Environment and Natural Resources Trust Fund
2021 Request for Proposal

General Information

Proposal ID: 2021-424

Proposal Title: Improving Pollinator Conservation by Revealing Habitat Needs

Project Manager Information

Name: Colleen Satyshur

Organization: U of MN - College of Biological Sciences

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Project Basic Information

Project Summary: Wild pollinators must survive outdoors during our harsh Minnesota winters. We aim to help them persist by discovering habitats they require for shelter through statewide citizen scientists and novel analyses.

Funds Requested: $614,000

Proposed Project Completion: 2024-06-30

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?
> 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.

Pollinators have two main needs -- food and shelter. The overall goal of this project is to understand the largely unknown needs that wild bee pollinators have for shelter. Efforts to protect pollinators have properly focused on which flower species provide their food. But to effectively help pollinators persist we also must preserve the species of plants they need for nesting and overwintering. Small, solitary, and secluded wild bee nests are hard to find and difficult to study, resulting in the current lack of foundational data. Our native bees survive the winter inside their nests, which are often built with plant materials the bees have chewed up and compacted. This plant material is integral to nests, but what plant species are used is unrecognizable by sight. We have the opportunity to conduct a large scale project building off recent working relationships with citizen scientists corps, Three Rivers Parks District, MN Master Naturalists, SNA and other networks, in order to to reveal the plants bees use in their nests and allow more specific protection and enhancement of bee pollinator habitat across the state.

What is your proposed solution to the problem or opportunity discussed above? i.e. What are you seeking funding to do? You will be asked to expand on this in Activities and Milestones.

Our innovative approach takes advantage of a fortuitous convergence of projects. Using the platform of the successful ENRTF project "Minnesota Native Bee Atlas" M.L. 2015, Chp. 76, Sec. 2, Subd. 03g and leveraging DNA sequencing methods developed in the University of Minnesota Future's grant "The Art and Science of Nesting Bees," we will deploy nest-traps statewide through an existing enthusiastic citizen science volunteer base. Nest-traps are a widely used method for studying the numerous wild bee species that nest in dead wood and stems. Bees will bring their outside plant matter into the traps to build nests, which we will collect and rear to adulthood for bee species identification. Plant matter in traps will be identified by applying Next Generation genetic sequencing and molecular techniques. Because bees only nest in spring and summer and do not reach adulthood until the following spring or summer, we are asking for a three-year grant. That would allow one complete bee nesting and sequencing cycle. However, we plan to expand that by taking advantage of some bonus nests from the Minnesota Bee Atlas which could be deployed in the following growing season, allowing for two years of data in the three-year grant.

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 identities of plants used for nesting and overwintering shelters, paired with bee species, will be made available to land managers and citizens through the UMN Extension, UMN Bee Lab and, through scientific articles. Our statewide bee species data will be maintained by the Minnesota Biodiversity Atlas hosted and accessible through the Bell Museum and added to data compiled through the ENRTF Minnesota Bee Atlas project. In addition, citizen volunteers across the state will be trained in our methods and receive our latest information on how they can help bees in their area.

Activities and Milestones

Activity 1: Development and deployment of nest traps, volunteer recruitment.

Activity Budget: $282,000

Activity Description:

We will recruit volunteers from all around Minnesota, through the successful Minnesota Bee Atlas corps, as well as Master Naturalist, and other programs. Volunteers will be trained in our field methods and will each be given a nest trap to hang at their site. In the first spring we will send out standard economical nest traps as used in the Minnesota Bee Atlas from which we can still obtain some nest materials. A small subset of traps, up to 16, will be designed or acquired to facilitate greater in-nest plant matter collection. This easy-open subset will be placed in select locations projected to return especially high quality results, while the project as a whole will continue to seek bee populations in semi-natural sites. We will update current Bee Atlas websites to continue to receive volunteer seasonal observations, track nests and disseminate results. In the second spring we will take advantage of bonus nest traps from the Minnesota Bee Atlas to send out a smaller round of nest traps within the scope of what can be reared and identified before the grant end date.

Activity Milestones:

Description	Completion Date
Standard economical and easy-open nest traps built or acquired, website prepared, volunteer manual written	2022-02-28
Volunteers recruited and trained, nest traps deployed (year 1)	2022-04-30
Standard and easy-open traps returned for rearing and nest plant matter collection (year 2)	2022-11-30
Bonus nest traps built and deployed (year 2)	2023-04-30
Bonus nest traps returned and nest plant matter collected (year 3)	2023-11-30

Activity 2: Jun 2024

Activity Budget: $332,000

Activity Description:

Nests will be reared to identify bee species. Leaf plant matter will be collected from as many bee nests as possible in the standard traps, as well as from nests in the easy-open traps. We anticipate up to 100 nests in year one and 15-20 bonus nests the following year. DNA will be extracted from leaf samples, and submitted for amplification and sequencing preparation of 2-3 gene regions through the services of the UMN Microbiome Institute. Sequencing will be done using Next Generation technologies, such as Illumina, through the UMN Genomics Center. We will match the resulting sequence data to existing plant databases or reference samples to obtain plant identification. Resin will be collected from up to 10 additional bee nests traps and resin fingerprinting and identification will be accomplished using untargeted metabolomic analysis by ultra-performance liquid chromatography-mass spectrometry. Resin analysis requires a reference collection, so this includes driving to up to 10 sites to nondestructively collect tree resin.

Activity Milestones:

Description	Completion Date
Nest plant matter samples collected. leaf: 80/year-1, resin: >8	2023-02-28
Bees nests reared to adulthood in lab, year 1	2023-05-31
Nest matter samples receive analyses year 1	2023-10-31
Bees emerging from nests will be identified to species, year 1	2023-12-31
Nest plant matter samples collected. leaf: 15-20/year-2	2023-12-31
Nest matter samples receive analyses year 2	2024-05-31
Bees nests reared to adulthood in lab, year 2	2024-05-31

Final results prepared; database contributions complete	2024-06-30
Bees emerging from nests will be identified to species, year 2	2024-06-30

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Dr. Jerry Cohen	University of Minnesota	will provide resin analysis methods and expertise, lab space for resin work and access to equipment.	No
Dr. Declan Shroeder	University of Minnesota	will provide molecular methods and bioinformatics expertise and analysis assistance.	Yes
Dr. Clarence Lehman	University of Minnesota	will provide advice and assistance on data management and archiving and provide laboratory bench and nest rearing space in the Ecology building.	Yes
Dr. Marla Spivak	University of Minnesota	will provide advice on citizen science and bee science as needed and the MN Bee Lab will provide lab space for molecular work.	No
Dr. Rob Blair	University of Minnesota	will provide advice on citizen science and bee science as needed	No
Britt Forsberg	University of Minnesota-Extension	Britt Forsberg, current project coordinator and outreach specialist of MN Bee Atlas working in UMN Extension. She will contribute her expertise in this area either as project personnel or in an advisory role.	Yes

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 be funded?

The long-term strategy for the project is to discover what plants and habitats bees use for shelter and provide this data in open-access form so that land managers and citizens can apply it in the conservation of Minnesota's wild bees. Plant identification data will be maintained through the UMN Bee Lab and sequence data archived in an appropriate open access database. Bee specimens will be deposited for long term curation in UMN Insect collection, and bee species data will be added to the Biodiversity Atlas housed at the Bell Museum.

Project Manager and Organization Qualifications

Project Manager Name: Colleen Satyshur

Job Title: Researcher 5

Provide description of the project manager's qualifications to manage the proposed project.

Colleen Satyshur is a principal investigator at the University of Minnesota. For the past five years Colleen has been investigating stem- and wood-nesting bees as a Project Coordinator in the College of Biological Sciences, working closely with the UMN Bee Lab. She has designed, implemented, and completed research on stem-nesting bees and grassland insect populations. Colleen has worked on three LCCMR projects -- Wildlife and Biofuels, Enhancing Pollinator Landscapes, and Minnesota Bee Atlas. She works as Principal Investigator for the Minnesota Futures Pollinator Project and as Entomologist on the MN Bee Atlas. Her work spans project management, scientific design, logistical implementation, laboratory management, data collection, and dissemination of results. On the present proposal she will act as principal investigator as well as entomologist and will hire one or more project personnel to coordinators with the public, bee rearing specialists, molecular analysts, and other necessary operations.

Organization: U of MN - College of Biological Sciences

Organization Description:

The University of Minnesota is a land-grant institution dedicated to understanding -- through research and discovery, teaching and learning, and public service and interaction. The College of Biological Sciences applies these principles to all levels of organization, from molecules to ecosystems, seeking solutions that improve health and the environment locally, nationally and globally.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Principal Investigator		overall project coordination, bee rearing and ID, nest plant matter collection and basic laboratory work on molecular components, analysis of results, development of dissemination materials			26.7%	3		$240,487
Citizen Science Coordinator		Coordination of citizen science outreach and logistics components. Including necessary bee rearing and archiving work, as well as development of dissemination material			26.7%	3		$189,859
Lab assistant		assist with bee nest rearing and archiving, including: pinning, data entry. Assist with basic bee nest materials analysis, such as initial DNA extraction in preparation for sequencing on vegetation samples, plant resin database creation, travel to collect and ID vegetation/resin			24.1%	1.5		$67,783
Databasing and Archiving Assistance		Assist with genetic databasing			26.7%	0.03		$3,972
Molecular DNA sequencing and bioinformatics assistance		Provide high level sequencing and bioinformatics analysis assistance.			26.7%	0.03		$4,416
							Sub Total	$506,517
Contracts and Services								
Witty Web Design	Professional or Technical Service Contract	Citizen science web site maintenance and updates as needed. Witty Web Design was picked competitively for building the Minnesota Bee Atlas web site. Our work will build on the existing website instead of starting over.				0		$10,000
Bioinformatics analyst	Professional or Technical	Bioinfomatics analysis for resin or DNA sequences. Pay rate approximately equivalent to post doc level work at UMN but allows access greater expertise in				0		$2,500

	Service Contract	some analysis which exists outside the UMN. ~$31/hr *80 hours:						
							Sub Total	**$12,500**
Equipment, Tools, and Supplies								
	Tools and Supplies	120 trap nesting blocks with signs and postage	Nests will attract native bees, modified design will allow for easier sampling	X				$10,000
	Tools and Supplies	Rearing supplies including collection tubes, glue, containment bags, insect cabinet for permanent storage, pins, bags, tubes, glue, label paper	to rear nests, collect, identify and archive adult bees, collect nest vegetation samples					$8,000
	Tools and Supplies	Molecular lab supplies including vials, tubes, bead-beater beads, pipettes and tips, reagents, and primers.	Supplies for vegetation and resin sample acquisition and preparation and initial DNA extraction					$6,200
	Tools and Supplies	Outreach and educational supplies	necessary materials for volunteers to participate					$463
							Sub Total	**$24,663**
Capital Expenditures								
							Sub Total	-
Acquisitions and Stewardship								
							Sub Total	-
Travel In Minnesota								
	Miles/ Meals/ Lodging	Travel expenses including hotel, mileage or vehicle rental	Travel to deliver or retrieve nest traps, conduct volunteer training (1/year), attend conferences with study results, collect resin from 10 sites for resin tree ID, mileage or small vehicle rental from UMN Fleet Services s months/year					$7,200
							Sub Total	**$7,200**
Travel Outside Minnesota								

							Sub Total	-
Printing and Publication								
	Printing	volunteer manuals and other materials	printed supplies so volunteers can paticipate					$2,300
							Sub Total	$2,300
Other Expenses								
		University of Minnesota Genomic Center	cost of expert labor to prepare three specific necessary gene regions of vegetation samples					$53,820
		Plant metabolomics internal service organization	Analysis by Liquid Chromatography Mass Spectrometer for analysis of resin samples					$7,000
							Sub Total	$60,820
							Grand Total	$614,000

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
Equipment, Tools, and Supplies		120 trap nesting blocks with signs and postage	In order to reach a statewide corps of citizen science volunteers in all parts of the state, and allow them to feasibly return nest-traps to the University of Minnesota, it is occasionally necessary to mail nest-traps, rather than arrange for in-person drop-off or pick-ups. In this case we want to pay for postage and not ask volunteers to take on this expense. Mailing can also provide budget savings over milage costs that would be accrued if project personnel drove to each volunteers site.

Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
State				
In-Kind	INDIRECT - 55% MTDC	Indirect costs associated with this proposal at 55% MTDC	Pending	$336,000
In-Kind	UMN Dr. Jerry Cohen - 1% FTE for 3 years ($6,900)	UMN Dr. Jerry Cohen - 1% FTE for 3 years ($6,900) From assistance on resin analysis.	Pending	$6,900
			State Sub Total	**$342,900**
Non-State				
-			**Non State Sub Total**	-
			Funds Total	**$342,900**

Attachments

Required Attachments

Visual Component

File: [f4bc8283-c55.pdf](f4bc8283-c55.pdf)

Alternate Text for Visual Component

Graphic showing the components of bee habitat: food resources, nesting substrate, and the largely unknown nest building materials, and the process by which statewide volunteers will result in identification of nesting materials

Administrative Use

Does your project include restoration or acquisition of land rights?

No

Does your project have patent, royalties, or revenue potential?

No

Does your project include research?

Yes

Does the organization have a fiscal agent for this project?

Yes, Sponsored Projects Administration
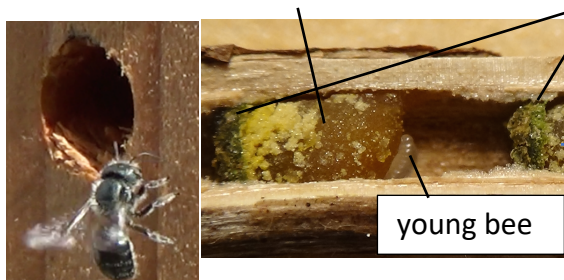
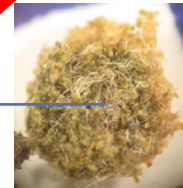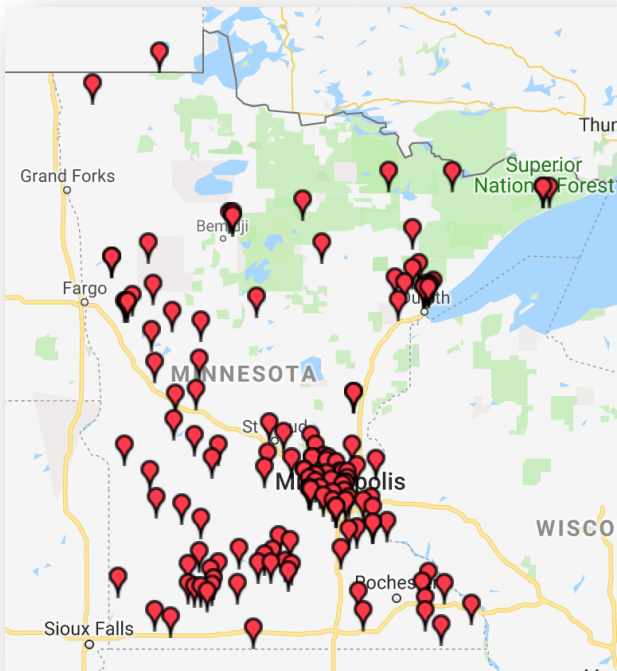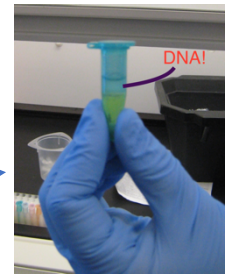# Wild Bee Habitat Needs

Substrate
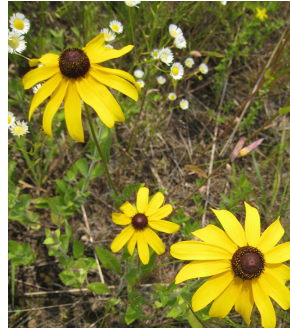
Food

Building material

young bee

?? Habitat

Improving pollinator conservation by revealing habitat needs

Map of 2018 MN Bee Atlas bee block locations

DNA!

UMN insect collection and Biodiveristy Atlas

M Extension
Minnesota
Native Bee Atlas

Statewide network of citizen science volunteers deploy and monitor nest traps