# Environment and Natural Resources Trust Fund

2027 Request for Proposal

## General Information

**Proposal ID:** 2027-319

**Proposal Title:** The Impact of Microplastics on Minnesota's Wildlife

## Project Manager Information

**Name:** Sushma Reddy

**Organization:** U of MN - Bell Museum

**Office Telephone:** (612) 625-4977

**Email:** sreddy@umn.edu

## Project Basic Information

**Project Summary:** Birds are indicators of emergent environmental threats. Using salvaged wildlife from across the state, we will investigate the prevalence of microplastics in wildlife and ecosystems to develop mitigation strategies.

**ENRTF Funds Requested:** $430,000

**Proposed Project Completion:** June 30, 2030

**LCCMR Funding Category:** Resiliency (A)

## Project Location

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

Statewide

**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

## Narrative

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

Birds are excellent indicators of how human activities impact wildlife, such as landmark studies showing pesticides harm not just birds but also have cascading effects across the ecosystem. These studies led to environmental policies that benefit wildlife and humans. An emergent contaminant is microplastics, that are now ubiquitous in the environment. Plastic pollution has been increasing in both aquatic and terrestrial ecosystems for decades. Wildlife can be exposed to these contaminants through varied sources - roadsides, waterways, agricultural fields, dust, etc. The impacts of microplastics on health include associations with rising rates of diseases. Birds occur in all habitats and interact within ecosystems in diverse ways, making them valuable proxies for ecosystem health. The risks of microplastics to the already steeply declining bird populations are still unknown. We are well-positioned to conduct a comprehensive analysis of microplastics contamination using carcasses collected throughout Minnesota from a previously funded LCCMR project. Microplastics are currently considered an unregulated contaminant of concern by most pollution and environmental agencies as data on their risks and sources are needed to help make decisions regarding strategies and policies to mitigate microplastics accumulation. An analysis of diverse species from across the state will identify areas of heightened concern.

**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 assess microplastics prevalence in birds across Minnesota using salvaged wildlife from an ongoing community science project. We have hundreds of specimens available for this study from across the state including from different habitats and species. We will address two foundational questions: 1- What is the prevalence of microplastics across birds of different species, lifestyles, habitats, and human use? 2- Does microplastic accumulation impact bird health? The first objective will measure whether the concentration of microplastics differs across ecosystem categories – 4 biomes, 10 feeding guilds (ex: carnivore, granivore, insectivore), 5 habitats (urban, grassland, shore, water, and forest), 2 lifestyles (migratory, resident), 2 uses (game, non-game). We will measure which species and which areas are more prone to accumulated microplastics. The second objective will test whether amount of microplastics accumulation is associated with increased heath issues, such as diseases and pathologies. Using samples of gastrointestinal tracts, we will measure the contents for amount and characteristics of microplastics and microbial diversity (microbiome) to assess gut heath. We will communicate results, such as areas or species with substantial accumulations, to state agencies for mitigation strategies. We will develop public engagement through the Bell Museum to communicate threats associated with microplastic pollution.

**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 produce a comprehensive investigation of microplastics across a large distribution of Minnesota's birds representing all four biomes and varied ecosystems. We will produce data for 30-50 species and approximately 200-400 individuals, making this one of the most wide-ranging surveys conducted to date across the globe. We will produce scientific publications, reports for state agencies, and public engagement programs. We will collaborate with other MN microplastics projects to assess which areas need the most attention for mitigation efforts. Our study will provide critical data for developing policies and strategies for reducing the impact of microplastics on wildlife.

## Activities and Milestones

### Activity 1: Organize, dissect, prepare specimens for analyses

**Activity Budget:** $86,210

**Activity Description:**
We will identify which specimens are available through the Bell Museum's Salvage Wildlife program, which has accumulated hundreds of bird specimens from across the state. We have already processed over a 100+ samples for this study and will continue to assess which species to use as specimens are constantly being collected. We will aim to choose specimens from different regions and species to make the following comparisons – 4 MN biomes (mixed forest, broadleaf forest, prairie, tallgrass), 10 feeding guilds (carnivore, crustaceavore, molluscovore, frugivore, granivore, herbivore, insectivore, omnivore, piscivore, vermivore), 5 habitats (urban, grassland, shore, aquatic, forest), 2 lifestyles – migratory and non-migratory, and 2 human uses - game, non-game. Our goal is to sample ~30 birds in each category and aim to cover multiple species with 5-10 individuals per species/ecotype to get adequate data to calculate trends rather than one-offs. For each specimen, we will take standard body measurements and weight, dissect gastrointestinal tracts for microplastics and microbiome analyses, and prepare the remaining carcass for archival storage of other tissues and body parts at the Bell Museum for future studies. We have developed a dissecting procedure to avoid contamination from lab plastics. In total we expect to process 200-400 specimens.

**Activity Milestones:**

| Description | Approximate Completion Date |
|---|---|
| Sort and Identify specimens for analysis | December 31, 2027 |
| Develop SOP for dissection; Dissect first 50 specimens | December 31, 2027 |
| Dissect 100-150 specimens | June 30, 2028 |
| Dissect final specimens (50-150) | June 30, 2029 |

### Activity 2: Conduct analyses of microplastics and microbiomes

**Activity Budget:** $328,080

**Activity Description:**
The sampled organs will be processed as follows: 1- samples will be processed for microplastics screening by digesting organic matter in a strong hydrogen peroxide solution, then density separation of microplastics. Inorganic matter (such as plastics) will be filtered, stained, and identified by size, shape, and quantity – the exact plastic polymer of particle classes will be confirmed through FTIR spectroscopy for ~10% of each category. 2-a small amount of the organic matter (containing digested and microbial cells) from the lower intestines will be used for microbiome analysis while the remaining organ will be used for step 1. We will extraction DNA and sequence the gut microbiome to identify the composition of microbes. 3- we will visually examine the morphology of the GI tract to see if microplastics have caused pathologies. Using high resolution digital images, we will examine for physical impactions or other pathologies of macro- and micro- plastics. Our analyses will compare microplastics load (quality and quantity) across the ecological categories to assess if there is differential impact across areas/ecosystems/niches. We will also examine their relationships with microbiome variation to assess the impact on health, with diseased birds showing limited microbial diversity.

**Activity Milestones:**

| Description | Approximate Completion Date |
|---|---|
| Digestion of GI tract for microplastics | March 31, 2029 |
| Microbiome analyses of GI tracts | March 31, 2029 |
| Visual examination of GI tracts for pathologies | March 31, 2029 |

## Activity 3: Publish and disseminate results to agencies and conduct public programs

**Activity Budget:** $15,710

**Activity Description:**

We will compare levels of microplastics across species, biomes, feeding guilds, and habitats to see if there are significant differences of load across categories. We expect our results to indicate differences in exposure based on how birds interact with their environments and process resources. Differences in microbiomes or presence of impactions (bolus) are indications that microplastics affect absorption of nutrients (malnutrition). We hypothesize that there will be significantly different microbial communities in birds with high versus low microplastics loads. Previous studies have shown differences between terrestrial and aquatic environments, but our innovative study would be the first to examine microplastics load across several ecological categories. Since we will have specimens from across the state, we will compare our results to bird survey data and test the role of these pollutants in contributing to recent trends of population declines. We will collaborate with other projects examining microplastics in specific ecosystems such as stormwater systems, lakes, urban areas, to examine whether information gathered from different wildlife sources are congruent. We will disseminate our results through scientific papers, a public website, and reports to agencies. We will conduct public engagement programs to inform the public about the dangers of these emerging pollutants.

**Activity Milestones:**

| Description | Approximate Completion Date |
|---|---|
| Create a website to disseminate project information (aligned with Salvage Wildlife at the Bell Museum) | December 31, 2027 |
| Analyze microplastic load data and prepare publication | June 30, 2029 |
| Compare microbiome and microplastics data and prepare publication | June 30, 2029 |
| Public engagement opportunities through the Bell Museum (1-2 per year) | June 30, 2030 |
| Update website 2x per year | June 30, 2030 |

## Project Partners and Collaborators

| Name | Organization | Role | Receiving Funds |
|---|---|---|---|
| Emilie Snell-Rood | University of Minnesota - Twin Cities | Partner | Yes |
| Lea Pollack | University of Minnesota - Twin Cities | Collaborator | No |
| Melissa A. Maurer-Jones | University of Minnesota - Duluth | Collaborator | No |
| Sebastian Behrens | University of Minnesota | Collaborator | 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 disseminate information about the progress and results of our project in multiple ways. All of activities, communication products, and outreach program will acknowledge the Environment and Natural Resources Trust Fund through use of the trust fund logo or attribution language on project print and electronic media, publications, signage, and other communications per the ENTRF Acknowledgment Guidelines. Here are specific plans for dissemination of information -
1- create a website to provide collaborating institutions and the public information about our project and ways to participate. This site will be publically accessible and will include annual progress reports.
2- publish scientific publications. We will use the data from this project to produce scientific publications of our analyses. All collaborators will be invited to be co-authors on all publications resulting from this project. We expect ~5 publications to result from this project.
We will partner with the Bell Museum's Public Engagement and Science Learning (PESL) team to develop and implement a series of activities to engage K-12 and family audiences. The Bell Museum serves over 110,000 visitors from every county in Minnesota and nearly every state in the US each year.
The PESL team will meet with the project group in years 2 and 3 of the grant to develop the project team's core competencies in science communication, public engagement in science, and informal science learning. In year 2, the project team will participate in one of the Bell Museum's monthly Spotlight Science programs, a day-long exploration of a science topic, with opportunities for visitors to engage in hands-on learning, directly converse with researchers and special guests, and explore science careers. Team members, with coaching from the PESL team, will create and deliver one or more hands-on activities related to core themes of the grant such as the potential threats of microplastics. Spotlight Science draws a diverse, intergenerational audience, and the Bell Museum has discounted and free offerings to increase access for visitors who participate in public assistance programs. We will assess outcomes of these events, on both the visitors and the participating scientists and students, using our visitor experience survey and follow-up conversations with special guests.
In year 3, the team will continue work with the PESL team to either further develop and improve their hands-on activities to deliver in a second Spotlight Science or in a hands-on, inquiry-based learning module for a Bell Museum summer camp for middle school students (grades 7-8). The Bell Museum's popular summer camp serves over 800 K-8 students each year. To ensure access to all school-aged children and make a positive impact on STEM equity, the museum provides scholarships to a minimum of 10% campers based on participation in free and reduced lunch programs. Campers will interact with members of the project team, who will lead them in activities aligned with NGSS science practices, including making observations, collecting and analyzing data, and using science tools and equipment.

The Bell camp team uses a combination of camper/guardian surveys as well as reflective journaling practices to understand how camper engagement and attitudes towards STEM content, disciplines, and careers evolved through their participation in the module.

Year 1: Preparation and planning for broader impacts work. Year 2: Develop the project team's core competencies in science communication, public engagement in science, and informal science learning. Develop and deliver hands-on experience(s) in one public science program. Evaluate public and scientist learning. Year 3: Improve activity and deliver in a public science program with emphasis on grades 7-8 experience, with evaluation.

## 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?**
Our study will be of interest to many researchers, policy makers, and the public who are learning about microplastics. Given the high number of specimens and comparisons in this study, we anticipate publishing our results in high-profile scientific journals, garnering attention for MN's role in researching this emergent threat. We will aim to disseminate our results to wildlife agencies and municipal governments, if there are trends that can be mitigated through management. We will also use opportunities throughout the project duration for public engagement – these include social media posts, statewide engagement events, and public programs through the Bell Museum.

## Other ENRTF Appropriations Awarded in the Last Six Years

| Name | Appropriation | Amount Awarded |
|---|---|---|
| Salvaged Wildlife to Inform Environmental Health, Ecology, Education | M.L. 2023, , Chp. 60, Art. 2, Sec. 2, Subd. 03i | $486,000 |
| Visualizing Minnesota's Natural Resources with CT-Scanning | M.L. 2025, First Special Session, Chp. 1, Art. 2, Sec. 2, Subd. 03n | $955,000 |

## Project Manager and Organization Qualifications

**Project Manager Name:** Sushma Reddy

**Job Title:** Associate Professor and Curator of Birds

**Provide description of the project manager's qualifications to manage the proposed project.**
Sushma Reddy is the Breckenridge Chair of Birds, Curator of Birds at the Bell Museum, and Associate Professor at the Department of Fisheries, Wildlife, and Conservation Biology at the University of Minnesota. Her training includes a BA from Barnard College, MA and PhD from Columbia University. Reddy has extensive experience at museums, working at the American Museum of Natural History in New York and the Field Museum of Natural History in Chicago, and conducting research in over 20 museums across the globe. Reddy has over two decades of experience working with birds, natural history collections, specimen research, public outreach, and education. She has published dozens of peer-reviewed research articles, conducted numerous biodiversity surveys, and trained more than 100 high-school, undergraduate, and graduate students in research methods. In addition to being the curator in charge of the bird collection, Reddy is currently actively involved in several different aspects of the Bell Museum such as research, exhibits, education, and public engagement. She has several years of experience coordinating large, multi-institutional collaborations. She trains students and coordinates educational and public programs for people of all ages. Reddy has built ties to many statewide organizations related to conservation and wildlife to establish connections to natural history museum collections. Most recently, Reddy is the project manager of the LCCMR funded project called Salvage Wildlife

that has created a community-science initiative to collect freshly dead birds and mammals for scientific use and archival at the Bell Museum. This project has brought together many wildlife organizations in this collaboration and hundreds of wild specimens per year available for research, a tremendous resource for studying MN wildlife.

**Organization:** U of MN - Bell Museum

**Organization Description:**
We are Minnesota's official natural history museum, established by the legislature in 1872 and held in trust by the University of Minnesota. For over a century, the museum has preserved and interpreted our state's rich natural history and served learners of all ages. Additionally, our scientific collections contain over one million specimens, representing every county in Minnesota and various locales around the globe. Collections are a source for Minnesota's biodiversity record, scientific research, and teaching materials for all levels of education. As Minnesota's state natural history museum, our mission is to ignite curiosity and wonder, explore our connections to nature and the universe, and create a better future for our evolving world. Our vision is to energize a community that embraces the transformative nature of science.
We believe education is a journey and delight in the process of hands-on discovery. We believe in authenticity to engage curiosity. We reflect and respect diversity. We seek to preserve knowledge and biodiversity for the future. We value our visitors and partners and seek collaboration to enrich learning. We strive for excellence in all that we do and we are principled in the way we take care of our people and the planet.

## Budget Summary

| Category / Name | Subcategory or Type | Description | Purpose | Gen. Ineligible | % Benefits | # FTE | Classified Staff? | $ Amount |
|---|---|---|---|---|---|---|---|---|
| **Personnel** | | | | | | | | |
| Sushma Reddy, faculty | | project coordination and training; Budget includes 3 weeks of summer salary per year; Dr. Reddy is on a 9-month salary with UMN; 3% COLA per year | | | 36.6% | 0.24 | | $39,670 |
| Emilie Snell-Rood | | project organization; Budget includes 0.5 months of summer salary per year; Dr. Snell-Rood is on a 9-month salary with UMN; 3% COLA per year | | | 36.6% | 0.18 | | $35,760 |
| Angela Hornsby, Collections Manager | | data management; Budget includes 1 month of salary per year with 3% COLA | | | 36.6% | 0.3 | | $30,665 |
| Graduate Student, Research Assistant | | Graduate Research Assistant support for data collection ; 3 summers of RA with 3% COLA; Graduate student fringe is 24.2% | | | 24.2% | 0.75 | | $30,300 |
| Undergraduate researchers | | research support for data collection and analysis; 2 undergraduate per semester [15 weeks] for 4 semesters at 15.25/hr, 10 hrs per week | | | 0% | 0.1 | | $19,245 |
| Postdoctoral Fellow | | Data analysis and coordination of dissemination of results; 2.5 years with 0.03% COLA and 0.261 Fringe | | | 26.1% | 2.5 | | $222,650 |
| Director Of Public Engagement and Science Learning | | Project oversight of development of material and public engagement content for a series through the Bell Museum; years 2 and 3; 3% COLA per year | | | 36.6% | 0.04 | | $4,360 |
| Gallery Programs Coordinator | | Science communication training, program and activity development and implementation; years 2 and 3; 3% COLA per year | | | 36.6% | 0.06 | | $4,350 |
| | | | | | | | **Sub Total** | **$387,000** |
| **Contracts and Services** | | | | | | | | |
| University of Minnesota Genomics Center | Service Contract | Library prep [$14/sample for 500] and sequencing of microbiomes [2 runs at $2000] | | | | 0.2 | | $11,000 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| UMN Characterization Facility | Service Contract | Use of spectroscopy for identification of microplastic composition - cost of training plus 2 hours per specimen (40-50) | | | | 1 | | $5,000 |
| | | | | | | | **Sub Total** | **$16,000** |
| **Equipment, Tools, and Supplies** | | | | | | | | |
| | Tools and Supplies | supplies for dissection, reagents for processing microplastics, extracting DNA, containers for storing samples | scalpels, glassware, containers, foil, reagents, chemicals | | | | | $20,000 |
| | | | | | | | **Sub Total** | **$20,000** |
| **Capital Equipment** | | | | | | | | |
| | | | | | | | **Sub Total** | **-** |
| **Acquisitions and Stewardship** | | | | | | | | |
| | | | | | | | **Sub Total** | **-** |
| **Travel In Minnesota** | | | | | | | | |
| | | | | | | | **Sub Total** | **-** |
| **Travel Outside Minnesota** | | | | | | | | |
| | | | | | | | **Sub Total** | **-** |
| **Printing and Publication** | | | | | | | | |
| | Publication | open source publication fees | 2 publications | | | | | $2,000 |
| | Printing | outreach materials such as pamphlets, posters, exhibit content | printed material for outreach | | | | | $5,000 |
| | | | | | | | **Sub Total** | **$7,000** |
| **Other Expenses** | | | | | | | | |
| | | | | | | | **Sub Total** | **-** |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | **Grand Total** | **$430,000** |

## Classified Staff or Generally Ineligible Expenses

| Category/Name | Subcategory or Type | Description | Justification Ineligible Expense or Classified Staff Request |
|---|---|---|---|

## Non ENRTF Funds

| Category | Specific Source | Use | Status | Amount |
|---|---|---|---|---|
| **State** | | | | |
| | | | **State Sub Total** | **-** |
| **Non-State** | | | | |
| | | | **Non State Sub Total** | **-** |
| | | | **Funds Total** | **-** |

**Total Project Cost: $430,000**

**This amount accurately reflects total project cost?**

Yes

## Attachments

### Required Attachments

*Visual Component*

File: 1278a98b-9b2.pdf

*Alternate Text for Visual Component*

Graphic of varied landscape with caption: Microplastics are everywhere! Wildlife is exposed to microplastics through multiple sources and across different environments. Second graphic of bird dissection with caption: Dead birds tell tales! Salvaged birds from across the state contain information about the prevalence of microplastics and associated health impacts....

### Supplemental Attachments

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

| Title | File |
|---|---|
| Proposal Submission Authorization | 51f758ec-47e.pdf |
| Letter of Support Sebastian Behrens | 034f3f97-15d.pdf |
| Letter of Support Melissa Maurer-Jones | 09533b9f-7b2.pdf |
| Letter of Support Lea Pollack | fb03b3ad-8a1.pdf |

## Administrative Use

**Does your project include restoration or acquisition of land rights?**

No

**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?**

N/A

**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?**

Yes, Sponsored Projects Administration

**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 proposal:**

N/A

**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