



Environment and Natural Resources Trust Fund

M.L. 2021 Approved Work Plan

General Information

ID Number: 2021-032

Staff Lead: Corrie Layfield

Date this document submitted to LCCMR: July 21, 2021

Project Title: What's "Bugging" Minnesota's Insect-Eating Birds?

Project Budget: \$199,000

Project Manager Information

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Project Reporting

Date Work Plan Approved by LCCMR: July 20, 2021

Reporting Schedule: December 1 / June 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. 6, Sec. 2, Subd. 03a

Appropriation Language: \$199,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota for the Natural Resources Research Institute to 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.

Appropriation End Date: June 30, 2024

Narrative

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.

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.

Project Location

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

Region(s): Central, NW, SW, NE,

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

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.	November 30, 2021
Monitor nest fate and hatchling growth and survival.	August 31, 2023
Assess nestling diets using C:N stable isotopes.	October 31, 2023
Quantify breeding and feeding behavior with cameras and RFID technology.	October 31, 2023

Activity 2: 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
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Provide guidelines to agricultural extension educators and land use managers and agencies.	June 30, 2024
Development of conservation guidelines and priority actions.	June 30, 2024
Quantify impacts of timing of availability of high-quality insects on focal species productivity.	June 30, 2024

Activity 3: 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:

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

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.

This project will provide foundational information necessary to assess how land-use affects insect and bird communities, this is the first critical step in developing comprehensive guidelines for long-term conservation of Minnesota's overall biodiversity. We will use the data collected to provide guidance on how land-use practices can best serve both people and native wildlife species. We will distribute our findings to land-use managers, agricultural extension agents and others who manage lands and influence land-use practices. The findings will be distributed to stakeholders and will be made available through the Internet as a Natural Resources Research Institute report. In addition, we expect several manuscripts to be written and submitted for publication in peer-reviewed journals. Results will also be disseminated through webinars and through local, regional, and national conferences. All reports and publications from this project will be made available via the Natural Resources Research Institute website. We will acknowledge the ENRTF funding in publications, signage, and other public communications and outreach related to work associated with the project using the trust fund logo or inclusion of language attributing support from the trust fund as appropriate.

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

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
Personnel								
Research technicians		Bird monitoring, behavior analysis, and insect identification (CS)			24.1%	0.9		\$58,730
Graduate Research Assistants		Two Summer GRA appointments to assist with data collection and analysis.			16.6%	0.5		\$25,312
Research Scientists		Project management, data collect, and analysis (P&A)			26.7%	0.57		\$58,210
Alexis Grinde, Wildlife Ecologist		Principal investigator; Project management and coordination.			33.5%	0.15		\$18,754
							Sub Total	\$161,006
Contracts and Services								
							Sub Total	-
Equipment, Tools, and Supplies								
	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 = \$8640 Food availability. We will collect insect samples from each study area 3 times per year for 2 years = \$864					\$9,800
	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	Insect sampling equipment	Flight intercept traps (2 per study area), nets for vegetation sampling, and collection analysis vials.					\$6,014
							Sub Total	\$21,094
Capital Expenditures								
							Sub Total	-
Acquisitions and Stewardship								
							Sub Total	-
Travel In Minnesota								
	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
							Sub Total	\$16,900
Travel Outside Minnesota								
							Sub Total	-
Printing and Publication								
							Sub Total	-
Other Expenses								
							Sub Total	-
							Grand Total	\$199,000

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
State				
			State Sub Total	-
Non-State				
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. (https://research.umn.edu/units/oca/fa-costs/direct-indirect-costs)	Secured	\$109,450
			Non State Sub Total	\$109,450
			Funds Total	\$109,450

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 ...

Optional Attachments

Support Letter or Other

Title	File
Sponsored Projects Authorization Letter	3b5c4934-57d.pdf
Research Addendum (revised)	c4e4faec-c40.docx
Background Check Certification Form	464e6bb1-155.pdf

Difference between Proposal and Work Plan

Describe changes from Proposal to Work Plan Stage

I changed the "S" in the title to lowercase.

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



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



Bird and insect populations are declining worldwide.

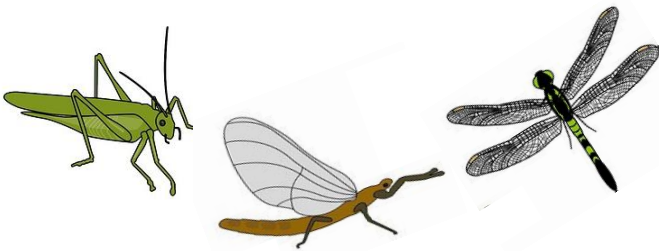
Aerial insectivore populations have declined 32%
Flying insect abundance has declined 75%

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.

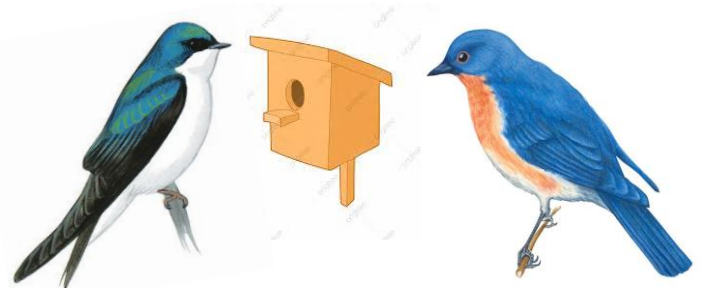


Agriculture dominated

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.