Environment and Natural Resources Trust Fund

2025 Request for Proposal

General Information

Proposal ID: 2025-130

Proposal Title: Visualizing Minnesota's Natural Resources with CT-Scanning

Project Manager Information

Name: Kassandra Ford

Organization: U of MN - Bell Museum of Natural History

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Project Basic Information

Project Summary: This project will provide a new and innovative way to obtain and disseminate internal morphology data from the Bell Museum's organismal collections.

ENRTF Funds Requested: $1,062,000

Proposed Project Completion: July 31, 2027

LCCMR Funding Category: Foundational Natural Resource Data and Information (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?

Region(s): Central, Metro, NE, NW, SE, SW,

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.

The Bell Museum is the state's natural history museum and stores an invaluable collection of Minnesota biodiversity specimens. Scientists obtain extensive data from these specimens (e.g. genetics, ecology, geography, external morphology) and Minnesota researchers are at the forefront of this research. Information about the internal morphology of organisms has historically been hard to obtain, but modern technology, such micro-CT scanners, allows us to preserve intact specimens and obtain valuable information about internal structures to inform diet, sensory systems, pathologies, and anatomy. We propose purchasing this equipment and housing it at the Bell Museum to increase the scope of Minnesota's scientific efforts, and the state's global research impact. The Bell Museum has existing infrastructure to support a scanner and the frameworks for disseminating the data (Arctos, Minnesota Biodiversity Atlas). Micro-CT scanning generates 3D objects for visualization and printing for hands-on outreach and education experiences. While other university departments have similar types of equipment, they're not accessible to many Minnesota researchers because of the equipments' specifications, availability, and cost. This new equipment will be a scanner dedicated to biodiversity research and will function as a complementary and affordable way to foster collaborative studies on Minnesota organisms, both native and invasive.

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 take an innovative approach to obtain internal morphology information from Bell Museum specimens using a micro-CT scanner: Nikon XTH 225. A smaller and more powerful version of a medical CAT scanner, a micro-CT scanner performs non-destructive sampling of bones and soft tissue of organisms. These scanners have broad scientific applications and are in high demand, with hundreds of institutions applying for scanners through NSF grants and thousands of relevant publications each year (e.g., #ScanAllFishes, oVert). LCCMR has funded 2D digitization of the Bell Museum's herbarium, but this funding would allow for the 3D digitization of all vertebrate collections for research, education, and outreach. Adding this data to museum databases will improve the accessibility of the Bell Museum collections and each scanner user would expand the impact of LCCMR through citations. There are immediate applications for this data, with confirmed collaborators working on native and invasive species across the state (see list below and supplemental letters of support). The scans would provide additional opportunities for outreach and education through these collaborators. The Bell Museum has the capacity for housing the equipment and relevant data, both through physical space, technical experience, and online repositories for information storage and dissemination.

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 would effectively double the information capacity of the natural history collection for academic and agency research. Our long-term goals are to scan the entire Bell Vertebrate Collection and ensure the equipment is always available for scanning Minnesota organisms. We aim to scan a minimum of 200 specimens from each Bell collection (Fish, Birds, Mammals, Reptiles & Amphibians, and Plants) for dissemination through museum databases. We anticipate 20 visiting researchers from Minnesota during the award period, connecting the Bell to important statewide projects. Scans and 3D printers will provide teaching material for K-12 educators, Bell exhibits, and statewide engagement events.

Activities and Milestones

Activity 1: Purchase and Implementation of a new Minnesota Resource

Activity Budget: $695,000

Activity Description:
We will obtain bids from various micro-CT scanning companies, including Nikon and Bruker, to assess which model best fits the state's research needs. The first specimens scanned will be Minnesota organisms from the Bell Museum collections and the LCCMR-funded Salvage Wildlife project. We will create a website to disseminate technical specifications, example scans, and our proposed sustainability model for covering the annual costs. The priority for this scanner will remain focused on Minnesota, with additional scanning projects will provide the necessary funds to cover the annual maintenance fees for repair, troubleshooting, and software updates. During the first year of the grant, the scanner will be free to use and restricted to Minnesota researchers. After the first year of scanning, we will transition to a projected sustainable budget model to obtain $20,000 per year for annual maintenance costs. We will assess tiered fees ranging from $25/hour to $50/hour, depending on the services provided, the researcher's institution, and if the project involves Minnesota organisms. We will continue to keep the machine free for Minnesota-focused researchers for the first two years and longer if we can maintain a sustainable budget.

Activity Milestones:

Description	Approximate Completion Date
Obtain bids for CT Scanner purchase	July 31, 2025
Purchase of CT Scanner	August 31, 2025
Preparation of the physical space for scanner installation	October 31, 2025
Creation of website for dissemination of information and Sustainability Model for CT Scanner use	October 31, 2025
Installation of CT Scanner	January 31, 2026
Maintenance Costs for calendar year (2026)	January 31, 2026
Implement Sustainability Model (begin advertisement of scanner and protocol to request access)	January 31, 2026
Maintenance Costs for calendar year (2027)	January 31, 2027

Activity 2: CT Scanning Minnesota organisms and connection to Museum Databases #ScanMNOrganisms

Activity Budget: $297,000

Activity Description:
The Bell Museum will scan at least 200 specimens from each vertebrate collection and the herbarium during the first two years of the grant and will distribute that data to Arctos and the Minnesota Biodiversity Atlas. We will notify Minnesota researchers about this equipment and its uses in their research, aiming for at least 10 visitors each year of the grant. We already have 27 individuals from 13 universities and institutions who have a strong interest in using this scanner for their research, teaching, and education efforts (see supplementary letters of support). In the first year of our grant we will begin advertising the cost-effective scanning options that will cover the maintenance costs. All data collected from these scans will be shared two ways: online through the museum databases and through physical copies provided to the individual who performed or paid for the scans. We anticipate this data will be used in published academic research, agency work on native and invasive species in Minnesota, and in outreach and education efforts across the state. This will broaden the reach of the Bell Museum and LCCMR, launching the state of Minnesota to the forefront of innovative research.

Activity Milestones:

Description	Approximate Completion Date
Connect Scanning data to museum databases for easy data acquisition (ARCTOS and Minnesota Biodiversity Atlas)	December 31, 2026
Minnesota Researchers Visit and Use Equipment (2026)	December 31, 2026
Upload Bell Museum Year 1 scans to Arctos (2026)	December 31, 2026
Train students through obtaining 100 specimen scans of each Bell Museum Collection (2026)	December 31, 2026
Minnesota Researchers Visit and Use Equipment (2027)	July 31, 2027
Train students through obtaining 100 specimen scans of each Bell Museum Collection (2027)	July 31, 2027
Upload Bell Museum Year 2 scans to Arctos (2027)	July 31, 2027

Activity 3: Expanding the reach of Minnesota's Natural History Collections

Activity Budget: $70,000

Activity Description:

The scans obtained using the micro-CT scanner will be further disseminated through 3D prints of anatomical structures and publicly available files. Several new 3D printers will be part of the Bell Museum's research facilities and will assist with education and outreach tools needed by various partner institutions across the state (e.g., Science Museum of Minnesota, Minnesota Ecological Centers, and the Bell Museum's Statewide Engagement team). The Bell Museum has received several requests from public outreach centers in Northern Minnesota for bone samples from the vertebrate collection for educational purposes. Because of the legal protections associated with some species and the fragile nature of bones, sending 3D prints is a better solution than loaning museum specimens. The scans from Activity 2 can be used to 3D print replicas of these bones for use by these institutions, without any of the issues listed above. These prints can also be used in the organismal courses offered by Minnesota universities and K-12 classrooms across the state. Additionally, the files associated with these prints can be uploaded to open-source platforms for 3D printing, further expanding the reach of the Bell Museum's collections across the world.

Activity Milestones:

Description	Approximate Completion Date
Purchase of 3D printers	January 31, 2026
Installation of 3D printers	February 28, 2026
Establish connection between Minnesota organismal scans and open-source platforms for 3D printing	June 30, 2026
Outreach programs at the Bell Museum and partner institutions (2026)	December 31, 2026
Educational programs at the University of Minnesota - Twin Cities and statewide K-12 classrooms (2026)	December 31, 2026
Outreach programs at the Bell Museum and partner institutions (2027)	July 31, 2027
Educational programs at the University of Minnesota - Twin Cities and statewide K-12 classrooms (2027)	July 31, 2027

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Sushma Reddy	University of Minnesota - Bell Museum of Natural History	Co-PI	Yes
Sharon Jansa	University of Minnesota - Bell Museum of Natural History	Co-PI	Yes
Keith Barker	University of Minnesota - Bell Museum of Natural History	Co-PI	Yes
Nicholas Phelps	Minnesota Aquatic Invasive Species Research Center, Fisheries, Wildlife, and Conservation Biology Department, University of Minnesota - Twin Cities	User/Collaborator	No
Solomon David	Fisheries, Wildlife, and Conservation Biology Department, University of Minnesota - Twin Cities	User/Collaborator	No
Peter Makovicky	Earth and Environmental Science Department, University of Minnesota - Twin Cities	User/Collaborator	No
Samantha Thi Porter	Liberal Arts Technologies and Innovation Services, University of Minnesota - Twin Cities	User/Collaborator	No

Victoria Hall	The Raptor Center, University of Minnesota - Twin Cities	User/Collaborator	No
Alan Mensinger	Biology Department, University of Minnesota - Duluth	User/Collaborator	No
Thomas Hrabik	Biology Department, University of Minnesota - Duluth	User/Collaborator	No
Kurt Illig	Neuroscience Department, University of St. Thomas	User/Collaborator	No
Sarah Boyer	Biology Department, Macalester College	User/Collaborator	No
Kristi Curry Rogers	Biology Department, Macalester College	User/Collaborator	No
Raymond Rogers	Biology Department, Macalester College	User/Collaborator	No
Catherine Early	Science Museum of Minnesota	User/Collaborator	No
Alex Hastings	Science Museum of Minnesota	User/Collaborator	No
Jennifer Lamb	Biology Department, St. Cloud State University	User/Collaborator	No
Matthew Davis	Biology Department, St. Cloud State University	User/Collaborator	No
Andrew Hafs	Biology Department, Bemidji State University	User/Collaborator	No
Takashi Maie	Biology Department, St. Olaf College	User/Collaborator	No
Tony Gamble	Biology Department, Marquette University	User/Collaborator	No

Dean Adams	Ecology, Evolution, and Organismal Biology Department, Iowa State University	User/Collaborator	No
John Stuler	UW Zoological Museum, University of Wisconsin - Madison	User/Collaborator	No
Anna Pidgeon	UW Zoological Museum, University of Wisconsin - Madison	User/Collaborator	No
Laura A Monahan	UW Zoological Museum, University of Wisconsin - Madison	User/Collaborator	No
Brandon Waltz	Biology Department, University of Iowa	User/Collaborator	No
L. Patricia Hernandez	Biological Sciences Department, George Washington University	User/Collaborator	No

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 goal is to create a self-sustaining micro-CT scanning facility for long-term research on Minnesota organisms. We can obtain the necessary funds for the maintenance costs of the micro-CT scanner while still providing ample time for scanning Minnesota organisms. We believe this equipment will bring natural history collection data directly into the hands of Minnesota youth through innovative teaching methods and hands-on learning experiences. Researchers can use information from our efforts for their scientific research, broadening the impact of our state. The Bell Museum, with the assistance of LCCMR, can bring science to the public in brand new ways.

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
Minnesota Biodiversity Atlas - Phase 3	M.L. 2023, , Chp. 60, Art. 2, Sec. 2, Subd. 03s	$797,000
Northward Expansion of Ecologically-Damaging Amphibians and Reptiles	M.L. 2023, , Chp. 60, Art. 2, Sec. 2, Subd. 06a	$163,000

Project Manager and Organization Qualifications

Project Manager Name: Kassandra Ford

Job Title: Assistant Professor and Curator of Ichthyology & Malacology at the Bell Museum

Provide description of the project manager's qualifications to manage the proposed project.
The project manager is a tenure-track assistant professor and museum curator with the University of Minnesota - Twin Cities and the Bell Museum of Natural History. They are responsible for managing a large ichthyology collection, mentoring graduate students, and performing research at a high caliber. The manager has extensive experience with the proposed project and its equipment and will be qualified and ready to lead the project during the grant period and beyond.

Organization: U of MN - Bell Museum of Natural History

Organization Description:
The Bell Museum of Natural History is the state's natural history museum and houses incredibly important biodiversity specimens from Minnesota. It provides opportunities for research, public engagement, and education at a statewide level. The Bell ignites and sustains curiosity for nature and the universe through programming, curation, and outreach.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Research Support 2 employee		Management and Performance of duties associated with CT scanner, including scanning specimens sent to the facility for scanning. Will also train students and users on equipment. 2 years of funding at $80k (salary + benefits).			33.5%	2		$160,000
Faculty Summer Salary for Project Manager		Research on scanned Minnesota museum specimens during the summer terms during two years of the award			37.1%	0.5		$95,500
Faculty Salary-Summer & AY (Sharon Jansa)		Management of both Research Support 2 position and Graduate Students funded by grant.			37.1%	0.02		$5,100
Faculty Salary-Summer & AY (Keith Barker)		Management of both Research Support 2 position and Graduate Students funded by grant.			37.1%	0.02		$4,100
Faculty Salary-Summer & AY (Sushma Reddy)		Management of both Research Support 2 position and Graduate Students funded by grant.			37.1%	0.02		$4,300
Graduate Student Assistantship		Graduate student assistantships for running the scanner, coordinating specimen loans and scans, outreach efforts, and maintaining the 3D printers. 1 full year of 75% funding. Benefits include Tuition ($22.41/hour)			25.1%	1		$88,000
							Sub Total	**$357,000**
Contracts and Services								
							Sub Total	**-**

Equipment, Tools, and Supplies								
	Equipment	Desktop computer, Computer monitor	Necessary equipment to properly run the CT scanner and its relevant software.	X				$5,000
	Equipment	3D printers (2x Form3Labs printers)	Equipment to print resin models of scanned specimens for outreach, education, and research purposes					$5,000
	Tools and Supplies	3D printing supplies (resin, tanks, etc.)	Equipment to print resin models of scanned specimens for outreach, education, and research purposes					$5,000
							Sub Total	**$15,000**
Capital Expenditures								
		Nikon XTH-225 CT Scanner	Micro CT-scanner for visualizing internal shape of organisms in 3D using x-rays. Annual maintenance contract through Nikon to cover repairs, emergencies, and software associated with the scanner. 2 years of funding.	X				$690,000
							Sub Total	**$690,000**
Acquisitions and Stewardship								
							Sub Total	**-**
Travel In Minnesota								
							Sub Total	**-**
Travel Outside Minnesota								
							Sub Total	**-**
Printing and Publication								

							Sub Total	**-**
Other Expenses								
							Sub Total	**-**
							Grand Total	**$1,062,000**

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
Capital Expenditures		Nikon XTH-225 CT Scanner	Information about the internal morphology of organisms has historically been hard to obtain, but modern technology, such micro-CT scanners, allows us to preserve intact specimens and obtain valuable information about internal structures to inform diet, sensory systems, pathologies, and anatomy. This new equipment will be a scanner dedicated to biodiversity research and will function as a complementary and affordable way to foster collaborative studies on Minnesota organisms, both native and invasive. **Additional Explanation :** Our long-term goals are to scan the entire Bell Vertebrate Collection and ensure the equipment is always available for scanning Minnesota organisms, beyond the grant time period.
Equipment, Tools, and Supplies		Desktop computer, Computer monitor	Necessary equipment to properly run the CT scanner and its relevant software. The scanner will not function without a desktop computer with approximately 128GB of RAM and a high-quality graphics card. **Additional Explanation :** This equipment is necessary for running the requested equipment and will remain with the micro-CT scanner for the entirety of the computer's lifespan.

Non ENRTF Funds

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

Total Project Cost: $1,062,000

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: 895b1506-a82.pdf

Alternate Text for Visual Component

The graphic shows current data housed in Minnesota's Bell Museum collections, the missing information (internal morphology), and the Missing Link to obtain that data: a micro-CT scanner (Nikon XT H 225). The graphic shows collaborators who would use the equipment for research purposes, along with our sustainability model....

Supplemental Attachments

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

Title	File
Letters of Support	406773f1-8b0.pdf
Ford Endorsement letter	12e544bc-4d2.pdf

Administrative Use

Does your project include restoration or acquisition of land rights?

No

Does your project have potential for royalties, copyrights, patents, sale of products and assets, or revenue generation?

Yes

Do you understand and acknowledge IP and revenue-return and sharing requirements in 116P.10?

No

Do you wish to request reinvestment of any revenues into your project instead of returning revenue to the ENRTF? If so, describe here (1) the source and estimated amounts of any revenue and (2) how you propose to use those revenues:

Yes, During the first year of the grant, the scanner will be free to use and restricted to Minnesota researchers. After the first year of scanning, we will transition to a projected sustainable budget model to obtain $20,000 per year for annual maintenance costs. We will assess tiered fees ranging from $25/hour to $50/hour, depending on the services provided, the researcher's institution, and if the project involves Minnesota organisms. We will continue to keep the machine free for Minnesota-focused researchers for the first two years and longer if we can maintain a sustainable budget. Those fees will only be used to cover maintenance fees for the machine during its lifespan.

Does your project include original, hypothesis-driven research?

No

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:

Dr. Kassandra Ford (UMN-Bell Museum), Jennifer Olson (Bell Museum), Blaine Chaulklin (Sponsored Projects Administration UMN)