**PROJECT TITLE:** Improving pollinator conservation by revealing habitat needs

**I. 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 Bee Lab and 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. PROJECT ACTIVITIES AND OUTCOMES**

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| **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 nest blocks designed to facilitate in-nest plant matter collection. Bee populations in semi-natural sites will continue to be sought. We will update current Bee Atlas websites to continue to receive volunteer seasonal observations, track nests and disseminate results.  **ENRTF BUDGET: $280,000** |  |

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| **Outcome** | **Completion Date** |
| *1.* ***Bonus nest traps returned for rearing and nest plant matter collection (year 1)*** | **Oct 2020** |
| *2.* ***Easy-open nest traps designed and built, website prepared*** | **Feb 2021** |
| *3.* ***Volunteers recruited and trained, nest traps deployed*** | **April 2021** |
| *4.* ***Easy-open traps returned for rearing and nest plant matter collection (year 2)*** | **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 and what plant species they use. Specimens will be contributed to the UMN insect collection. Leaf plant matter will be collected from the same bee nests. We anticipate 20 bonus nests in year one and 100 in the year two. Next generation Illumina sequencing will be applied to leaf plant matter samples. Up to 10 additional bee nests will receive resin analysis and identification using chromatogram analyses. Resin analysis requires a reference collection, so this includes driving to 10 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: $335,000** |  |

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| **Outcome** | **Completion Date** |
| *1.* ***Nest plant matter samples collected. leaf: 20/year-1, 100/year-2, resin: >10*** | **Feb 2021, Feb 2022** |
| *2.* ***Bees nests reared to adulthood in lab, year 1, year 2*** | **May 2021, May 2022** |
| *2.* ***Nest matter samples receive analyses*** | **Oct 2021, Oct 2022** |
| *2.* ***Bees emerging from nests will be identified to species in year 1 and 2*** | **Dec 2021, Dec 2022** |
| *3.* ***Final results prepared; database contributions complete*** | **Jun 2023** |

**III. PROJECT PARTNERS AND COLLABORATORS:**

***Colleen Satyshur*** *will be lead project coordinator and will hire a volunteer coordinator and bee nest rearing assistant.* ***Britt Forsberg,*** *current project coordinator of MN Bee Atlas, will contribute her expertise in this area either as project personnel or in an advisory role.* ***Drs.******Rob Blair, Dan Cariveau and Marla Spivak*** *will provide advice on citizen science and bee science as needed and the MN Bee Lab will provide lab space for molecular work.* ***Erin Treiber****, current molecular science post doc on MN Future’s grant, will contribute her expertise on genetic sequencing methods in an advisory role. Expertise in resin analysis will be sought (eg* ***Dr.******Mike Wilson*** *a collaborator on a previous pilot project****)*** *and collaboration with DNR (eg* ***Megan Benage,*** *who contributes to the MN Bee Atlas****)*** *as needed****. Citizen scientists*** *will contribute volunteer manpower needed to conduct this large-scale study. We will collaborate with* ***MN Master Naturalist, SNA*** *and other networks as appropriate.* ***Dr Clarence Lehman*** *will contribute to data management and provide lab space in the Ecology building.*

**IV. 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. 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.*