Environment and Natural Resources Trust Fund

2027 Request for Proposal

General Information

Proposal ID: 2027-111

Proposal Title: Building a Superior Understanding of Minnesota's Small Mammals

Project Manager Information

Name: Dakota Rowsey

Organization: Science Museum of Minnesota

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Project Basic Information

Project Summary: We will mobilize data from small mammal specimens to identify factors driving Lyme disease expansion and support emerging pathogen research on these species that are key to ecosystem function.

ENRTF Funds Requested: $690,000

Proposed Project Completion: June 30, 2030

LCCMR Funding Category: Fish and Wildlife (D)

Project Location

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

Region(s): NE, Metro,

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.

Small mammals are important for Minnesota's ecosystem, including as food for larger animals, seed dispersers, pest managers, and parasite hosts. Institutions such as the Science Museum of Minnesota (SMM) steward collections that provide a basis for understanding these roles. Our specimens embody verifiable data from past and present that managers and policymakers can use to protect biodiversity and ecosystem function, predict changes in species rarity, and safeguard against emerging threats. In the latter case, one of the largest emerging threats to Minnesotans' ability to recreate and work in outdoor spaces is the growing prevalence of Lyme Disease. This disease, caused by the bacteria Borrelia burgdorferi, is spread by Ixodes ticks from rodents to other mammals, including humans. This disease was first monitored in Minnesota in 1982; it has grown to an estimated 3,000 new cases annually but remains poorly understood. SMM stewards a rich collection of approximately 17,000 small mammals collected between 1983-1999 from Superior National Forest, including state-listed species of conservation concern. However, the necessary data to research emerging threats from a historical lens are currently inaccessible to outside researchers, preventing their use to better understand how wildlife and pathogens are changing in Minnesota's boreal zone.

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 make the ~17,000 specimens from the SNF available to a broader audience, particularly for researchers studying emerging threats relating to Minnesota wildlife, as well as state and federal wildlife management professionals. First, we will secure the specimens' long-term stability. We will update the storage of this collection to modern standards, for example, by replacing deteriorating plastic buckets with archival glass jars for the alcohol-preserved specimens in this collection. Second, we will compile and publish data, including where and when each specimen was collected, measurements, ecological data, physiological data, specimen photographs, and more, for every specimen through curated online databases, a process known as digitization. We will also mobilize the data in formats accessible to agencies such as the Minnesota County Biological Survey to connect these historical data to current mammal sampling in the region. Finally, the project will culminate in use of the specimens by Dr. Benjamin Clarke, biomedical researcher studying zoological diseases at the University of Minnesota, to study changing patterns of tick-borne pathogens in small mammal populations within and among species, an important step in understanding how those patterns have impacted wildlife and human populations over time.

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?

The outcomes of this project encompass the 2027 LCCMR funding priority D: Fish and Wildlife, specifically goals 1, 2, 4, and 7, while enabling resource managers to act on goals 3, 5, and 6. Data mobilized by this project will enhance knowledge of population trends for state-listed small mammal species and predictions of food stocks for predatory birds and larger mammals.

Additionally, these data will provide historic baselines for mammal surveys conducted by entities like MNCBS and the 1854 Treaty Authority. Analyzing historic trends in emerging wildlife pathogens will help inform how these pathogens persist in reservoir species in Minnesota.

Activities and Milestones

Activity 1: Inventorying and rehousing SNF skulls and fluid-preserved carcasses

Activity Budget: $161,140

Activity Description:
These specimens are prepared in fluid (ideal for anatomical and pathogen studies), dried skins (ideal for ectoparasite and pelage coloration studies), and skeletons and skulls (ideal for morphological and size studies). They are currently stored in different locations with no database of storage locations, making it difficult for researchers to study an entire individual. The initial work of the project will be to safeguard the specimens in the collection for future research by upgrading their storage to archival quality and generating a specimen inventory for creating digital records in Activity 2. We will do this by transferring fluid-preserved specimens from the degrading plastic buckets in which they are currently stored to glass jars, which are the best long-term storage solution. We will also move the skulls and skeletons from the older cabinets in unsecured locations where they are currently stored. The inventory we will generate during handling each specimen for rehousing will include the unique identifier for every specimen and storage location so we can begin electronically reassociating the disparate prepared portions of each specimen (fluid preserved carcasses, skins, skeletons, and skulls). Progress on Activity 1 will enable the specimens to be used in research conducted in Activity 3.

Activity Milestones:

Description	Approximate Completion Date
Hire collection technician to carry out Activities 1 and 2	August 31, 2027
Inventory and rehousing of SNF fluid-preserved carcasses into archival glass jars	March 31, 2028
Reorganize Osteology Collection and Transfer SNF Skulls	June 30, 2028
Inventory SNF skulls	November 30, 2028

Activity 2: Digitizing SNF specimen records and disseminating project results

Activity Budget: $163,756

Activity Description:
Using the electronic inventory generated in Activity 1, we will next create data-rich records from the full complement of information associated with each specimen. Each specimen's unique identifier points to detailed field notes that include information about where and when the specimen was collected as well as habitat notes, physical measurements, and reproductive data. We will scan the SNF field catalogs, transcribe data, georeference locality information into our collection management system (CMS), and print these data onto tags to attach to the specimens for quick identification. These data will enable more accurate species distributions and county checklists, highlight locations and times of the year that require additional sampling, enable comparison between unknown specimens and those vouchered at the SMM, and allow summaries of prey base availability for birds and larger mammals (see Attachments). We will format these data so that they can be exported for use not only for other researchers, through portals like GBIF and iDigBio, but also for Minnesota-based wildlife management professionals through platforms like the Minnesota Biodiversity Atlas hosted by the Bell Museum of Natural History (LCCMR ENRTF 2023-248) and the Minnesota Natural Heritage Information System hosted by the Minnesota Department of Natural Resources.

Activity Milestones:

Description	Approximate Completion Date
Scanning and transcribing field notes and georeferencing specimens	November 30, 2029
Printing and attaching data tags to specimens	March 31, 2030
Presenting project results at American Society of Mammalogists meeting	June 30, 2030

Sharing SMM's database records with data aggregators	June 30, 2030

Activity 3: Using SNF small mammals to predict wildlife pathogen risk

Activity Budget: $365,104

Activity Description:

Activity 3 is a targeted surveillance strategy to map the ecological transmission of tick-borne pathogens within small mammal populations. This strategy is made possible by this unique source of specimens from a 20-year timespan, but cannot be implemented until the specimens are made accessible through Activities 1 and 2. The protocol begins with a comprehensive microbiome assay of a diverse spatiotemporal sample of previously-inventoried specimens to assess total microbial diversity. Upon detecting pathogenic bacteria, high-sensitivity confirmatory analyses are utilized to verify the pathogens' identity and quantity. Central to this investigation is the white-footed mouse (Peromyscus leucopus), the keystone reservoir for the blacklegged tick. As these mice effectively harbor and transmit Lyme-disease-causing Borrelia burgdorferi without exhibiting illness, they are the foundational markers for identifying high-risk geographic regions. Following this initial screening, the study extends to other small mammals, such as voles and shrews, to evaluate host plasticity. This comparative analysis determines whether the bacteria can adapt to the immune environments of different species. By tracking this cross-species adaptation, the research aims to quantify how various members of the ecosystem contribute to the persistence of Lyme disease, providing critical insights for wildlife management practices that could mitigate the spread of tick-borne pathogens.

Activity Milestones:

Description	Approximate Completion Date
Establish standardized protocols and SOPs for the genetic analysis of research specimens	December 31, 2027
Recruit, hire, and train a Postdoctoral fellow in specialized genetic sequencing and analysis techniques.	June 30, 2028
Select and analyze SMM specimens to map and document broad microbial diversity	June 30, 2030
Perform targeted testing on specimens to confirm the presence of specific pathogenic microbes	June 30, 2030
Synthesize data, submit manuscripts for publication, and deliver public presentations on project findings.	June 30, 2030

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.
A major deliverable of this project is availability of data for natural resource management and research purposes. Through uploading the data to a variety of portals used by different communities of professionals, we hope to reach a wide audience over time. We also plan to communicate the availability of these data by presenting the availability and summary of this resource at the American Society of Mammalogists conference in Summer 2030 - one of the milestones of Activity 2. We also plan to present these results to the non-game wildlife division of the MN DNR via virtual webinar in year 3 of the project. Results from Activity 3 will be shared thourhgthe Ixodes Outreach Project established by collaborator Dr. Benjamin Clarke, which disseminates information about ticks and associated pathogens through public seminars, multimedia interviews, and social media. Results from the wildlife pathogen surveillance activity will be published in peer-reviewed publications that credit the ENRTF as a funding source. Finally, because the project will take place at the Science Museum of Minnesota, our institution is afforded the opportunity to communicate the depth of this collection and its importance for Minnesota natural resource conservation through events such as in-house and external tabling to discuss it with visitors to the museum and partnering organizations, which we routinely do as a part of our mission of science accessibility for all.

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?
The specimens being organized in this proposal are part of SMM's Biology Collection, the maintenance of which is funded by SMM's operating budget and the curation of which is funded by an endowed position. The digitized specimen data will be stored in SMM's collection management system, which is also funded by SMM's operating budget and is backed up nightly. That data will also be shared with data aggregators like the Global Biodiversity Information Facility (GBIF), which is funded by a multi-institutional network of governments and other agencies to support biodiversity data infrastructure. Data shared with the Natural History Information System (NHIS) will

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Digitizing the Science Museum of Minnesota's Mollusk Specimens	M.L. 2025, First Special Session, Chp. 1, Art. 2, Sec. 2, Subd. 03e	$386,000

Project Manager and Organization Qualifications

Project Manager Name: Dakota Rowsey

Job Title: Biology Collection Manager

Provide description of the project manager's qualifications to manage the proposed project.
Dakota Rowsey has a PhD in Ecology, Evolution, and Behavior from the University of Minnesota, where he studied the evolution of small mammals using museum specimens. As a postdoctoral researcher, he worked at the Field Museum of Natural History in Chicago, IL, performing specimen-based research. In 2020, he started a position as the Vertebrate Collections Manager at Arizona State University Natural History Collections, where he maintained and added specimens to the collection for research use, including reactivating a mammal collection that had languished for 30 years and

making data from all vertebrate collections searchable by the public. In his current role as the Science Museum of Minnesota's Biology Collection Manager he plans and manages digitization project workflows, including the recently funded ENRTF-supported Minnesota Mollusk Digitization project (2025-070) as well as subawards from ENRTF-supported projects awarded to the Bell Museum of Natural History (2023-248 and 2023-146). He also oversees the care and maintenance of the estimated 140,000 specimens that are a part of the Science Museum of Minnesota's biology collection. Among his chief priorities are making natural history specimens and their data accessible to a broad audience for use in biodiversity and conservation research.

Organization: Science Museum of Minnesota

Organization Description:
The Science Museum of Minnesota (SMM) was founded as the St. Paul Academy of Arts and Letters in 1907. The Academy offered lectures on scientific issues relevant to the community; in its first year, the Academy sponsored over 100 lectures, attracting thousands of attendees. In the over one hundred years since, SMM has grown from an exclusive scientific literary society to an institution nationally and internationally recognized for its innovative programming, dynamic exhibits, research, and science learning resources, from professional development workshops for K--12 teachers and student programming to cutting-edge digital resources to share our assets internationally. Today, we are one of Minnesota's leading cultural attractions and educational resources, focused on equitable and impactful STEM learning opportunities for all. We specialize in interactive STEM (science, technology, engineering, and math) exhibits that emphasize hands-on learning while integrating our tradition as a natural history museum with interpretive exhibits, collections featuring two million artifacts and specimens, and scientific research that address issues vital to our collective future. Our stewardship of a world-class collection of artifacts and specimens, along with the ongoing active research in our Center for Research and Collections, plays a crucial role in informing policies, practices, and solutions.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Biology Collection Manager		Developing project workflows, assisting Digitization Technician, coordinating specimen use, managing specimen data transfer			24%	0.63		$56,277
Barbara Brown Chair of Ornithology		Supervising Digitization Technician, designing workflows and responsibilities			24%	0.57		$72,913
Director of Collections Stewardship		Consulting on and helping to plan moving, rehousing, and long-term storage of specimens.			24%	0.33		$47,083
Registrar		Planning digitization, data management, and data sharing of specimens			24%	0.33		$41,431
Digitization Technician		Conducting specimen inventory, implementing digitization workflow			24%	2.85		$163,245
							Sub Total	**$380,949**
Contracts and Services								
Dr. Benjamin Clarke, Professor, University of Minnesota Department of Biomedical Sciences	Subaward	Subaward for Clarke Lab for small mammal pathogen analysis. Includes PI salary at 0.08 FTE/yr ($79,013), Postdoc salary at 0.52 FTE/yr ($126,929), microbiome sample analysis reagents ($90,973), and 3 trips to SMM for sample pickup and transport to UMD ($1,317)				1.8		$298,232
							Sub Total	**$298,232**
Equipment, Tools, and Supplies								
	Tools and Supplies	Cost for specimen tags to encompass ~17000 fluid preserved specimens and study skins. Price includes proofs and shipping.	These tags are used to identify individual specimens and are designed					$2,863

			not to fade due to alcohol immersion or light.					
	Tools and Supplies	Specimen storage costs, including jars, lids, and ethanol for ~15,000 specimens	These costs will enable rehousing specimens into containers that will better safeguard the specimens' future than their current deteriorating fluid storage					$4,397
	Tools and Supplies	PPE, including disposable gloves, 3 reusable aprons, and 3 pairs of safety goggles	These supplies will allow workers to safely handle fluid specimens for large-scale rehousing projects					$482
	Tools and Supplies	Vials, cheesecloth, and poly tubing for packing tissue samples and whole specimens in alcohol	These supplies will enable specimens to be packed and transferred between SMM and UMN Duluth while preserving sample integrity and complying with US Department of Transportation regulations					$1,019
							Sub Total	**$8,761**
Capital Equipment								
							Sub Total	**-**
Acquisitions and Stewardship								
							Sub Total	**-**
Travel In Minnesota								
							Sub Total	**-**
Travel Outside Minnesota								
	Conference Registration Miles/ Meals/ Lodging	Registration for American Society of Mammalogists Conference	Travel to ASM conference to present results of LCCMR project to an audience of potential users	X				$575
	Conference Registration Miles/ Meals/ Lodging	lodging for 6 nights at ASM conference	Allows travel to ASM conference to present results of LCCMR project to an audience of potential users	X				$600

	Conference Registration Miles/ Meals/ Lodging	Airfare cost for travel to ASM Conference	Allows travel to ASM conference to present results of LCCMR project to an audience of potential users	X				$475
	Conference Registration Miles/ Meals/ Lodging	Per Diem for Travel to ASM	Allows travel to ASM conference to present results of LCCMR project to an audience of potential users	X				$258
	Conference Registration Miles/ Meals/ Lodging	Ground transportation while at ASM conference	Allows travel to ASM conference to present results of LCCMR project to an audience of potential users	X				$150
							Sub Total	**$2,058**
Printing and Publication								
							Sub Total	**-**
Other Expenses								
							Sub Total	**-**
							Grand Total	**$690,000**

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
Travel Outside Minnesota	Conference Registration Miles/Meals/Lodging	Registration for American Society of Mammalogists Conference	The funds requested will allow us to travel to the annual American Society of Mammalogists conference to present this new vast dataset to encourage its research use
Travel Outside Minnesota	Conference Registration Miles/Meals/Lodging	lodging for 6 nights at ASM conference	The funds requested will allow us to travel to the annual American Society of Mammalogists conference to present this new vast dataset to encourage its research use
Travel Outside Minnesota	Conference Registration Miles/Meals/Lodging	Airfare cost for travel to ASM Conference	The funds requested will allow us to travel to the annual American Society of Mammalogists conference to present this new vast dataset to encourage its research use
Travel Outside Minnesota	Conference Registration Miles/Meals/Lodging	Per Diem for Travel to ASM	These funds will allow us to travel to the American Society of Mammalogists conference to present the results of this LCCMR funded project - a vast assortment of specimen data - to an audience of scientists who may find use in the data.
Travel Outside Minnesota	Conference Registration Miles/Meals/Lodging	Ground transportation while at ASM conference	These funds will allow us to travel to the American Society of Mammalogists conference to present the results of this LCCMR funded project - a vast assortment of specimen data - to an audience of scientists who may find use in the data.

Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
State				
			State Sub Total	**-**
Non-State				
In-Kind	Unrecovered indirects	Overhead costs needed to implement project at Science Museum of Minnesota	Pending	$191,054
			Non State Sub Total	**$191,054**
			Funds Total	**$191,054**

Total Project Cost: $881,054

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: 4acf425f-f57.pdf

Alternate Text for Visual Component

This graphic shows examples of small mammal specimens in the SMM collection. It also shows fluorescent spectroscopy of Borrelia burgdorferi infecting rodent tissues, with a description of how this pathogen is transmitted to humans. The image describes how specimens can help scientists study emerging pathogens and other wildlife biology topics....

Supplemental Attachments

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

Title	File
Subaward Institutional Commitment Form - UMN SPA	4c9c29e2-f6f.pdf
Subaward Statement of Work - UMN SPA	71dd63b7-26d.pdf
Subaward Budget Justification - UMN SPA	d51bb036-106.pdf
Institutional Support Letter - Alison Rempel Brown, CEO SMM	2b47db12-953.pdf
Letter of Support - Michael Joyce	d33f3e95-a3d.pdf
Letter of Support - Sharon Jansa	eedd39c8-228.pdf
Letter of Support - Benjamin Clarke	29dca05f-da5.pdf
Independent Audit	8f191e40-bca.pdf
Good Standing MN Secretary of State Letter	583721aa-b2a.pdf
SMM FY24 990	164f5cb7-622.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?

Yes, I understand the Commissioner's Plan applies.

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?

No

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:

Catherine Early, Science Museum of Minnesota
Benjamin Clarke, University of Minnesota

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

N/A