



# Environment and Natural Resources Trust Fund

2021 Request for Proposal

## General Information

**Proposal ID:** 2021-032

**Proposal Title:** What's "bugging" Minnesota's Insect-Eating Birds?

## Project Manager Information

**Name:** Alexis Grinde

**Organization:** U of MN - Duluth - NRRRI

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## Project Basic Information

**Project Summary:** Examine the relationship between insect abundance, timing of insect availability and breeding success for multiple bird species across land-use intensities to develop comprehensive guidelines to conserve bird and insect diversity.

**Funds Requested:** \$199,000

**Proposed Project Completion:** 2024-06-30

**LCCMR Funding Category:** Small Projects (H)

**Secondary Category:** Foundational Natural Resource Data and Information (A)

## Project Location

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

Region(s): Central, NW, SW,

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

Statewide

**When will the work impact occur?**

During the Project and In the Future

## Narrative

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

Declines in bird and insect abundance have been documented worldwide with recent reports providing sobering statistics: 29% of North American birds have been lost in the last 50 years and 50% of insect species worldwide are declining. Birds that specialize in eating flying insects such as nighthawks, swallows, and flycatchers, collectively known as aerial insectivores, have shown alarming population declines. Across North America, aerial insectivores have declined 32% since 1970. Populations of familiar and beloved bird species such as Common Nighthawks and Tree Swallows have dropped between 40% and 70%!

While the potential causes of population declines of aerial insectivores include changes in habitat and climate, their reliance on flying insects as an essential food source is likely a key driver. Timing of insect quantity and quality (i.e. high caloric value) throughout the breeding season are important; birds need insects high in fat at key times in the breeding season to produce more offspring. Shifts in timing of insect emergence and loss of insect diversity, abundance, and quality is expected to have cascading effects on food webs and impact ecosystem services (e.g., pollination), thus making the issue especially important for the conservation of Minnesota's biodiversity.

### **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.**

Land-use intensification may be a major factor contributing to declines in insect abundance; however timing of high-quality food availability during the breeding season may influence breeding bird productivity more than insect abundance alone. This study will assess if land-use intensification affects insect abundance, timing of insect availability, and breeding success for multiple bird species.

Specifically, we will assess differences in insect availability across landscapes, ranging from agriculturally dominated to restored grassland prairies. We will then evaluate differences in breeding bird communities in relation to insect availability as well as measure nest and fledging success for two insect-dependent species, Tree Swallow and Eastern Bluebird. These species live in open habitats and while both rely on insects during the breeding season, Eastern Bluebird forage for insects in the vegetation layer whereas Tree Swallows forage for insects in the air. Focusing on these species will allow us to investigate many different types of insects that provide food for birds. Specific objectives include:

- Identify differences in overall insect abundance, diversity, and availability across land-use intensities.
- Assess relative importance of insect quantity and quality on breeding bird communities and focal species nesting and fledging success.
- Develop comprehensive guidelines for long-term conservation of Minnesota's biodiversity.

### **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?**

Minnesota's bird and insect populations are in steep decline. There are no large-scale programs in place to monitor Minnesota's populations of insects or aerial insectivores. We know little about how these populations vary across landscapes and how they are affected by human land use. We will provide foundational information to assess the how land use effects insect and bird communities. This information is critical for the development of holistic, meaningful, and practical land management strategies and also to inform and prioritize conservation actions for the long-term preservation of Minnesota's biodiversity.

## Activities and Milestones

### Activity 1: Determine impacts of land-use and insect availability on breeding bird communities and document focal species productivity.

**Activity Budget:** \$106,000

#### Activity Description:

We will identify 12 study areas across land-use intensities (i.e., intensive agriculture to restored prairie). At the study areas we will conduct point count surveys to document the composition of breeding bird communities. To measure nest and fledging success for two insect-dependent species, Tree Swallow and Eastern Bluebird, we will establish a grid of 16 nest boxes at each of the 12 study areas (n = 192) in the fall prior to the first field season. Nests will be monitored in-person during twice weekly visits during the breeding season and camera traps will be deployed at boxes occupied by focal species to document feeding activity, food items, and potential causes for nest failure and juvenile mortality (e.g., predation events). After eggs hatch, we will use a radio-frequency identification (RFID) system to monitor how often adults are feeding juveniles until young leave the nest. Lastly, we will measure weekly growth rates of nestlings and collect fecal samples for dietary analysis. We will use carbon and nitrogen stable isotopes to estimate lipid content and identify types of prey items eaten.

Outcome: Determine relationship between nestling survival and insect food provided by parents. Relate this to insect availability (Activity 2).

#### Activity Milestones:

Description	Completion Date
Identify 12 study areas across land-use intensities and deploy nest boxes.	2021-11-30
Monitor nest fate and hatchling growth and survival.	2023-08-31
Assess nestling diets using C:N stable isotopes.	2023-10-31
Quantify breeding and feeding behavior with cameras and RFID technology.	2023-10-31

### Activity 2: Assess impacts of land-use intensity on insect abundance and composition.

**Activity Budget:** \$60,000

#### Activity Description:

We will conduct insect surveys twice weekly during the breeding bird season (mid-May-June). Four 50 m insect survey plots will be established in each study area (n= 48), and will be randomly placed to ensure complete and unbiased sampling. Plant dwelling insects will be sampled by sweep netting along three of the virtual borders of the survey plots (150 m transect). Flying insects will be sampled using flight-interception traps that will be placed in a sub-set of survey plots. We will calculate size-specific abundance by sorting Insects into size categories that we will count, dry and weigh to estimate size-specific biomass available to feed bird nestlings. We will assess insect diversity in a subset of samples. A subset of samples from each biweekly sampling period will be analyzed for fat content to assess nutritional quality and document the timing and availability of high-quality prey items for birds. Together, these data will allow us to quantify differences in insect total abundance (quantity) and changes in insect composition (quality) throughout the breeding season across land-use intensities.

Outcome: Determine how various land uses affect insect quantity, quality and availability for supporting bird nestlings during breeding season.

#### Activity Milestones:

5/17/2020

Description	Completion Date
Conduct insect surveys from mid-May to June in 2022 and 2023 breeding seasons.	2021-08-31
Quantify impact of land-use on insect abundance, composition, and timing of availability.	2024-05-31

### Activity 3: Identify conservation priorities and strategies to mitigate loss of insect and bird diversity.

**Activity Budget:** \$33,000

#### Activity Description:

Findings from Activities 1 and 2 will be integrated to determine if insect and breeding bird communities vary across a gradient of land-use intensity and determine the extent to which availability and quality of food affects breeding success. We will develop comprehensive guidelines that outline how agricultural land use intensity can influence food web dynamics and ultimately productivity which is necessary to maintain Minnesota’s biodiversity and to conserve it for future generations. Combining tracking technologies (RFID and stable isotopes) with traditional survey techniques (nest monitoring and insect collection) will produce a robust dataset that will provide a comprehensive picture of how land use influences food web dynamics. Findings from this study will provide the foundational data needed to provide evidence-based guidance on how land use practices can best serve both people and native wildlife species. We will provide our findings to land use managers, agricultural extension agents and others who influence land use practices.

Outcomes: 1) Determine if influence of land-use intensity on insect abundance, timing of insect availability, and breeding success for multiple bird species. 2) Develop guidelines for long-term conservation of Minnesota’s biodiversity.

#### Activity Milestones:

Description	Completion Date
Provide guidelines to agricultural extension educators and land use managers and agencies.	2024-06-30
Development of conservation guidelines and priority actions.	2024-06-30
Quantify impacts of timing of availability of high-quality insects on focal species productivity.	2024-06-30

## 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?**

There is growing concern among scientists that insects, including pollinators such as bees, butterflies and moths, are in steep decline in many areas of the world, which may not only lead to a global biodiversity crisis but also an economic agricultural crisis due to lack of pollinators. This study will provide critical information needed for assessing the impacts of human land use on insects and bird communities and help to identify practical land management strategies for conserving Minnesota's biodiversity. Our results will provide information that land managers can use to promote land management that conserves Minnesota's insects and birds.

## Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Conserving Minnesota's Forest Birds of Management Concern	M.L. 2018, Chp. 214, Art. 4, Sec. 2, Subd. 03g	\$500,000
Mapping Avian Movement in Minnesota	M.L. 2018, Chp. 214, Art. 4, Sec. 2, Subd. 03h	\$200,000

## Project Manager and Organization Qualifications

**Project Manager Name:** Alexis Grinde

**Job Title:** Wildlife Ecologist

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

Dr. Grinde is a Wildlife Ecologist and Research Lab Manager at the Natural Resources Research Institute, University of Minnesota Duluth. She has over 15 years of research experience focusing on conservation ecology. Dr. Grinde manages five full-time research scientists and multiple research projects and contracts focusing on the development of management strategies for habitats and wildlife. Her research focuses on conservation ecology including studying the large-scale impacts of environmental change on wildlife, biodiversity, and ecosystem functions. Applications of her research include informing forest management decisions in relation to changing land use patterns and providing recommendations for conservation plans for species of conservation concern.

Dr. Valerie Brady will serve as the Co-PI for this project. Dr. Brady leads the Natural Resources Research Institute's Environmental Assessment group and has 30 years' experience conducting invertebrate research to assess environmental health and condition. Her team includes two highly skilled and certified taxonomists. The group does research on aquatic invertebrates, food webs, and invasive species effects in wetlands, streams and lakes across Minnesota and the Great Lakes. She has managed numerous grants worth over \$3M.

**Organization:** U of MN - Duluth - NRRI

**Organization Description:**

The Natural Resources Research Institute (NRRI) is an applied research and economic development engine for the University of Minnesota research enterprise. NRRI employs over 130 scientists, engineers and technicians to deliver on its mission to deliver research solutions to balance our economy, resources and environment for resilient communities. NRRI collaborates broadly across the University system, the state and the region to address the challenges of a natural resource based economy.

NRRI scientists have extensive experience in managing large, interdisciplinary projects. Major objectives include the

development of tools for environmental assessment and resource management. NRRRI's role is as an impartial, science-based resource that develops and translates knowledge by characterizing and defining value-resource opportunities, minimizing waste and environmental impact, maximizing value from natural resource utilization and maintaining/restoring ecosystem function.

The NRRRI Avian Ecology Lab is led by Dr. Alexis Grinde (over 15 years of wildlife and education experience) and consists of five full-time research scientists. Our research focuses on the development of economically sustainable conservation strategies and land management guidelines to preserve and enhance the species diversity of Minnesota bird populations and to protect species of conservation concern.

## Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
<b>Personnel</b>								
Alexis Grinde, Wildlife Ecologist		Principal investigator; Project management and coordination.			33.5%	0.15		\$18,754
Research Scientists		Project management, data collect, and analysis (P&A)			26.7%	0.57		\$58,210
Graduate Research Assistants		Two Summer GRA appointments to assist with data collection and analysis.			16.6%	0.5		\$25,312
Research technicians		Bird monitoring, behavior analysis, and insect identification (CS)			24.1%	0.9		\$58,730
							<b>Sub Total</b>	<b>\$161,006</b>
<b>Contracts and Services</b>								
							<b>Sub Total</b>	-
<b>Equipment, Tools, and Supplies</b>								
	Tools and Supplies	Insect sampling equipment	Flight intercept traps (2 per study area), nets for vegetation sampling, and collection analysis vials.					\$6,014
	Tools and Supplies	Nest box monitoring equipment	RFID receivers (\$120 ea.) and tags and cameras (\$100 ea.) used to monitor nest box activity (Calculated at a total of \$220 per nest box for 24 nest boxes)= \$5280					\$5,280
	Tools and Supplies	Diet analysis	Isotope samples (\$12.00 ea.); 3 samples of feces and food availability during each breeding season. Total= \$9800 Fecal samples. We estimate there will be 120 active nests each year, and will collect samples 3 times per year for 2 years from each nest =					\$9,800

			\$8640 Food availability. We will collect insect samples from each study area 3 times per year for 2 years = \$864					
							<b>Sub Total</b>	<b>\$21,094</b>
<b>Capital Expenditures</b>								
							<b>Sub Total</b>	-
<b>Acquisitions and Stewardship</b>								
							<b>Sub Total</b>	-
<b>Travel In Minnesota</b>								
	Miles/ Meals/ Lodging	Travel associated with fieldwork	Travel for fieldwork, including mileage, lodging, and per diem for field technicians and researchers. Travel is largely associated with nest box monitoring and insect collection and lodging during the 2022 and 2023 field seasons.					\$16,900
							<b>Sub Total</b>	<b>\$16,900</b>
<b>Travel Outside Minnesota</b>								
							<b>Sub Total</b>	-
<b>Printing and Publication</b>								
							<b>Sub Total</b>	-
<b>Other Expenses</b>								
							<b>Sub Total</b>	-
							<b>Grand Total</b>	<b>\$199,000</b>

## Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
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## Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
<b>State</b>				
			<b>State Sub Total</b>	-
<b>Non-State</b>				
In-Kind	UMN unrecovered indirect costs are calculated at the UMN negotiated rate for research of 55% 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. ( <a href="https://research.umn.edu/units/oca/fa-costs/direct-indirect-costs">https://research.umn.edu/units/oca/fa-costs/direct-indirect-costs</a> )	Secured	\$109,450
			<b>Non State Sub Total</b>	<b>\$109,450</b>
			<b>Funds Total</b>	<b>\$109,450</b>

## Attachments

### Required Attachments

#### *Visual Component*

File: [b7988957-693.pdf](#)

#### *Alternate Text for Visual Component*

Title reads "What's "bugging" Minnesota's insect-eating birds?". Two pictures of birds flying frame the text.

Text reads "Bird and insect populations are declining worldwide. Aerial insectivore populations have declined 32% Flying insect abundance has declined 75% Knowledge Gap: Land-use intensification may be a major factor contributing to declines in insect abundance; however timing of insect availability may influence breeding bird productivity more than insect abundance alone." Below is a representation of a land-use gradient with three pictures of agriculturally dominated landscape, one with a farm and mix of trees, and other prairie.

Text box reads "Assess impacts of land-use intensity on insect abundance and composition" with pictures of insects; another text box reads "Measure nestling survival of Tree Swallows and Eastern Bluebirds and document feeding activity." and has a picture of two birds and a nest box. Final text header reads "Project Outcomes: Determine the relationship between insect abundance, timing of insect availability and breeding success for multiple bird species across land-use intensities to develop comprehensive guidelines to conserve bird and insect diversity."

### Optional Attachments

#### *Support Letter or Other*

Title	File
Sponsored Projects Authorization Letter	<a href="#">3b5c4934-57d.pdf</a>

## 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



# What's "bugging" Minnesota's insect-eating birds?



**Bird and insect populations are declining worldwide.**

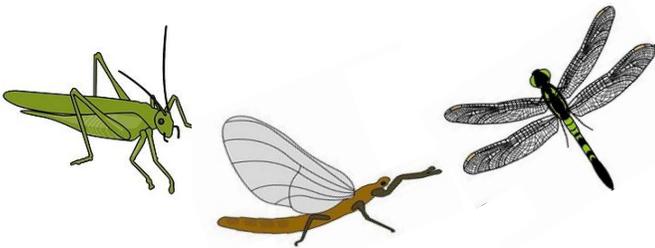
Aerial insectivore populations have declined 32%  
Flying insect abundance has declined 75%

**Knowledge Gap:** Land-use intensification may be a major factor contributing to declines in insect abundance; however timing of insect availability may influence breeding bird productivity more than insect abundance alone.

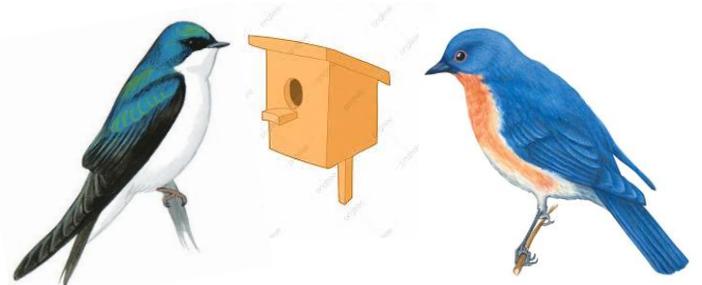


Agriculture dominated

Restored prairie



Assess impacts of land-use intensity on insect abundance and composition.



Measure nestling survival of Tree Swallows and Eastern Bluebirds and document feeding activity.

**Project Outcomes:** Determine the relationship between insect abundance, timing of insect availability and breeding success for multiple bird species across land-use intensities to develop comprehensive guidelines to conserve bird and insect diversity.