Environment and Natural Resources Trust Fund

2027 Request for Proposal

General Information

Proposal ID: 2027-442

Proposal Title: Saving Common Terns: Decoding Drivers of Population Decline

Project Manager Information

Name: Annie Bracey

Organization: U of MN - Duluth - NRRI

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Project Basic Information

Project Summary: Minnesota's state-threatened Common Tern faces declining colony productivity. This project integrates long-term monitoring, mercury exposure, and environmental data to identify drivers of decline and guide conservation actions supporting population recovery.

ENRTF Funds Requested: $290,000

Proposed Project Completion: June 30, 2030

LCCMR Funding Category: Small Projects (G)

Secondary Category: Fish and Wildlife (D)

Project Location

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

Region(s): NE

What is the best scale to describe the area impacted by your work?

Statewide

When will the work impact occur?

During the Project

Narrative

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

Common Terns are a state-threatened species and the number of active nesting locations has declined sharply, falling to only two primary colonies in less than a decade. These colonial waterbirds migrate thousands of miles annually and face multiple environmental pressures across their life cycle. During the breeding season, management focuses on reducing immediate threats such as predation and severe weather through nest shelters and enclosures. These actions have helped reduce nest loss and improved protection at active colonies.

However, despite these protections, productivity remains low and the population may fall short of the state recovery goal. Previous research identified Common Terns as sentinel indicators of mercury contamination in aquatic ecosystems, and mercury exposure can reduce chick survival, growth, and reproductive success without causing obvious mortality. As a result, colonies may appear protected from physical threats while still experiencing hidden environmental pressures that limit long-term population recovery. Despite decades of monitoring, managers still lack a clear understanding of which environmental factors most strongly influence productivity and colony persistence.

Managers lack information on which risks most affect Common Terns across their annual life cycle. Identifying drivers of reduced reproduction is necessary to evaluate whether current management can sustain Minnesota's population.

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.

Common Tern colonies are monitored and managed by the MNDNR and the Leech Lake Band of Ojibwe. Recent monitoring indicates that the Leech Lake colony has not successfully fledged young since 2021, raising concerns about long-term population persistence. Through our previous LCCMR-funded project, Assessing the Status of Common Terns in Minnesota, we compiled and archived > 100,000 nest monitoring and productivity records from colonies statewide. These data include long-term monitoring from Lake Superior colonies (Interstate Island and Ashland Island) as well as Mille Lacs, Leech Lake, and Lake of the Woods. Mercury exposure data from chick feathers collected between 2016 and 2025 are also available for the Lake Superior colonies.

To address this gap, we will integrate long-term monitoring records, mercury exposure data, and existing tracking data describing movements across the species' annual life cycle into a population-level risk assessment model. This model will evaluate how environmental drivers during the breeding season and throughout migration influence reproductive success and population growth. Using a competing-risks framework, we will assess how weather, predator density, and mercury exposure interact to affect breeding outcomes and determine whether current management actions are sufficient to sustain Minnesota's Common Tern population.

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 identify environmental drivers of reduced productivity for Common Terns by integrating long-term nesting data with environmental covariates in a population-level analysis. The project will also quantify mercury exposure and contaminant sources across breeding colonies by analyzing feather samples for mercury concentrations and stable isotopes. Finally, survival and tracking data will be incorporated into a full annual-cycle population model linking breeding success with migration and wintering conditions. Together, these analyses will improve understanding of factors limiting colony productivity, support contaminant mitigation and habitat protection, and provide managers with critical information on how to sustain Minnesota's Common Tern population.

Activities and Milestones

Activity 1: Identify environmental drivers of reduced productivity for the state-threatened Common Tern

Activity Budget: $95,000

Activity Description:
Minnesota has accumulated > 43 years of Common Tern productivity monitoring data, archived in the LCCMR Common Tern database. These records provide a rare opportunity to evaluate long-term trends in colony productivity and reproductive success. To fully leverage this dataset, we will develop an Avian Life Cycle Model that integrates long-term productivity records with environmental variables to identify the drivers of reproductive success and estimate long-term population growth. Nest survival will be modeled using multi-state transition models that distinguish key life stages, including egg laying, hatching, and fledging success. Environmental covariates such as weather, predator density, and mercury concentrations will be incorporated to evaluate how these factors influence reproductive outcomes. The resulting model will estimate population growth rates, assess whether colonies are self-sustaining, and identify the environmental factors most strongly associated with productivity declines.

Activity Milestones:

Description	Approximate Completion Date
Compile and quality check productivity data from the LCCMR Common Tern database	October 31, 2027
Acquire and compile environmental covariates (weather, predator density, mercury concentrations)	January 31, 2028
Develop initial nest survival models using a multi-state transition framework	March 31, 2028
Integrate environmental covariates into the productivity models	August 31, 2028
Generate preliminary estimates of productivity drivers and population growth rates	January 31, 2029
Update model with new ecological data collected during this project	January 31, 2030

Activity 2: Quantify mercury exposure and contaminant sources across the breeding colonies

Activity Budget: $110,000

Activity Description:
Mercury exposure data from chick feathers collected at Lake Superior colonies provide valuable insight into breeding-season contaminant exposure. However, it remains unclear how mercury exposure varies among all current breeding locations or how it relates to reproductive outcomes. To address this gap, we will expand ecological monitoring to include Lake of the Woods colonies and conduct two breeding seasons of fieldwork (June–July 2028 and 2029). Nest monitoring will estimate colony productivity, and feather samples collected from chicks will be analyzed for total mercury (THg), mercury stable isotopes (to distinguish legacy industrial contamination from atmospheric deposition), and carbon and nitrogen stable isotopes to characterize foraging habitats and trophic position. These analyses will allow us to compare mercury exposure and ecological conditions among colonies and determine whether contaminant exposure is contributing to reduced reproductive success.

Activity Milestones:

Description	Approximate Completion Date
Finalize sampling design and coordinate monitoring with MN DNR and partners	March 31, 2027
Conduct breeding season monitoring and feather sampling (Year 1 field season)	August 31, 2028
Conduct breeding season monitoring and feather sampling (Year 2 field season)	August 31, 2029
Analyze feather samples for total mercury (THg) concentrations	January 31, 2030
Analyze feather samples for mercury stable isotopes	January 31, 2030

Analyze feather samples for carbon and nitrogen stable isotopes	January 31, 2030
Compare contaminant exposure and productivity across colonies	March 31, 2030

Activity 3: Incorporate survival and tracking data into the population model

Activity Budget: $85,000

Activity Description:

Breeding-season productivity represents only one component of population dynamics for long-distance migratory species. However, environmental conditions experienced during migration and wintering periods can influence survival and reproductive success through carry-over effects, and these influences are not currently incorporated into population models for Minnesota's Common Tern populations. To address this gap, we will incorporate adult survival estimates (available from long-term mark recapture efforts at the Lake Superior colonies) and tracking data from GPS tags, light-level geolocators, and radio transmitters (also available from previously funded projects), to develop a spatially explicit full annual cycle model. These analyses will estimate seasonal survival, migratory connectivity, and environmental risks associated with migration routes and wintering habitats. By linking breeding and non-breeding season processes, this model will provide a more comprehensive understanding of the environmental drivers influencing Common Tern population persistence.

Activity Milestones:

Description	Approximate Completion Date
Compile existing tracking and mark-recapture datasets	April 30, 2028
Identify environmental covariates associated with migration and wintering habitats	January 31, 2029
Estimate adult survival and migratory connectivity	May 31, 2029
Integrate survival and migration data into the full annual cycle model	October 31, 2029
Develop spatially explicit full annual cycle population model	February 28, 2030
Produce final risk assessment identifying drivers of population change	May 31, 2030
Manuscript development and dissemination efforts	June 30, 2030

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Dr. Alexis Grinde	Natural Resources Research Institute	Dr. Grinde will assist with project management and coordination as well as provide input on statistical analyses and product development.	Yes
Gaea Crozier	Minnesota Department of Natural Resources	Gaea will assist with fieldwork coordination and logistics at the Lake Superior colonies. She will also provide input on data analyses as requested.	No
Adam Maleski	Minnesota Department of Natural Resources	Adam will assist with fieldwork coordination and logistics at the Lake of the Woods colonies. He will also provide input on data analyses as requested.	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.
Project results will be actively disseminated to scientists, resource managers, tribal partners, and the public through multiple communication pathways. The project team will share results directly with the MN DNR and consult with the Leech Lake Band of Ojibwe to ensure findings inform ongoing management of Common Tern colonies. Results will also be presented at statewide meetings that bring together conservation practitioners and agency biologists, including MN DNR wildlife meetings and regional and national colonial waterbird working group meetings. These venues provide opportunities to translate research findings into practical management guidance for state, federal, tribal, and nongovernmental conservation partners.
Scientific findings will be disseminated through peer-reviewed publications and conference presentations focused on contaminant exposure, colonial waterbird productivity, and population modeling. We anticipate developing at least two peer-reviewed publications describing environmental drivers of Common Tern productivity and mercury exposure across Minnesota breeding colonies.
Project data, analytical methods, and documentation will be archived and made available through institutional repositories consistent with University of Minnesota data management practices. All project presentations, publications, and public materials will follow Environment and Natural Resources Trust Fund (ENRTF) acknowledgement requirements and guidelines, including appropriate recognition of ENRTF support.

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?
Results will be used by MN DNR and partners to guide management actions. The population-level risk assessment will help managers identify environmental factors limiting productivity and prioritize conservation actions. Archived productivity data will remain integrated within the LCCMR Common Tern database and updated as new monitoring data are collected. Future work will expand and maintain these analyses through complementary funding from federal agencies, state programs, and research grants administered through the University of Minnesota and collaborating partners. These efforts will allow continued monitoring, model updates, and evaluation of conservation strategies needed to support long-term recovery of Minnesota's Common Tern population.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
What's "Bugging" Minnesota's Insect-Eating Birds?	M.L. 2021, First Special Session, Chp. 6, Art. 6, Sec. 2, Subd. 03a	$199,000
Assessing Status of Common Tern Populations in Minnesota	M.L. 2023, , Chp. 60, Art. 2, Sec. 2, Subd. 03h	$199,000

Project Manager and Organization Qualifications

Project Manager Name: Annie Bracey

Job Title: Avian Ecologist

Provide description of the project manager's qualifications to manage the proposed project.
Dr. Annie Bracey has worked as an Avian Ecologist at the Natural Resources Research Institute, University of Minnesota Duluth for over 15 years, working primarily on projects related to marsh birds in Great Lakes coastal wetlands. Much of her research is focused on conservation and management issues related to Common Terns in the Great Lakes region including; 1) documenting exposure to contaminants, 2) tracking terns using light-level geolocators and GPS tags to document migration routes, wintering areas, and foraging habitats, and 3) using Integrated Population Models to make inferences about population dynamics. Her broad interest is determining how human activities influence bird populations and how research that integrates ecology, biology, and conservation sciences can be used to better inform management decisions. Annie has been primary investigator on numerous projects related to population ecology and waterbirds.

Organization: U of MN - Duluth - NRRI

Organization Description:
The Natural Resources Research Institute (NRRI) is a state-chartered applied research institute of the University of Minnesota's Research and Innovation Office. NRRI maintains three sites in Northern Minnesota, focused on informing sound, long-term decisions on the use and stewardship of natural resources.

Our mission: Deliver integrated research solutions that value our resources, environment and economy for a sustainable and resilient future.

NRRI collaborates broadly across the University system, the state and the region to address the challenges of a natural resource-based economy. Research is developed via extensive partnerships with industry, state and federal agencies and governmental units.

As an impartial, science-based resource, NRRI develops and translates knowledge through large-scale, interdisciplinary research. Our expertise focuses on defining resource opportunities, minimizing waste and environmental impact, maximizing natural resource value, and maintaining or restoring ecosystem function.

Major outcomes from NRRI projects include informing environmental management and policy and assisting industry and communities in defining and maintaining the social license to operate in natural systems. NRRI has established mechanisms for sharing outcomes through press releases, peer-reviewed journals, technical reports, annual reports, periodicals, and social media.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Dr. Annie Bracey, Principal Investigator		Avian ecologist, with a focus on waterbirds, will lead the project, including study design development, coordinating field logistics, data analyses, report and manuscript preparation, and outreach.			26.8%	0.66		$71,034
Dr. Alexis Grinde, Co-Investigator		Wildlife ecologist, Forest and Land Research Group Leader, will contribute to study design, data interpretation, report and manuscript preparation.			26.8%	0.15		$24,545
Researcher 5		Avian ecologist, will contribute to coordinating field logistics, acquisition of spatial data, data analyses, report and manuscript preparation.			26.8%	0.33		$35,747
Researcher 4		Avian ecologist, will contribute field work coordination and conducting field work. Will assist with data entry and quality assurance.			26.8%	0.02		$2,015
Researcher2		Avian ecologist, will assist with field work coordination, logistics, and field work as needed. Will help with data entry and quality assurance measures as needed.			24.4%	0.36		$24,389
Civil Service		will assist with coordinating sample collection from sites in Lake of the Woods. Will organize and store feather samples to be processed for mercury and isotopes.			24.4%	0.02		$1,425
Bargaining Unit		Will assist with accessing Lake Superior colonies when in need of a boat driver or assistant in the field.			24.4%	0.02		$2,172
Graduate Assistant		Will help with data collection (nest monitoring and feather sample collection) during the summer field season (2 years)			19.5%	0.6		$38,297
Undergraduate Assistant		Will assist with organizing meetings, data entry, and report writing.			0%	0.06		$1,779
Temp/Casual		Will assist with any aspects of the study that require additional time, including data entry, organizing field equipment, helping with field season logistics.			7.4%	0.03		$1,896
							Sub Total	**$203,299**

Contracts and Services								
Lake of the Woods	Service Contract	Field work for Lake of the Woods Field work to monitor nest success and productivity at several colonies within Lake of the Woods for two field seasons (2028 and 2029).				0.04		$23,200
University of Maryland	Service Contract	C&N SI analysis of feather samples.		X		0.02		$9,200
USGS Mercury Lab	Service Contract	Total mercury and mercury stable isotopes testing		X		0.04		$39,200
							Sub Total	**$71,600**
Equipment, Tools, and Supplies								
	Tools and Supplies	Field Supplies: nitrile gloves ($25/box of 100 x 2 = $50), coin envelopes ($50/box of 500), clipboard ($40 x 1).	Supplies needed to collect feather samples and monitor nests.					$280
							Sub Total	**$280**
Capital Equipment								
							Sub Total	**-**
Acquisitions and Stewardship								
							Sub Total	**-**
Travel In Minnesota								
	Miles/ Meals/ Lodging	Trips include vehicle and boat fees, based on NRRIs current rates, which are as follows: Travel to and from NRRI to Rice's Point Landing in Duluth MN. truck + trailer (1/2 day) = $40.13 x 12 days x 2 seasons = $963.12 truck + trailer (full day) = $65.25 x 12 days x 2 seasons = $1,566 mileage = 40 mi x 12 trips x 2 seasons x 0.31 mileage rate = $297.60 mileage	Field work to monitor nest success and productivity data.					$2,826
							Sub Total	**$2,826**

Travel Outside Minnesota								
	Miles/ Meals/ Lodging	Trips include vehicle and boat fees, based on NRRIs current rates, which are as follows: Travel to and from Ashland WI = 152 mi x 12 trips x 2 seasons x 0.31 mileage rate = $1,130.88 boat rental fees (based on Lund Boat) = $53/trip x 24 trips/season x 2 seasons = $2,544.00	To study the Ashland Common Tern colony.	X				$3,675
	Conference Registration Miles/ Meals/ Lodging	The Waterbird Society Annual Meeting	Present findings of the study.	X				$6,000
							Sub Total	**$9,675**
Printing and Publication								
	Publication	Publication fees	Publication fees for publishing findings in a peer-reviewed journal.					$2,000
							Sub Total	**$2,000**
Other Expenses								
		Shipping	Shipping costs for shipping feather samples to USGS mercury lab ($40/shipment x 2 years = $80) and U of Maryland Stable Isotope Lab ($40/shipment x 2 years = $80)					$320
							Sub Total	**$320**
							Grand Total	**$290,000**

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
Contracts and Services - University of Maryland	Service Contract	C&N SI analysis of feather samples.	We are using the University of Maryland as an out-of-state service contractor because they are one of the only vendors that we have found who will prepare the feathers from start to finish (e.g. washing, grinding, encapsulating) for a reasonable cost and in a reasonable timeframe. We have worked with this vendor on past projects and so keeping the same vendor will also provide consistency in methodology.
Contracts and Services - USGS Mercury Lab	Service Contract	Total mercury and mercury stable isotopes testing	We are using the USGS Mercury Laboratory as an out-of-state service contractor because they are one of the only vendors in the nation that can analyze both total mercury, methylmercury, and mercury stable isotopes. There are no venders in Minnesota, to my knowledge, that offer the same service. We have worked with this vendor on past projects and so keeping the same vendor will also provide consistency in methodology and ease of data interpretation.
Travel Outside Minnesota	Miles/Meals/Lodging	Trips include vehicle and boat fees, based on NRRIs current rates, which are as follows: Travel to and from Ashland WI = 152 mi x 12 trips x 2 seasons x 0.31 mileage rate = $1,130.88 boat rental fees (based on Lund Boat) = $53/trip x 24 trips/season x 2 seasons = $2,544.00	Including the Ashland Common Tern colony in this study is critical as it is an important part of the population (with many birds nesting between the colony in Ashland and the Duluth-Superior harbor). Without including this site we will loose critical information about population dynamics. Much of the long-term data available includes this colony site.
Travel Outside Minnesota	Conference Registration Miles/Meals/Lodging	The Waterbird Society Annual Meeting	The annual Waterbird Society meetings are typically held in Atlantic coastal states or internationally (every other year). Therefore all travel associated with attending these conferences will be out-of-state but the PI will present results of this study (or components of it) at each meeting.

Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
State				
In-Kind	MN DNR Nongame Wildlife Staff	In-Kind support of 60 hours at $50/hour to support management activities at Common Tern colonies on Lake of the Woods and Interstate Island and use recently compiled historical data to conduct a life cycle assessment evaluating the effects of local weather, mercury (Hg) exposure, and predation on productivity; and assess exposure of pharmaceuticals to Common Terns.	Secured	$3,000
			State Sub Total	**$3,000**
Non-State				
In-Kind	UMN unrecovered indirect costs are calculated at the UMN negotiated rate for research of 54% modified total direct costs.	Indirect costs are those costs incurred for common or joint objectives that cannot be readily identified with a specific sponsored program or institutional activity. Examples include utilities, building maintenance, clerical salaries, and general supplies. (https://research.umn.edu/units/oca/fa-costs/direct-indirect-costs)	Secured	$156,600
			Non State Sub Total	**$156,600**
			Funds Total	**$159,600**

Total Project Cost: $449,600

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: abee2a9c-253.pdf

Alternate Text for Visual Component

Multiple images of Common Terns, including an adult on a nest and chicks. Graphic showing annual cycle of migratory birds, including breeding, migration, and overwintering periods. Another graphic of the globe depicting multiple environmental risks which can be encountered throughout the year, including predation, habitat loss, climate change, contaminant exposure....

Supplemental Attachments

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

Title	File
Bracey Transmittal Letter - 2026	34eaca4c-6f1.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 UMN Policy on travel 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:

umdspa@d.umn.edu

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