection, and sustainable use of fisheries and wildlife resources through teaching, research, and outreach."