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

Project Title: **ENRTF ID: 032-A**

Mobilizing Vital Insect Baseline Data for Northeast Minnesota

Category: A. Foundational Natural Resource Data and Information

Total Project Budget: $ 210,757

Proposed Project Time Period for the Funding Requested: 3 years, July 2016 to June 2019

Summary:

We will database the holdings of the University of Minnesota Duluth Insect Collection so that citizens and scientists can use the data to evaluate environmental changes and guide management decisions.

Name: Rachel MaKarrall

Sponsoring Organization: U of MN

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Duluth MN 55812

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Web Address www.umn.edu

Location

Region: NE

County Name: St. Louis

City / Township:

Alternate Text for Visual:

Flowchart showing map of specimen origins in northeast Minnesota and process for converting mixed specimens into usable baseline data for managers and researchers.

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

PROJECT TITLE: Mobilizing Vital Insect Baseline Data for Northeast Minnesota

I. PROJECT STATEMENT

This project will database the holdings of the University of Minnesota Duluth Insect Collection so that citizens and scientists can use the data to evaluate environmental changes and guide management decisions.

Insects comprise over half the world's biodiversity and are used as bioindicators for conditions ranging from mercury pollution to burn frequency to trout habitat suitability to land restoration progress. Changes in insect populations or species assemblages over time can also indicate broader environmental impacts of climate change, habitat alteration, and invasive species. Examples include recent pollinator declines, scarcity of the once common Monarch butterfly, and decreases in relative abundance of native lady beetle species. However, **researchers cannot detect environmental changes without crucial baseline data**.

Located on the southwestern edge of North America's boreal forest biome, Duluth and northeast Minnesota are expected to undergo disproportionately large impacts as climate changes. In addition, this area faces critical new pressure from invasive species such as gypsy moth and emerald ash borer. **There is no richer source of baseline data on this region's insects than the holdings of the University of Minnesota Duluth Insect Collection**, which contains about 46,000 individual specimens from eight decades of collections in northeast Minnesota. The collection includes critical baseline survey data from Lake Vermilion State Park, Minnesota Point Pine Forest SNA, and Boulder Lake Management Area. Unfortunately, **these data are currently unavailable** because most of these specimens have not been identified and are viewable only by visiting the collection in person. Upon visiting the collection, anyone wanting information about a particular insect group must first hunt through several dozen drawers of mixed specimens, identify the desired species, then compile specimen label data information such as localities and dates. This process is so time-consuming that it is impractical for most projects; consequently, valuable data from our unique region often go ignored.

The goal of this project is to make UMD's Insect Collection **data easily available to everyone** through a searchable online database. This information can then be used in myriad ways, as illustrated by these examples:

- State Park and SNA managers can identify sensitive areas and monitor the progress of restored sites.
- Wildlife biologists can track invasive species and identify threatened species ranges.
- Farmers can check local seasonality of crop defoliators to guide pest management decisions.
- Teachers and students can investigate habitat preferences and interactions of local insect fauna.
- Minnesota citizens can verify garden pest identifications and backyard insect sightings.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Curate bulk specimens. **Budget: $26,017**

Almost half of UMD's specimen holdings are currently in mixed specimen bulk vials. Although these contain interesting specimens with good locality data and habitat information, they are not identifiable on an individual level in their current state. In order to identify and make use of these specimens, undergraduate research assistants will sort bulk samples, then pin and label specimens individually for proper storage and handling during identification.

Outcome	Completion Date
1. Sort, pin, dry and label mixed bulk vial specimens	May 15, 2017

Activity 2: Identify all specimens. **Budget: $136,504**

In order for insect data to be useful for most applications, specimens must be identified to species. This is a time-consuming and difficult process that requires ample reference material and long hours looking through a microscope. We will begin by sorting all specimens to higher taxonomic levels (e.g. family) and then work family by family to identify specimens to species. The budget includes periodic visits to the University of Minnesota Insect Collection on the St. Paul campus to access identified reference specimens for verification.

Outcome	Completion Date
1. Identify and sort all specimens to family level	May 15, 2018
2. Identify specimens to genus and species level	May 15, 2019

Activity 3: Database complete collection holdings. **Budget: $48,236**

Once specimens have been identified, their accompanying label information will be used to construct a searchable database that includes each specimen's location, collection date, species, sex, habitat and collector. Data will be entered using Specify software, a free, user-friendly industry standard for databasing natural history collection specimens. Once complete, the database will be used in-house as a specimen catalog and also published to the web for use by scientists, land managers, educators, students and citizens.

Outcome	Completion Date
1. Develop databasing strategy and written workflows	January 1, 2019
2. Enter data into Specify databasing software	May 31, 2019
3. Publish searchable database of UMD's insect holdings online	June 15, 2019
4. Inform researchers, educators, and citizens of the newly available data	June 30, 2019

III. PROJECT STRATEGY

A. Project Team/Partners

Rachel MaKarrall (UMD Biology) will direct the project, provide identification expertise, and hire, train, and supervise students and volunteers. UMD Biology Department Head **Dr. Timothy Craig**, an entomologist with an active research program and over sixty peer-reviewed publications, will provide identifications and oversight for the project. This funding request includes compensation for project manager, two graduate research assistants and two undergraduate research assistants. We will work in coordination with organizations that are well represented among UMD's Insect Collection holdings, including Lake Vermilion State Park, MN Point Pine Forest SNA, Boulder Lake Management Area, UMD Sustainable Agriculture Project, and the MN Biological Survey

B. Project Impact and Long-Term Strategy

Through several smaller University grants since 2011, UMD faculty, staff and students have begun improving the Insect Collection by installing new museum cabinets, sorting specimens into unit trays, completing local surveys and identifying small groups of insects. Receipt of ENRTF funds will help us leverage our prior work and make those efforts valuable to researchers, educators, and citizens. Once the databasing project is complete, UMD and its Department of Biology are committed to ongoing specimen maintenance and to making physical specimens available to researchers and state agencies for examination whenever necessary. As students and researchers continue adding specimens to the collection, identified specimens will serve as references and databasing will be ongoing, with costs borne by the University.

C. Timeline Requirements

This project will take three years to complete and is scalable by insect taxonomic group. Insect groups will be prioritized by ease of identification, established or potential conservation need, sensitivity of habitat, and utility as bioindicators.

2016 Detailed Project Budget

Project Title: Mobilizing Vital Insect Baseline Data for Northeast Minnesota

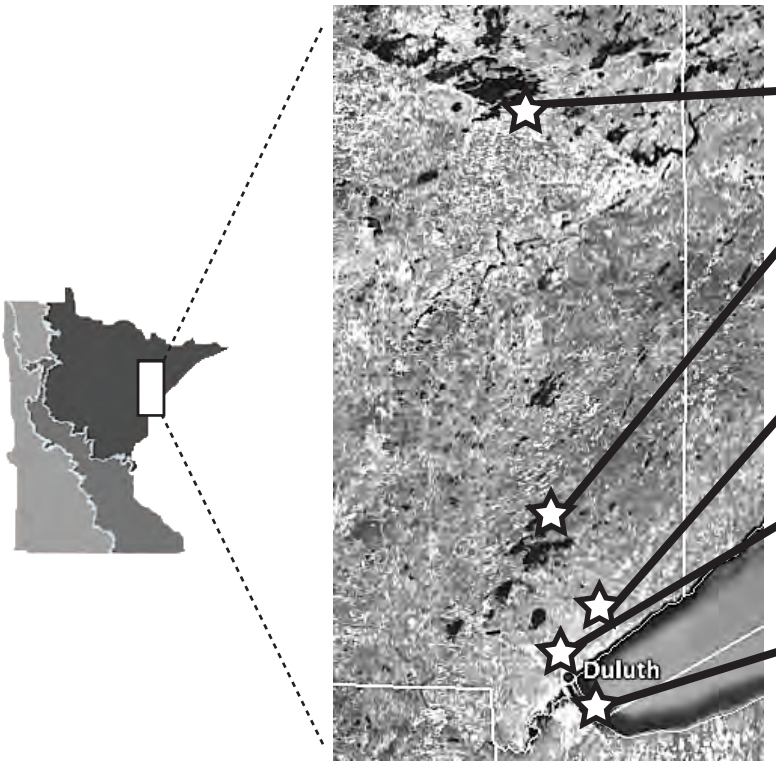
IV. TOTAL ENRTF REQUEST BUDGET: 3 years

BUDGET ITEM	AMOUNT
Personnel:	
Rachel MaKarrall, Project Manager: (75% salary, 25% benefits); 60% FTE for three years	$ 153,252
2 Graduate Research Assistants: (85% salary, 15% benefits); 50% FTE for each of two summer appointments	$ 13,510
2 Undergraduate Research Assistants: (hourly at $10.83/hr); 27% FTE (avg.) for each of three years	$ 38,964
Equipment/Tools/Supplies:	
Curation supplies: unit trays, insect pins, vials, ethanol	$ 1,976
Label printing supplies: laser printer, printer cartridges, archival cardstock	$ 325
Travel:	
Mileage, lodging and meals for 4 trips to UMTC Insect Collection to use reference specimens for identification	$ 2,730
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	$ 210,757

V. OTHER FUNDS

SOURCE OF FUNDS	AMOUNT	Status
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
Foregone by UMN F&A funding (52% MTDC)	$ 109,594	Secured
In-kind Services To Be Applied To Project During Project Period: UMD Integrated BioSciences Program summer GRA Timothy Craig PI effort	TBD	Pending
Funding History: $26,350 - UMD Swenson College of Science and Engineering Collegiate Fund $ 5,000 - UMD ICR Seed Grant $ 4,200 - Univeristy of Minnesota Undergraduate Research Opportunities Program Awards (3) $ 2,000 - UMD Chancellor's Small Grant $ 1,600 - UMD Biology Department Student Collegiate Fees	$ 39,150	Secured
Remaining $ From Current ENRTF Appropriation:	N/A	N/A

Mobilizing Vital Insect Baseline Data for Northeast Minnesota



Lake Vermilion State Park
5,200 specimens

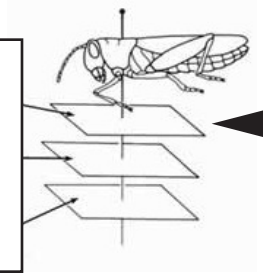
Boulder Lake Management Area
10,300 specimens

UMD Sustainable Agriculture Farm
8,100 specimens

Bagley Nature Area
2,000 specimens

Minnesota Point Pine Forest SNA
7,100 specimens plus historic data

Sorting and Identification



Date
Location
Habitat
Species
Collector

Data Entry

UMD Insect Collection Database

Web Publication

Minnesota Citizens
Students and Teachers
Regional Farmers
State Lands Managers
Minnesota Biological Survey
Conservation Biologists

PROJECT MANAGER QUALIFICATIONS

Rachel MaKarrall teaches at the University of Minnesota Duluth, where in 2012 she began leading a massive effort to restore and improve an insect collection that had suffered decades of neglect. She teaches courses in Entomology and Communication in Biology, supervises undergraduate research on insects and serves as faculty advisor to the Entomology Club. In 2014 she was awarded the UMD Biology Department's Inspirational Teacher of the Life Sciences Award for her ability to engage students in the study of insects. Her research interests center on insect biodiversity conservation, ground beetles as biological indicators, and attaining baseline survey data and range information for a variety of insect taxa in northern Minnesota. Rachel is also a scientific illustrator; her most recent work is a series of large detailed paintings of her favorite beetles. She is an active Minnesota Master Naturalist volunteer and serves on the Board of Directors for the Minnesota Dragonfly Society.

Education:
Master of Science, Biology. Minor in Applied and Computational Mathematics
University of Minnesota Duluth, 2009
Thesis: *Creating useful tools for learning insect anatomy*
Bachelor of Science, Biology. Minor in Chemistry
University of Minnesota Duluth, 2000

Work Experience:
Instructor, University of Minnesota Duluth, 2010-present
Courses: BIOL 4731 Entomology, BIOL 3802 Evolution, BIOL 3987 Communication in Biology, BIOL 3994 Undergraduate Research, BIOL 1001 Biology and Society
Senior Lecturer, University of Wisconsin Superior, 2010-2011
Courses: BIO 340 Genetics Laboratory, BIO 440 Cell Biology Laboratory
Lead Worker, Minnesota Department of Agriculture, 2008-2011
Plant Protection Division, Gypsy Moth Survey Crew
National Science Foundation GK-12 Teaching Fellow, 2007-2008
Graduate Teaching Assistant, University of Minnesota Duluth, 2005-2007
Courses: BIOL 2801 Ecology Laboratory, BIOL 3701 Animal Diversity

Training:
iDigBio Dried Insect Digitization Workshop, National Science Foundation, 2013
Odonata Nymph Identification Workshop, Minnesota Odonata Survey Project, 2013
Forest Pest First Detector Training, University of Minnesota Extension, 2013
Carabid Beetle Taxonomy Short Course, International Organization for Biological Control, 2012
Fruit and Vegetable Pest First Detector Training, University of Minnesota Extension, 2010

Professional Affiliations:
Entomological Society of America, Society for the Preservation of Natural History Collections, Michigan Entomological Society, Entomological Collections Network

ORGANIZATION DESCRIPTION

The **University of Minnesota Duluth** integrates liberal education, research, creative activity, and public engagement and prepares students to thrive as lifelong learners and globally engaged citizens. UMD's **Department of Biology**, located within the Swenson College of Science and Engineering, is the hub for fundamental biological sciences at UMD. Faculty and students in Biology form a collaborative network that conducts cutting-edge research that furthers our understanding of the natural world and finds application in fields from conservation to biomedical sciences. Among the largest of UMD programs, it serves in excess of 700 majors and offers degrees in Biology (B.S. and B.A.) and Cell and Molecular Biology (B.S.). The Biology Department's 24 faculty members recognize the importance of scholarship and service, the intrinsic value of research, and the significance of a primary commitment to quality teaching.