



Environment and Natural Resources Trust Fund (ENRTF)

M.L. 2020 ENRTF Work Plan (Main Document)

Today's Date: August 23, 2019

Date of Next Status Update Report: January 1, 2021

Date of Work Plan Approval:

Project Completion Date: June 30, 2023

Does this submission include an amendment request? ___

PROJECT TITLE: Improving pollinator conservation by revealing habitat needs

Project Manager: Colleen Satyshur

Organization: University of Minnesota

College, Department, or Division: Department of Ecology, Evolution and Behavior

Mailing Address: 140 Gortner Laboratory, 1479 Gortner Avenue

City, State, Zip Code: Saint Paul, MN 55108

Project Manager Direct Telephone Number: (612) 625-3761 (office)

Email Address: csatyshu@umn.edu

Web Address: <https://extension.umn.edu/natural-resources-volunteers/minnesota-bee-atlas>;
<https://www.beelab.umn.edu>

Location: Statewide

Total Project Budget: \$500,000

Amount Spent: \$0

Balance: \$500,000

Legal Citation: M.L. 2020, Chp. xx, Sec. xx, Subd. xx

Appropriation Language:

PROJECT STATEMENT:

Overall goals: 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. Next-generation genetic sequencing will reveal for the first time on a large scale which plants pollinating bees need to build their nest and overwintering shelters throughout Minnesota.

Need: 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. This project would work to reveal the plants bees use in order to allow more specific protection and enhancement of their habitat across the state.

Specific outcomes: 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, if staff time allows, through scientific articles. Our statewide bee species data will be added the MN Biodiversity Atlas data compiled through the ENRTF MN Bee Atlas project and curated by and accessible through the Bell Museum. 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.

Process: Our innovative approach will take advantage of a fortuitous convergence of projects. Using the momentum of the successful ENRTF project "The Minnesota Bee Atlas" 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 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 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 3-year grant. That would allow one complete bee nesting and sequencing cycle. However, we hope to expand that by taking advantage of bonus nests deployed by MN Bee Atlas volunteers in the last partial summer of that project. Bonus nests could then complete their lifecycles in the first year of this proposal, providing two full years of data for this project within the 3-year grant cycle.

II. OVERALL PROJECT STATUS UPDATES:

First Update January 1, 2021:

Second Update July 1, 2021:

Third Update January 1, 2022:

Fourth Update July 1, 2022:

Fifth Update January 1, 2023:

Final Report between project end (June 30) and August 15, 2023:

III. PROJECT ACTIVITIES AND OUTCOMES:

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

Description: We will recruit volunteers from the successful MN Bee Atlas, as well as Master Naturalist,

and other programs around the state. Volunteers will be trained in our field methods and be given a nest trap to hang at their site. The first year we hope to take advantage of bonus nests deployed in the last partial summer of the MN Bee Atlas, the second year we will send out standard economical nest blocks as used in the MN Bee Atlas from which we can still obtain some nest materials. A small subset of blocks, up to 16, will be designed or acquired to facilitate greater in-nest plant matter collection. This 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.

ENRTF BUDGET: \$230,000

Outcome	Completion Date
1. <i>Bonus nest traps returned for rearing and nest plant matter collection (year 1)</i>	Oct 2020
2. <i>Standard economical and easy-open nest traps built or acquired, website prepared</i>	Feb 2021
3. <i>Volunteers recruited and trained, nest traps deployed</i>	April 2021
4. <i>Standard and easy-open traps returned for rearing and nest plant matter collection (year 2)</i>	Nov 2021

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Activity 2 Title: Nest rearing and material analysis

Description: Bees from the nests will be reared to identify their species. Specimens will be contributed to the UMN insect collection. Leaf plant matter will be collected from as many of the same bee nests as possible in the standard blocks, as well as from bee nests in the subset of easy-open blocks. We anticipate 15-20 bonus nests in year one and up to 80 nests in year two. DNA will be extracted from leaf samples, and then submitted for amplification and sequencing preparation of 2-3 gene regions through the basic services of the UMN Microbiome Institute. Sequencing will be done using Next Generation technologies, such as Illumina, through the UMN Genomics Center. We will sort the resulting sequence data and match it to existing plant databases or reference samples to obtain plant identification. Basic Microbiome Institute services are economical, assuming no unexpected troubleshooting, and the DNA sequence data returned from the basic service should be sufficient to allow us to fulfill our most important project goal of pairing bee species with nest plants. Resin will be collected from up to 8 additional bee nests blocks 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 6 sites to nondestructively collect tree resin. Bee and plant species identifications will be returned to volunteers along with our latest information on bee science and conservation.

ENRTF BUDGET: \$270,000

Outcome	Completion Date
1. Nest plant matter samples collected. leaf: 15-20/year-1, 80/year-2, resin: >8	Feb 2021, Feb 2022
2. Bees nests reared to adulthood in lab, year 1, year 2	May 2021, May 2022
3. Nest matter samples receive analyses	Oct 2021, Oct 2022
4. Bees emerging from nests will be identified to species in year 1 and 2	Dec 2021, Dec 2022
5. Final results prepared; database contributions complete	Jun 2023

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IV. DISSEMINATION:

Description: 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 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” (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](#).

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V. ADDITIONAL BUDGET INFORMATION:

A. Personnel and Capital Expenditures

Explanation of Capital Expenditures Greater Than \$5,000:

Explanation of Use of Classified Staff:

Total Number of Full-time Equivalents (FTE) Directly Funded with this ENRTF Appropriation:

Enter Total Estimated Personnel Hours for entire duration of project: 13,277.6	Divide total personnel hours by 2,080 hours in 1 yr = TOTAL FTE: 6.4
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Total Number of Full-time Equivalents (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation:

Enter Total Estimated Contract Personnel Hours for entire duration of project: 198.75	Divide total contract hours by 2,080 hours in 1 yr = TOTAL FTE: 0.1
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VI. PROJECT PARTNERS:

PROJECT PARTNERS AND COLLABORATORS:

Colleen Satyshur will be lead project coordinator, will rear and identify bees, collect nest materials and perform basic molecular and resin work. **Britt Forsberg**, current project coordinator of MN Bee Atlas, will contribute to contribute her expertise in this area and take on some bee rearing and archiving duties. **Drs. Rob Blair and Marla Spivak** will provide advice on citizen science and bee science as needed and the MN Bee Lab will provide lab space for basic level molecular work. **Dr Clarence Lehman** will contribute to data management and provide lab space in the Ecology building. **Dr Declan Schroeder** will provide molecular methods and bioinformatics expertise and analysis assistance. **Dr. Jerry Cohen** will provide resin analysis methods and expertise, lab space for resin work and access to equipment. **Dr. Mike Wilson** will provide resin analysis and bioinformatics assistance and advice. **Erin Treiber**, the molecular science post doc on MN Future's grant, will contribute her expertise on genetic sequencing methods in an advisory role.

A. Partners outside of project manager's organization receiving ENRTF funding

B. Partners outside of project manager's organization NOT receiving ENRTF funding

Citizen scientists will contribute volunteer manpower needed to conduct this large-scale project. We will continue the MN Bee Atlas relationship with the **Three Rivers Parks District** for access to nest block locations and volunteers. We will collaborate with **MN Master Naturalist, SNA** and other networks for volunteers and study locations as appropriate.

VII. LONG-TERM- IMPLEMENTATION AND FUNDING:

LONG-TERM IMPLEMENTATION AND FUNDING:

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.

VIII. REPORTING REQUIREMENTS:

- Project status update reports will be submitted January 1 and July 1 each year of the project
- A final report and associated products will be submitted between June 30 and August 15, 2023

IX. SEE ADDITIONAL WORK PLAN COMPONENTS:

A. Budget Spreadsheet

B. Visual Component or Map

Attachment A: Project Budget Spreadsheet
 Environment and Natural Resources Trust Fund
 M.L. 2020 Budget Spreadsheet



Legal Citation:
 Project Manager: Colleen Satyshur
 Project Title: Improving pollinator conservation by revealing habitat needs
 Organization: University of Minnesota
 Project Budget: \$500,000
 Project Length and Completion Date: 3 years, completed June 2023
 Today's Date: August 15, 2019

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Budget	Amount Spent	Balance
BUDGET ITEM			
Personnel (Wages and Benefits)	\$ 422,000	\$ -	\$ 422,000
Colleen Satyshur, PI - 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. FTE reduced due to tentatively recommended reduction in project funding. \$193,000 (74% Salary, 26% benefits), 80% FTE for 3 years			
Citizen science coordinator, education and outreach specialist. Coordination-of citizen science outreach and logistics components. Including necessary bee rearing and archiving work, as well as development of dissemination material. FTE reduced due to tentatively recommended reduction in project funding. \$151,000 (74% Salary, 26% benefits), 80% FTE for 3 years			
Lab Assistant - assist with bee nest rearing and archiving, including: pinning, data entry. Assist with basic bee nest material analysis, such as initial DNA extraction in preparation for sequencing on vegetation samples, plant resin database creation, travel to collect and ID vegetation/resin. \$67,000 (77% salary, 23% benefits), 75% FTE for 2 years			
Databasing and Archiving Assistance; FTE reduced due to tentatively recommended reduction in project funding. \$4,000 (74% salary, 26% benefits), 3% FTE in year 2			
Molecular DNA sequencing 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; \$4,500 (74% salary, 26% benefits), 3% FTE in year 2			
Post doc resin or 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; \$2,500 (80% salary, 20% benefits), 4% FTE in year 2			
Professional/Technical/Service Contracts	\$ 12,000	\$ -	\$ 12,000
Witty Design: Citizen science web site maintenance and updates as needed. Witty design was picked competitively for building the Minnesota Bee Atlas web site. Our work will build on the existing web site. Instead of starting from scratch, it would be efficient to expand the system that is already in use. at ~\$80/hour; \$9,500			
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 U, such as Michael Wilson. This analysis is needed in order for main project staff to perform more project functions. ~\$31/hr *80 hours: \$2,500			
Equipment/Tools/Supplies	\$ 21,000	\$ -	\$ 21,000
Blocks, signs, outreach manuals, postage to mail them, etc. ~100 blocks of standard economic design, ~16 blocks of modified design that allows them to be opened more easily. 1 year blocks. \$8,000			
Rearing supplies (eg insect cabinets and insect pins, bags, tubes, glue, label paper etc); \$6,000			
Molecular lab supplies for vegetation and resin sample acquisition and preparation (eg vials, tube, reagents, primers, general lab supplies, small lab equipment, etc). \$6,000			
Outreach and educational supplies (including printing); \$1,000			
Travel expenses in Minnesota	\$ 7,000	\$ -	\$ 7,000
Travel to collect nests at end of growing season (2 years) including hotel and mileage or vehicle rental. Travel to small number of locations to place/retrieve easy-open blocks. Travel to conduct volunteer trainings (1 year), attend conferences with study results. Travel to collect resin from 4-8 sites for resin tree ID, mileage or small vehicle rental from fleet 2 months/year.			
Other	\$ 38,000	\$ -	\$ 38,000

University of Minnesota Genomic Center: cost of expert labor to prepare 2-3 specific necessary gene regions of vegetation samples. Expert labor is to cover basic level DNA preparation services, which is economical, and thought to meet basic project goals though less complete and informative than advanced services. Paying for expert labor is more economical than hiring additional project staff. Also includes sequencing with a Next Generation Sequencing machine (eg. Illumina, PacBio) for 2-3 gene regions. \$31,000				
Metabonomics internal service organization Mass Spectrometer Service Fees and column costs to provide analysis by Liquid Chromatography Mass Spectrometer. For analysis of resin samples; \$7,000				
COLUMN TOTAL		\$ 500,000	\$ -	\$ 500,000
SOURCE AND USE OF OTHER FUNDS CONTRIBUTED TO THE PROJECT	Status (secured or pending)	Budget	Spent	Balance
Non-State:		\$ -	\$ -	\$ -
State:			\$ -	\$ -
In kind: Indirect costs associated with this proposal at 54% MTDC (\$270,000)	secured	\$ 276,900	\$ -	\$ 276,900
Jerry Cohen - 1% FTE for 3 years (\$6,900)				
Other ENRTF APPROPRIATIONS AWARDED IN THE LAST SIX YEARS	Amount legally obligated but not yet spent	Budget	Spent	Balance
		\$ -	\$ -	\$ -