Environment and Natural Resources Trust Fund 2018 Request for Proposals (RFP)

Project Title: ENRTF ID: 029-A
Monitoring and Mapping of Mercury in Western Minnesota
Category: A. Foundational Natural Resource Data and Information
Total Project Budget: \$ 489,376
Proposed Project Time Period for the Funding Requested: <u>3 years, July 2018 to June 2021</u>
Summary:
We will collect/synthesize Hg information from 50 water bodies in order to better understand Hg hotspots within western Minnesota. Results will support long term monitoring and mapping of this toxin.
Name: David Kramar
Sponsoring Organization: Minnesota State University - Moorhead
Address: 1104 7th Ave S
Moorhead MN 56563
Telephone Number: (218) 477-2832
Email david.kramar@mnstate.edu
Web Address
Location
Region: Central, Northwest, Southwest
County Name: Becker, Big Stone, Clay, Clearwater, Douglas, Grant, Hubbard, Mahnomen, Norman, Otter Tail, Pennington, Polk, Pope, Red Lake, Stevens, Swift, Todd, Traverse, Wadena, Wilkin

City / Township:

Γ

Alternate Text for Visual:

Map and grapics showing proposed study area within the State. We propose to sample from approximately 20 counties in the western region of the State.

Funding Priorities Multiple Benefit	s Outcomes Knowledge Base
Extent of Impact Innovation	Scientific/Tech Basis Urgency
Capacity ReadinessLeverage	TOTAL%



TRUST FUND Project Title: Monitoring and Mapping of Mercury in Western Minnesota

PROJECT TITLE: Monitoring and Mapping of Mercury in Western Minnesota

I. PROJECT STATEMENT

Faculty from Minnesota State University Moorhead (MSUM) are interested in better understanding mercury Hg concentrations in lakes and rivers associated with western Minnesota, and in particular, the Red River Valley. We want to quantify the bioaccumulation/biomagnification factors and map Hg hotspots in biota throughout the region. Results from this study will directly support current efforts in the State to understand environmental factors and risks that relate to elevated Hg concentrations in fish and birds. This study will also provide a more detailed analysis of Hg across the entire Red River Valley.

If selected for funding, faculty will randomly select waterbodies, including lakes and rivers, from which to collect biological Hg samples. When possible we will sample waterways that are currently lacking significant Hg information. Faculty and students associated with the project will collect samples from fish, birds, and invertebrates within these systems in order to gain a greater understanding of how methylmercury (MeHg) is accumulating. Measured MeHg concentrations will relate back to land-use and land cover practices, and water quality variables to determine if there are relationships between current management strategies and CH³Hg+ concentrations in selected biota. Sampling across the food chain will also provide a means to understand the bioaccumulation factors (BAF's) associated with each of the distinct water bodies.

Results from this project will provide new MeHg information that will directly support current state efforts to understand how pervasive this toxin is within the Red River Valley, and will provide a robust dataset from which we can continue to gain valuable information regarding the impact of CH³Hg+ on aquatic species in the state.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Site visits to identified lakes and rivers to be included in study and acquireBudget: \$35,000currently available data. Sampling will include at least 50 different waterbodies.Budget: \$35,000

The goal of Activity 1 is to visit and begin collection of water quality information from the lakes and rivers that will be included in the study. Using Geographic Information Systems (GIS) we will map both lakes and rivers that are within the study area and begin development of a geospatially enabled relational database. We will leverage currently available data within the State such as geospatial information from State resources, county resources, and municipal resources.

Outcome	Completion Date
1. List of water quality variables of lakes and rivers that will be sampled for biological	August 2018
concentrations of CH ³ Hg+	
2. Site visits to each of the selected waterbodies, and collection of any available water	August 2018
quality data.	
3. Acquisition of aerial imagery for each of the selected waterbodies.	August 2018
Activity 3. Design Collection and Identification of Dialogical Complex (Fish Avian and	Budget 6150 000

Activity 2: Begin Collection and Identification of Biological Samples (Fish, Avian, and Budget: \$150,000 Invertebrate)

We propose to collect samples for a total of 3 years beginning in July 2018. Samples will be collected from fish, birds, and invertebrates from each of the selected waterbodies. Samples will be collected seasonally when possible (e.g. fish and invertebrates). Over the three year time period we will collect Hg samples from each of the 50 waterbodies selected for a total of 1500 samples. Specific details regarding sampling methodology are provided below:

Macroinvertebrates and Fish:

Macroinvertebrate and fish samples will target those species that represent the primary and secondary feeding groups in the selected streams and lakes, and those that are in sufficient numbers to provide an adequate sample size. Macroinvertebrate samples will be analyzed by functional feeding groups (i.e., shredders, scrapers, omnivores, and predators; Vannote et al. 1980, Merrit and Cummins, 1996) and fish samples by species.



Birds:

Avian samples will target typical forest songbird species, as well as aquatic ducks and loons. Mercury samples will consist of both feather and blood, following established protocols. Standard morphometrics will be collected and Individuals will be banded under appropriate Federal and State permits, and released upon collection of the samples and morphometrics.

Outcome	Completion Date	
1. Collection and Identification of Fish Hg Samples	June 2021	
2. Collection and Identification of Invertebrate Hg Samples	June 2021	
3. Collection and Identification of Avian Hg Samples	June 2021	
4. Database Creation and Entry of All Morphometric and Species Information	June 2021	

Activity 3: Mercury Analysis of Biological Samples

Budget: \$170,000

This project proposes to use funds requested for the project to purchase a Milestone Tri-Cell DMA-80 Direct Mercury Analysis system. Given the large number of samples that will be collected over the 3 year project (1500) and the continued research the instrumentation will allow, it was determined that the purchase of analytical equipment for Hg analysis was justified, and will provide ongoing and affordable Hg analysis support to state and local shareholders.

Outcome	Completion Date
1. Hg concentrations in Fish, Birds, and Invertebrates from Sampled Lakes and Rivers	June 2021
(Analysis conducted upon collection, and continuing until project completion)	
2. Development of RDBMS for the Storage, Retrieval, and Dissemination of Hg data.	June 2021

Activity 4: Development of an online interactive map of Hg in the Red River Valley Budget: \$48,751 The online map will provide a fast way to disseminate Hg information regarding its distribution in Western Minnesota waterbodies. The application will serve as a valuable resource for understanding where Hg hotspots exist, and will provide a mechanism for long-term monitoring and sharing of information that will directly affect human health.

Outcome	Completion Date
1. Interactive Web-based Map Showing Hotspots of Hg	June 2021
2. Increased Awareness of Hg in Western Minnesota Wild and Aquatic Biota	June 2021
3. Greater Access to Information on Mercury as it Relates to consumable Fish Tissue	June 2021

III. PROJECT STRATEGY

A. Project Team/Partners

David Kramar (Project Manager, GIS Specialist, and Avian Researcher) receiving funds, Brian Wisenden (Fisheries Biologist) and Allison Wallace (Ecologist) receiving funds. ENTRF funds will fund Valquiria Quirino (Remote Sensing, GIS Specialist, Data Analyst) and MSUM students.

B. Project Impact and Long-Term Strategy

The long-term goal of this research is to gain a greater understanding of the issues surrounding Hg bioaccumulation and availability in Minnesota lakes and rivers. More specifically, this research will provide a valuable resource for better understanding "at-risk" environments and how physical and anthropogenic influences relate to available Hg in these systems. This research will strengthen ongoing Hg monitoring activities in the State, and provide a greater depth of scientific knowledge to the underlying mechanism associated with Hg in aquatic systems, particularly as it relates to seasonal variability. This study will also provide baseline data for long-term studies of the region.

C. Timeline Requirements

This is a three-year project beginning in July 2018 and continuing until June 2021. Fieldwork, data collection, and data analysis will occur continuously for the duration of the project. The last two years will also include data analysis, data presentation, and communication of research findings.

2018 Detailed Project Budget

Project Title: Monitoring Mercury in the Red River Valley

IV. TOTAL ENRTF REQUEST BUDGET: 3 years

BUDGET ITEM (See "Guidance on Allowable Expenses", p. 13)	AMOUNT
Personnel:	\$ 408,430
David Kramar, Project Manager (Geospatial and Biology, Avian Mercury) 1 month salary * 3	28,025.00
summers = 28,025.00	
Brian Wisenden, Biologist (Fisheries) 1 month summer salary * 3 summers = 33,078.00	33,078.00
Valquiria Quirino, Research Associate/Supervisor (Center for Geospatial Studies) 1 year FTE * 3	209,438.00
Years = 209,438.00. (45,000.00/year + Benefits).	
Alison Wallace (Ecologist) 1 month summer salary * 3 summers = 33,078.00	33,078.00
Michael Aho, Biologist (Invertebrates) 1 month salary * 3 summers = 19,186.00	19,186.00
Patricia Wisenden	28,025.00
10 Students Interns @ \$12/hour (100% salary) x 40h/wk x 1week x 4 seasons x 3 years.	57,600.00
Professional/Technical/Service Contracts:	N/A
Equipment/Tools/Supplies:	\$ 75,168
Milestone Inc. quote for DirectMercuryAnalyzer8230 Tri-Cell with enhance system option and low range detection; Includes	\$ 47,200.00
generation, a spare consumables kit, and one day operator and prevenate maintenance training.	
DMA Options: DMA-8347 Additional Quartz Boats (1500ui (pack of 10)	535.00
DMA Options: DMA-00640 AutoSampler tray with custom loading doc for continuous samping for 80 samples	1,600.00
DMA Options: 11145210 Mettler Toledo Balance	3,550.00
DMA Options: DMA-84846Deskjet Printer	235.00
DMA Options: Extended Warranty - 1 year Miles Care: includes all travel, parts & labor, priority in service scheduling and vearly maintenance visits : at 10% discount on \$4350	3,915.00
DMA Ontions: DMACSA Custom connector for balance	55.00
Consumable field sampling supplies (zinlock bags notebooks canillary tubes lancets beneranized vacutainers 25 guage	1 200 00
butterfly needles	1,200.00
Consumable Office and Laboratory supplies	3,000.00
Standard Reference Materials	6,000.00
Spex Certiprep @ \$42/bottle	378.00
Avian Banding Supplies (Mist Net, Bands, Banding Pliers, Poles) 1,500.00	1,500.00
Remote Sensing Software License (2000.00/year 3 years)	6,000.00
Acquisition (Fee Title or Permanent Easements):	N/A
Travel Expenses in Minnesota: Mileage to and from sampling locations: \$0.535/mile; 3 cars; 150	5778
miles; 4 seasons twice per season.	
Additional Budget Items: In this column, list any additional budget items that do not fit above	N/A
categories. List by item(s) or item type(s) and explain how number was determined One row per	
type/category.	
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND \$ REQUEST =	\$ 489,376

V. OTHER FUNDS (This entire section must be filled out. Do not delete rows. Indicate "N/A" if row is not applicable.)

SOURCE OF FUNDS	Α	MOUNT	<u>Status</u>
Other Non-State \$ To Be Applied To Project During Project Period:N/A	\$	-	N/A
Other State \$ To Be Applied To Project During Project Period: N/A	\$	-	N/A
In-kind Services To Be Applied To Project During Project Period: N/A	\$	-	N/A
Past and Current ENRTF Appropriation: PROJECT TITLE: Minnesota State University Moorhead	\$	132,294	Unspent
Prairie and Riparian Restoration and Monitoring. PM: Brian Wisenden \$132,294 remaining			
balance			
Other Funding History: N/A	\$	-	N/A



Project Manager Qualifications: David E. Kramar Assistant Professor, Dept of Anthropology and Earth Science, Minnesota State University – Moorhead

Education:

2014: Ph.D. - Geospatial and Environmental Analysis: Major Advisor: Dr. Bill Carstensen (Dept of Geography). Funded under the EPA STAR Fellowship Program. **Dissertation Title:** Evaluation, assessment, and determination of risk to high trophic level piscivores in Virginia: A spatial, biological, and comparative investigation of mercury in Virginia bald eagle populations.

2004: MS in Geography; Major Advisor: Dr. Bill W. Carstensen. Virginia Polytechnic Institute, Blacksburg, VA. **Thesis Title:** Estimating Hg Risk to the Common Loon (*Gavia immer*) in the Rangeley Lakes Region of Western Maine: a Regression Based GIS Model

1999: BS in Geography; Concentration in Geographic Information Systems. Appalachian State University, Boone, NC.

Relevant Research/Publications:

Bald and Golden Eagle Assistance and Trapping: Assessing Concentrations of Mercury and Lead in Adult Bald and Golden Eagles. Funded under the Virginia Dept. of Game and Inland Fisheries. Total Funding: 20,000.00. Fall 2011. 20,000.00. Fall 2010. Co-Pi.

Evaluation, assessment, and determination of risk to high trophic level piscivores in the Mid-Atlantic: A spatial, biological, and comparative investigation of mercury in Virginia and New England bald eagle populations. Funded under the EPA Star Fellowship Program. Total Funding: 120,000.

Kramar, David E., Goodale, W., Kennedy, L., Carstensen, L., Kaur, T. *Relating Land Cover and Mercury Levels in Common Loons Using Geographic Information Systems, Ecotoxicology,* Vol. 14, 2005

Kaur, Taranjit, Singh, J., Goodale, W., **Kramar, D.**, Nelson, P. *Development of a Cyber-Infrastructure for Integrated Assessments of Environmental Contaminants, Ecotoxicology,* Vol. 14, 2005

Throughout my academic career, I have focused on using geospatial technologies to understand the dynamics of Hg exposure in a multitude of different species. During this time I have actively participated in banding various passerines, kingfishers, ducks, common loons, osprey, bald eagles, and golden eagles. I have also collected and analyzed, per EPA Method 7473, Hg concentrations in fish tissue, avian blood, feather, and talon samples. Among some of the more important findings were relationships between land cover and land use, and Hg. Some of my recent research has indicated relationships between landscape fragmentation and Hg as well. Currently, my interests lie in further exploiting the capabilities of Geographic Information Systems for understanding how (and why) Hg concentrates in particular areas, and how it moves through the food chain.

Organization Description:

Minnesota State University Moorhead (MSUM) is a 4-year public university, and is accredited by the Higher Learning Commission. MSUM offers undergraduate four-year college programs leading to Baccalaureate degrees in a number of different disciplines.