



Environment and Natural Resources Trust Fund

M.L. 2020 Approved Work Plan

General Information

ID Number: 2020-032

Staff Lead: Corrie Layfield

Date this document submitted to LCCMR: August 13, 2021

Project Title: Improving Pollinator Conservation By Revealing Habitat Needs

Project Budget: \$500,000

Project Manager Information

Name: Colleen Satyshur

Organization: U of MN - College of Biological Sciences

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Project Reporting

Date Work Plan Approved by LCCMR: August 13, 2021

Reporting Schedule: July 1 / January 1 of each year.

Project Completion: June 30, 2024

Final Report Due Date: August 14, 2024

Legal Information

Legal Citation: M.L. 2021, First Special Session, Chp. 6, Art. 5, Sec. 2, Subd. 03g

Appropriation Language: \$500,000 the second year is from the trust fund to the Board of Regents of the University of Minnesota to use citizen scientists and novel analyses to determine the nesting and overwintering needs of wild bees to allow more specific protection and enhancement of pollinator habitat across the state.

Appropriation End Date: June 30, 2024

Narrative

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.

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 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 a citizen science volunteer base built during the Minnesota Bee Atlas. Nest-traps are a widely used method for studying the numerous wild bee species that nest in dead wood and stems. Bees will bring 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 anticipate being able to process a supplemental nest trap cycle with fewer bees in the final fiscal year, allowing for two years of data in the three-year timeline.

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.

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

Activities and Milestones

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

Activity Budget: \$230,000

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 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 Minnesota Bee Atlas websites to continue to receive volunteer seasonal observations, track nests and disseminate results. In the second spring we will send out a smaller supplemental 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	February 28, 2022
Volunteers recruited and trained, nest traps deployed	April 30, 2022
Standard and easy-open traps returned for rearing and nest plant matter collection	November 30, 2022
Bonus nest traps built and deployed	April 30, 2023
Bonus nest traps returned and nest plant matter collected	November 30, 2023

Activity 2: Nest rearing and material analysis

Activity Budget: \$270,000

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 the main trapping year 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. A subset of samples will receive advanced sequencing of longer strings of DNA for more full genome type analysis which should allow for more detailed identification results. 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 from main trapping season. 80 leaf, 8 resin	February 28, 2023
Bees nests reared to adulthood in lab, from main trapping season	May 31, 2023
Nest matter samples from main trapping season receive analyses	October 31, 2023
Nest plant matter samples collected from supplemental trapping season. leaf: 15-20/year	December 31, 2023
Bees emerging from nests from main trapping season will be identified to species	December 31, 2023

Bees nests from supplemental trapping season reared to adulthood in lab.	May 31, 2024
Nest matter samples from supplemental trapping season receive analyses	May 31, 2024
Bees emerging from nests from supplemental trapping season will be identified to species	June 30, 2024
Final results prepared; database contributions complete	June 30, 2024

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
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
Dr. Rob Blair	University of Minnesota	will provide advice on citizen science and bee science as needed	No
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. 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. Declan Schroeder	University of Minnesota	will provide molecular methods and bioinformatics expertise and analysis assistance.	Yes
Dr. Jerry Cohen	University of Minnesota	will provide resin analysis methods and expertise, lab space for resin work and access to equipment.	No
Thea Evans	University of Minnesota	Thea can be hired as project coordinator based on her work on the MN Bee Atlas and outreach background	Yes

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.

Dissemination of information developed during the project will occur through the following outlets: 1) The identities of plants used for bee nesting and overwintering shelters, paired with bee species, will be made available to land managers and citizens through the UMN Extension and UMN Bee Lab, for example, under the “Learn More” tab (on <https://www.beelab.umn.edu/>). 2) Bee species distributions will be made available through the digital portal for the Minnesota Bee Atlas under the “Species Guide” (eg on <https://apps.extension.umn.edu/environment/citizen-science/bee-atlas/bee-blocks/>), as well as the MN Biodiversity Atlas (<https://bellatlas.umn.edu>), adding to existing data compiled through the ENRTF MN Bee Atlas project and curated by and accessible through the Bell Museum. 3) We will distribute information to volunteers through print and web materials and face-to-face workshops. 4) DNA sequence data will be contributed to appropriate online databases and bee specimens will be contributed to the UMN Insect Collection. The Minnesota Environment and Natural Resources Trust Fund (ENRTF) will be acknowledged through use of the trust fund logo or attribution language on project print and electronic media, publications, signage, and other communications per the ENRTF Acknowledgement Guidelines.

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.

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			26.74%	2.25		\$158,023
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			24.13%	2.4		\$143,398
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			24.13%	2.25		\$67,783
Databasing and Archiving Assistance		Assist with genetic databasing			26.74%	0.03		\$3,855
Molecular DNA sequencing and bioinformatics assistance		Provide high level sequencing and bioinformatics analysis assistance.			26.74%	0.06		\$12,087
undergraduate worker		Assist with molecular lab work and/or with bee rearing and pinning. May include travel to field sites for nest or sample collection			0%	0.06		\$5,500
Post doc resin/DNA sequencing		advanced laboratory processing and bioinformatics analysis. This analysis is needed in order for main project staff to perform more project functions instead of using existing expertise such as from the UM Genomics Center			20.25%	0.12		\$7,796
							Sub Total	\$398,442
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		\$9,500
Bioinformatics analyst	Professional or Technical Service Contract	Bioinformatics analysis for resin or DNA sequences. Pay rate approximately equivalent to post doc level work at UMN but allows access greater expertise in some analysis which exists outside the UMN.				0		\$7,500
							Sub Total	\$17,000
Equipment, Tools, and Supplies								
	Tools and Supplies	Trap nesting blocks with signs and postage. ~100 blocks of standard economic design. ~16 blocks of modified design that allows them to be opened more easily.	Nests will attract native bees, modified design will allow for easier sampling. Postage is most efficient way to deliver nests to dispersed sites around the whole state	X				\$8,000
	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					\$6,000
	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. Some sequencing can be done by project personnel at \$150/sample so this also covers reagents needed for that work on approximately 75 samples					\$18,500
	Tools and Supplies	Outreach and educational supplies	necessary materials for volunteers to participate					\$500
	Equipment	laptop computer	This would be an instrument for data management and bioinformatics analysis. Also streamlines feasibility of supply purchasing, communication with volunteers including training, developing project reports and disseminating information.	X				\$2,500
							Sub Total	\$35,500

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					\$10,058
							Sub Total	\$10,058
Travel Outside Minnesota								
							Sub Total	-
Printing and Publication								
	Printing	volunteer manuals and other materials	printed supplies so volunteers can participate					\$1,000
							Sub Total	\$1,000
Other Expenses								
		University of Minnesota Genomic Center	cost of expert labor to sequence 2-3 specific necessary gene regions of vegetation samples using specialized equipment such as for Illumina sequencing					\$31,000
		Plant metabolomics internal service organization	Analysis by Liquid Chromatography Mass Spectrometer for analysis of resin samples. Mass Spectrometer Service Fees and column costs to					\$7,000

			provide analysis by Liquid Chromatography Mass Spectrometer.					
							Sub Total	\$38,000
							Grand Total	\$500,000

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
Equipment, Tools, and Supplies		Trap nesting blocks with signs and postage. ~100 blocks of standard economic design. ~16 blocks of modified design that allows them to be opened more easily.	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 mileage costs that would be accrued if project personnel drove to each volunteers site.
Equipment, Tools, and Supplies		laptop computer	This would be an instrument for the project coordinator to do their job, currently none is available for the purpose. It would support the core responsibilities of the project manager position such supporting planning and data management documents, purchasing, communication with volunteers including training, and for running bioinformatics analysis and developing reports and disseminating information. The portability of a laptop is needed to allow the project coordinator to work while conducting fieldwork or travel to train volunteers. This price reflects an approximate mid-range Mac laptop as available for purchase from UMN IT services. Mac is compatible with the other computers already available for this project.

Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
State				
In-Kind	INDIRECT - 55% MTDC	Indirect costs associated with this proposal at 55% MTDC	Secured	\$271,150
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	\$278,050
Non-State				
			Non State Sub Total	-
			Funds Total	\$278,050

Attachments

Required Attachments

Visual Component

File: [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...

Optional Attachments

Support Letter or Other

Title	File
Background check certification form	750fa979-262.pdf

Difference between Proposal and Work Plan

Describe changes from Proposal to Work Plan Stage

First we adjusted the work plan to accommodate the year gap between the Minnesota Bee Atlas project and funding. This was accomplished by moving the supplemental nest trapping year to the last year of the project instead of the first. We also adapt staff appointments to account for transitions to or from other projects.

Second, we were able to accomplish the project goals within the recommended reduced level of funding by four adjustments. First, we reduced the percentage of time of staff appointments. Second, to accommodate reduced staff time in the new budget, we scaled back the workload by, for example, reducing the number of nests and samples and switching to more economical but less easily opened nest block design. Third, we shifted some of the molecular work to project staff and consequently added short periods of analysis and bioinformatics from experts. Fourth, we opted for a more basic DNA sequencing service from the UMN Genomics Center for part of the samples. This service is more economical, assuming no unexpected troubleshooting fees are necessary. The DNA sequence data returned from the basic service should still be sufficient to meet project goals of nest plant identification, especially when paired with advanced long-region sequencing for some samples. These four accommodations will allow us to successfully fulfill the important original goals of the project.

Additional Acknowledgements and Conditions:

The following are acknowledgements and conditions beyond those already included in the above workplan:

Do you understand and acknowledge the ENRTF repayment requirements if the use of capital equipment changes?

N/A

Do you agree travel expenses must 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 agree to the UMN Policy.

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

No

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

N/A

Do you wish to request reinvestment of any revenues into your project instead of returning revenue to the ENRTF?

N/A

Does your project include original, hypothesis-driven research?

Yes

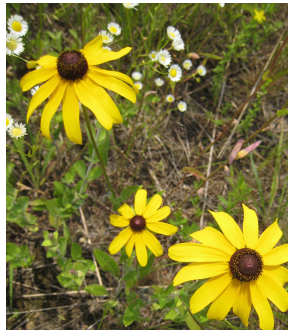
Does the organization have a fiscal agent for this project?

Yes, Sponsored Projects Administration

Wild Bee Habitat Needs



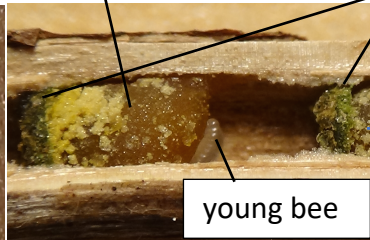
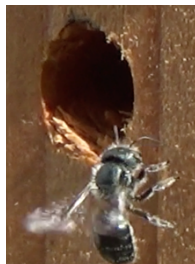
Substrate



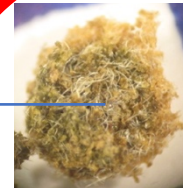
Food



Building material

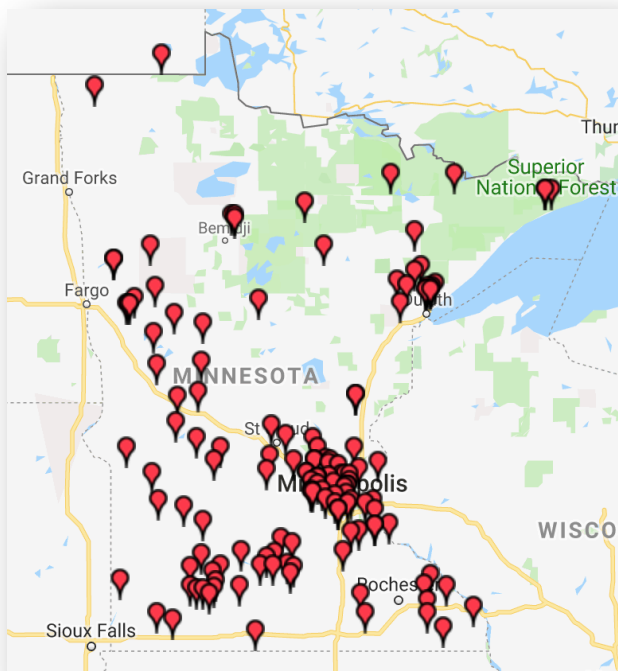


young bee

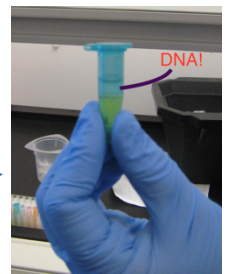


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Habitat

Improving pollinator conservation
by revealing habitat needs



Map of 2018 MN Bee Atlas bee block locations



UMN insect
collection and
Biodiversity Atlas



Statewide network of citizen science
volunteers deploy and monitor nest traps

