

Final Abstract

Final Report Approved on December 15, 2025

M.L. 2022 Project Abstract

For the Period Ending June 30, 2025

Project Title: Improving Golden-Winged Warbler Conservation and Habitat Restoration

Project Manager: Alexis Grinde

Affiliation: U of MN - Duluth - NRRI

Mailing Address: 5013 Miller Trunk Hwy

City/State/Zip: Duluth, MN 55811

Phone: (218) 788-2747

E-mail: agrinde@d.umn.edu

Website: <https://www.nrri.umn.edu/>

Funding Source:

Fiscal Year:

Legal Citation: M.L. 2022, Chp. 94, Sec. 2, Subd. 03a

Appropriation Amount: \$197,000

Amount Spent: \$197,000

Amount Remaining: -

Sound bite of Project Outcomes and Results

Golden-winged Warblers in northern Minnesota benefit from structurally complex vegetation rather than a single habitat type. Nest and fledgling survival improved with greater subcanopy cover, stem density, and coarse woody debris. Managing a mix of young forest and shrubby wetland conditions supports better growth, food availability, and overall reproductive success.

Overall Project Outcome and Results

Identifying ecological components that influence individual fitness during vulnerable life stages is essential for guiding conservation of declining species. The Golden-winged Warbler (*Vermivora chrysoptera*), a species of high conservation concern, relies on dynamic early successional habitats that are increasingly scarce across its breeding range. This multi year study assessed the relative quality of two primary breeding habitat types, young forest and shrubby wetland, in northern Minnesota by evaluating demographic performance including nest survival, fledgling survival, and nestling growth rates, along with vegetation structure and food resources. We hypothesized that the denser vegetation and wetter microclimates of shrubby wetlands would confer demographic advantages resulting in higher survival.

We monitored 125 nests and tracked fledglings at four study areas using VHF telemetry, fine scale vegetation surveys, landscape metrics, and arthropod sampling. Daily survival rates for nests and fledglings were estimated using a multi state Markov process model (MCestimate), and nestling growth was modeled using the Gompertz growth curve. Overall nest success was 36 percent, with predation the leading cause of failure (42.4 percent). Habitat type did not significantly affect nest or fledgling survival. Instead, survival improved in areas with increased subcanopy cover, higher stem density, reduced open ground cover, and coarse woody debris, and these structurally complex areas in shrubby wetlands also supported greater arthropod biomass and prey diversity, including key prey taxa such as Lepidoptera and Diptera.

No single habitat type maximized all fitness components. Management strategies that create structurally complex understories, maintain both young forest and shrubby wetland conditions, and promote tree species that support important prey resources may enhance reproductive success and post fledgling survival for Golden-winged Warblers in managed forest landscapes.

Project Results Use and Dissemination

Dissemination activities have centered on the Forestry for Minnesota Birds guidebook, released in April 2025, which incorporates Golden-winged Warbler findings to provide actionable habitat recommendations for forest nesting birds. Results were included in the Golden-winged Warbler species account and shared through collaboration with the Golden-winged Warbler Working Group to support regional conservation planning. Ongoing outreach includes presentations, workshops, and communication with agency partners and land managers. At least one peer reviewed publication is expected, and all associated data will be publicly accessible on the Natural Resources Research Institute website. ENRTF support will be acknowledged in all publications and outreach materials.



Environment and Natural Resources Trust Fund

M.L. 2022 Approved Final Report

General Information

Date: December 19, 2025

ID Number: 2022-043

Staff Lead: Lisa Bigaouette

Project Title: Improving Golden-Winged Warbler Conservation and Habitat Restoration

Project Budget: \$197,000

Project Manager Information

Name: Alexis Grinde

Organization: U of MN - Duluth - NRRI

Office Telephone: (218) 788-2747

Email: agrinde@d.umn.edu

Web Address: <https://www.nrri.umn.edu/>

Project Reporting

Final Report Approved: December 15, 2025

Reporting Status: Project Completed

Date of Last Action: December 15, 2025

Project Completion: June 30, 2025

Legal Information

Legal Citation: M.L. 2022, Chp. 94, Sec. 2, Subd. 03a

Appropriation Language: \$197,000 the second year is from the trust fund to the Board of Regents of the University of Minnesota for the Natural Resources Research Institute in Duluth to develop restoration and habitat management guidelines for protecting the imperiled golden-winged warbler by assessing habitat use and behavior of this species.

Appropriation End Date: June 30, 2025

Narrative

Project Summary: Assess Golden-winged Warbler productivity throughout the breeding season and inform habitat restoration to conserve Minnesota's biodiversity.

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

Golden-winged Warbler is one of the most critically threatened birds in North America with a global population estimated at only 400,000 individuals of which 50% nest in Minnesota. Densities of Golden-winged Warbler are highest in young, wet forests of Minnesota; this forest type is increasingly threatened due to maturation of early successional forests across the state.

American Bird Conservancy has completed over 10,000 acres of restoration and management action to create breeding habitat in upland forest and shrubby wetlands for the Golden-winged Warbler in Minnesota. Additional information is necessary to assess the effectiveness of these activities. Our project will assess habitat use of breeding females and fledglings to determine habitat characteristics associated with high quality habitats and restoration management actions that maximize breeding season productivity for this imperiled species.

Our specific objectives are to:

1. Compare nest success and juvenile survival for Golden-winged Warbler in young forest and shrubby wetlands.
2. Compare habitat use by Golden-winged Warbler during the breeding and post-fledging period in young forest and shrubby wetlands.
3. Provide metrics to guide restoration and habitat management at the landscape scale to maximize Golden-winged Warbler productivity and conservation.

What is your proposed solution to the problem or opportunity discussed above? Introduce us to the work you are seeking funding to do. You will be asked to expand on this proposed solution in Activities & Milestones.

Minnesota is a critical stronghold for the global Golden-winged Warbler population; developing breeding season management plans that address and incorporate fledgling survival and habitat use are necessary to continuously inform and improve habitat restoration efforts on the ground. American Bird Conservancy's restoration activities have focused on emulating natural disturbance by cutting dense alder, willow, and other forest or brushland species to create nesting habitat while retaining scattered, mature trees to create the structural diversity used by breeding males to sing and attract females.

To maximize the impact of these restoration efforts, additional information is needed to assess the habitat needs of nesting females and young birds after they leave the nest and before they disperse and/or migrate (i.e., the post-fledging period). To address this critical knowledge gap, we will use radio telemetry to study movements, cover-type selection, and survival of fledglings to determine how they use forest habitats during the critical post-fledging period. We will provide foundational information regarding the extent to which differences in breeding habitats impact bird productivity during the breeding season. Results will provide valuable insight into the landscape needs of Golden-winged Warblers which in turn will inform and improve management guidelines and conservation.

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 is a key state in the international Golden-winged Warbler full life-cycle conservation initiative. American Bird Conservancy collaborates with international partners in Central and South America to conserve Golden-winged Warbler wintering and stopover habitat, while implementing a regional program engaging public and private partners to restore and enhance breeding habitat throughout the Great Lakes and Appalachia. Understanding additional site-level characteristics that improve nest success and fledgling survival to help guide and prioritize site selection for habitat restoration and enhancement treatments is essential to creating the highest quality habitat to help prevent further population decline for this imperiled species.

Project Location

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

Region(s): Central, NW, 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: Assess differences in Golden-winged Warbler nest success between young forest and shrubby wetland habitats.

Activity Budget: \$66,000

Activity Description:

We will identify and select eight managed sites (four in young forest; four in shrubby wetlands). We will search for nests using a combination of standard nest searching methods and by radio-tagging females to find nests. Females will be tracked regularly to assess home range use during the nesting season, we will use an automated telemetry station near a subset of nests to document differences in time on and off nests in the different habitats. Nests will be monitored in-person during twice-weekly visits during the breeding season and camera traps will be deployed to document feeding activity, food items, and potential causes for nest failure and juvenile mortality (e.g., predation events). We will measure growth 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.

We will use high resolution imagery to characterize forest structure and composition at multiple spatial scales around nest locations. These data will allow us to evaluate habitat and landscape factors associated with nest success and hatchling survival.

Outcome: Determine differences in nestling survival and insect food provided by parents between breeding habitat types.

Activity Milestones:

Description	Approximate Completion Date
Identify eight study sites (four in young forest, four in shrubby wetlands).	November 30, 2022
Locate and monitor Golden-winged Warbler nests and track females.	August 31, 2024
Assess nestling growth and diets.	October 31, 2024
Evaluate factors associated with nest success and hatchling survival.	June 30, 2025

Activity 2: Compare habitat use by Golden-winged Warbler during the post-fledging period in young forest and shrub-dominated wetlands.

Activity Budget: \$104,000

Activity Description:

As nestlings approach the fledgling stage (~7-8 days post-hatch), we will tag juveniles with radio-transmitters. Juveniles will be tracked daily using ground telemetry methods to identify movements for approximately 20 days post-fledging to monitor survival and record habitat use. We will record habitat variables at two scales: 1) macro scale; forest cover type the juvenile is using, and 2) micro scale; within-stand features (e.g. sapling height, vegetation density) around juvenile locations. In addition to recording habitat information where birds are located, we will also record habitat variables at paired random locations that were “available” for use by juveniles. These data points will allow for analyses that will help us understand the functional interrelationships between habitat structure, landscape and juvenile survival and habitat use. We will use high resolution imagery to characterize forest structure and composition at multiple spatial scales around “used” and “available” locations. This portion of the study will allow us to assess post-fledging survival across space and time. This information is imperative to maximize the productivity of breeding birds and to provide management recommendations for species of conservation concern.

Outcome: Determine habitat use characteristics important during the post-fledging period.

Activity Milestones:

Description	Approximate Completion Date
Tag juveniles with radio-transmitters as they approach the fledgling stage of development.	July 31, 2024
Track juveniles and record habitat use for 14-21 days during the post-breeding season.	September 30, 2024
Evaluate juvenile habitat use.	June 30, 2025

Activity 3: Identify conservation priorities and strategies to promote habitat quality.

Activity Budget: \$27,000

Activity Description:

Findings from Activities 1 and 2 will be integrated to determine if there are differences in habitat quality and landscape context for the breeding season productivity of Golden-winged Warblers. We will analyze the data and incorporate the results to develop comprehensive management guidelines for Golden-winged Warblers habitat management in Minnesota. These guidelines will include silviculture approaches and treatments for forest and shrub habitats that focus on creating features important for the species. Finally, we will work with the Golden-winged Warbler working group (gwwa.org) to incorporate our findings into the Great Lakes conservation plans for the species.

Outcome: Identify and communicate conservation priorities.

Activity Milestones:

Description	Approximate Completion Date
Complete preliminary analysis of productivity and habitat-use 2023 data.	December 31, 2023
Development of conservation guidelines and priority actions.	June 30, 2025
Compilation and integration of breeding season habitat use.	June 30, 2025

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Peter Dieser	American Bird Conservancy	Project coordination and design.	No

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.

We expect that our results will quantify differences in habitat quality between shrubby wetlands and young forests. The findings and products developed from this project will be directly conveyed to project stakeholders through formal and informal meetings and incorporated into best management practices for the species. 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.

Scientific publications: We expect that this project will produce at least 1 peer reviewed journal article.

Presentations: Results will be disseminated through local, regional, and national conferences.

Data: Publicly available data will be hosted through the Natural Resources Research Institute website.

Project partners will use the results of this study to identify and improve practices to benefit Minnesota's forest resources.

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 work be funded?

This project will provide data to assess habitat use of Golden-winged Warbler and better understand habitat associations across their breeding cycle. Results will provide insight into targeting restoration monies for young forest and shrubland habitat management. Identification and implementation of science-based best management practices that create or maintain Golden-winged Warbler breeding habitat is an important step towards sustaining and enhancing populations of these species and helping to reverse widespread population declines observed throughout their breeding range. Findings and data generated from this project will also serve as a foundational resource to prioritize and assess future threats to Minnesota's 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	\$ Amount Spent	\$ Amount Remaining
Personnel										
Research technicians		Bird monitoring, tracking and data analysis (CS)			24.1%	0.75		\$55,665	-	-
Graduate Research Assistants		Two Summer GRA appointments to assist with data collection and analysis.			16.6%	0.5		\$25,312	-	-
Field technicians		Data collection and data entry			7.4%	0.46		\$17,937	-	-
Alexis Grinde, Wildlife Ecologist		Principal investigator; Project management and coordination.			26.7%	0.15		\$18,754	-	-
Graduate Research Assistant (academic year)		Graduate student (50% GRA 1 semester, academic year, tuition benefits)			50%	0.19		\$20,481	-	-
Field Technician		Data collection and data entry			0%	0.02		\$1,620	-	-
							Sub Total	\$139,769	\$139,769	-
Contracts and Services										
University of Minnesota	Internal services or fees (uncommon)	eDNA Processing will be used to identify insects consumed by birds and insects available in the environment. (estimate ~200 samples @ \$15/ sample)				0		\$3,000	\$3,000	-
TBD	Service Contract	Isotope analysis will be used to assess quality of insects consumed by birds and compared to insects available in the environment (estimate ~200 samples @ \$14.40/ sample).				0		\$2,880	\$2,880	-
							Sub Total	\$5,880	\$5,880	-

Equipment, Tools, and Supplies										
	Tools and Supplies	Diet analysis	DNA Kits for extraction DNA extraction from fecal and insect samples.					\$700	\$700	-
	Tools and Supplies	Telemetry equipment	Estimate 24 successful nests per year; we will tag all females (n=24 females / year) and two juveniles from each successful nest; 48 juveniles / year. Total of 144 transmitters (@\$160 / transmitter) = \$23,000 for transmitters. Yagi antennae, batteries, and replacement cables (\$2100). Note: Receivers purchased from previous studies will be used.					\$25,100	\$25,100	-
	Tools and Supplies	Insect sampling equipment	Flight intercept traps, nets for vegetation sampling, coolers for field storage, and collection analysis vials.					\$8,651	\$8,651	-
							Sub Total	\$34,451	\$34,451	-
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					\$16,900	\$16,900	-

			collection and lodging during the 2022 and 2023 field seasons.							
							Sub Total	\$16,900	\$16,900	-
Travel Outside Minnesota										
							Sub Total	-	-	-
Printing and Publication										
							Sub Total	-	-	-
Other Expenses										
							Sub Total	-	-	-
							Grand Total	\$197,000	\$197,000	-

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
---------------	---------------------	-------------	--------------------------------------------------------------

Non ENRTF Funds

Category	Specific Source	Use	Status	\$ Amount	\$ Amount Spent	\$ Amount Remaining
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	\$103,832	\$103,832	-
			Non State Sub Total	\$103,832	\$103,832	-
			Funds Total	\$103,832	\$103,832	-

Attachments

Required Attachments

Visual Component

File: [11e959b4-039.pdf](#)

Alternate Text for Visual Component

Title reads "Improving Golden-winged Warbler Conservation and Habitat Restoration".

Text reads "Problem: Golden-winged Warbler is one of the most critically threatened birds in North America.

Approximately 50% of the global population nests in Minnesota."

Below is a picture of a bird and map of the US and Canada showing the highest population density of Golden-winged Warblers in Minnesota.

Text box reads "American Bird Conservancy has completed over 10,000 acres of restoration and managemen...

Supplemental Attachments

Capital Project Questionnaire, Budget Supplements, Support Letter, Photos, Media, Other

Title	File
Letter of Support from ABC	2493f5fa-8d4.pdf
UMD Sponsored Projects Transmittal Letter	ba0aac8e-f07.pdf
Research Addendum	92f7a23e-113.pdf
Background check form	63cf0a7c-ed8.pdf
2023 Study Area Map	7704ade3-87f.pdf
Influence of habitat type on nest success, fledgling survival, and habitat-use of the Golden-winged Warbler	2761bf74-26c.pdf
Improving Golden-Winged Warbler Conservation and Habitat Restoration: Management Recommendations	1059c201-256.pdf
Improving Golden-Winged Warbler Conservation and Habitat Restoration: Research Summary	2139a369-b60.pdf
Golden-winged Warbler Conservation: Future Directions	3fb48d14-b80.pdf
Forestry for Minnesota Birds pdf	23285fa8-d54.pdf

Media Links

Title	Link
Forestry for Minnesota Birds	https://foreststewardsguild.org/wp-content/uploads/2025/03/ForestryForMNBirdsGuidebook.pdf

Difference between Proposal and Work Plan

Describe changes from Proposal to Work Plan Stage

- 1.) I added a milestone and changed the dates for Activity 2.
- 2.) I added text and additional milestones under Activity 3
- 3.) I uploaded the pdf of the research addendum
- 4.) I uploaded the correct background check document.

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 understand that travel expenses are only approved if they 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 understand the UMN Policy on travel applies.

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

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

Do you understand that a named service contract does not constitute a funder-designated subrecipient or approval of a sole-source contract? In other words, a service contract entity is only approved if it has been selected according to the contracting rules identified in state law and policy for organizations that receive ENRTF funds through direct appropriations, or in the DNR's reimbursement manual for non-state organizations. These rules may include competitive bidding and prevailing wage requirements

Not acknowledged

Work Plan Amendments

Amendment ID	Request Type	Changes made on the following pages	Explanation & justification for Amendment Request (word limit 75)	Date Submitted	Approved	Date of LCCMR Action
1	Completion Date	Previous Completion Date: 06/30/2025 New Completion Date: 12/31/2025	LCCMR workaround needed to submit March 2025 status update	May 22, 2025	Yes	May 29, 2025
2	Completion Date	Previous Completion Date: 12/31/2025 New Completion Date: 06/30/2025	LCCMR workaround needed to submit March 2025 status update - setting back to correct date	June 2, 2025	Yes	June 2, 2025

Status Update Reporting

Final Status Update August 14, 2025

Date Submitted: December 12, 2025

Date Approved: December 15, 2025

Overall Update

This project aims to advance Golden-winged Warbler conservation by comparing nest success and juvenile survival in young forests and shrubby wetlands, analyzing habitat use during breeding and post-fledging periods, and providing metrics to guide landscape-scale habitat restoration. Contrary to initial expectations, nest survival did not differ significantly between habitat types, indicating that both can support successful nesting when microhabitat conditions—such as dense subcanopy cover and high stem density—are met. These structural features consistently reduced predation risk, emphasizing the importance of vegetation complexity over habitat type in nest site selection.

Fledgling survival was influenced more by seasonal timing and vegetation structure than habitat type. Subcanopy cover remained a key factor in reducing predation, while open ground increased vulnerability. Fledglings showed strong natal habitat fidelity and selected microhabitats with dense cover and coarse woody debris, suggesting early-life experience shapes habitat preferences. Movement patterns varied by habitat, highlighting the need for connectivity and structural diversity.

Activity 1

We monitored 125 Golden-winged Warbler nests across 14 sites in northern Minnesota. Nest success was moderate, with 36% fledging young, while 42.4% failed due to predation and 23.2% due to weather, abandonment, or unknown causes. Trail cameras documented 25 predation events involving a diverse predator community, including raccoons, weasels, squirrels, bears, raptors, Blue Jays, and garter snakes.

Nestling growth was assessed using mass measurements from 226 individuals, resulting in a Gompertz growth curve ($R^2 = 0.8$). Nestlings in young forests were heavier than expected in 2023, but no consistent differences were found across other years. Fecal DNA analysis from 21 nestlings identified 51 arthropod species, with Lepidoptera and Diptera dominating the diet. While overall diet diversity did not differ significantly between habitats, young forest samples contained more unique prey species.

Arthropod surveys revealed no significant differences in community composition between habitats in 2023, but in 2024, shrubby wetlands supported significantly higher diversity and species richness. These results highlight interannual variability in prey availability, which may influence fledgling growth and survival.

Vegetation structure at nest sites was similar across habitats. Subcanopy cover and open ground exposure were key predictors of nest success, which averaged 29% across the full nesting

Activity 2

A total of 126 Golden-winged Warbler fledglings (81 from young forests, 45 from shrub wetlands) were tracked for an average of 13 days. Survival during the critical eight-day immobile post-fledging period was 60%, with predation accounting for 34% of mortality and unknown causes for 6%. Fledgling survival was more strongly influenced by vegetation structure and timing than habitat type. Higher subcanopy and herbaceous cover reduced predation risk, while increased canopy cover and later-season timing increased vulnerability.

Fledglings moved progressively farther from nests as they aged. During the mobile period (days 9–30), fledglings in

young forests traveled farther from the nest, while those in shrub wetlands exhibited greater daily movement distances. Maximum movement reached 677 meters by day 33.

Fledglings showed strong natal habitat fidelity, consistently selecting the same habitat type in which they hatched. Microhabitat selection was driven by structural features—subcanopy cover, stem density, and coarse woody debris—which were consistently higher at used sites. These preferences held across both immobile and mobile stages and were consistent within each habitat type.

Activity 3

Effective conservation of Golden-winged Warblers in Minnesota requires habitat management that prioritizes structural complexity over habitat type. Key microhabitat features—dense subcanopy cover, high stem density, coarse woody debris, and low open ground exposure—were consistently associated with reduced predation and improved fledgling survival.

In young forest habitats, recommended silvicultural approaches include rotational clearcutting or shelterwood systems to regenerate early successional growth while retaining legacy trees and downed woody material. Selective thinning can enhance light penetration and stimulate subcanopy development, while minimizing herbicide use supports dense understory regeneration.

For shrubby wetlands, management should focus on maintaining native shrub diversity through invasive species control and using prescribed fire or mechanical treatments to prevent succession to closed-canopy forest. Enhancing edge complexity and preserving hydrological integrity will support arthropod diversity and prey availability.

At the landscape scale, conservation efforts should ensure connectivity between breeding and post-fledgling habitats to support fledgling movement and survival. Restoration should be prioritized in areas with existing structural complexity, especially those with high subcanopy cover and coarse woody debris. Multi-year monitoring is essential to account for ecological variability, particularly in prey availability and predator pressure, ensuring adaptive and effective habitat management.

Dissemination

Dissemination efforts for this project have been closely aligned with the development and promotion of the Forestry for Minnesota Birds guidebook, released on April, 2025. This resource integrates NRRI's avian data and forest management expertise to provide actionable habitat recommendations for forest-nesting birds, including the Golden-winged Warbler. Findings from this project were directly incorporated into the Golden-winged Warbler species account, ensuring that the latest research on nest success, fledgling survival, and habitat use informs broader conservation strategies. Ongoing dissemination includes collaboration with the Golden-winged Warbler Working Group (gwwa.org) to integrate project findings into regional conservation planning, including updates to the Great Lakes strategy.

Article: NRRI avian data and expertise brings forest management and happy birds together in one manual for all. <https://nrri.umn.edu/news/forestry-bird-guide>

Workshop: Forestry for Minnesota Birds. June 18, 2025, 9:30 a.m. – 4:00 p.m. Cloquet MN.

Webinar: Applying the New Forestry for Minnesota Birds Guidebook. Jul 8, 2025. Christina Nelson.

<https://sfec.cfans.umn.edu/events/web25-july>

Status Update Reporting

Status Update March 1, 2025

Date Submitted: June 2, 2025

Date Approved: June 2, 2025

Overall Update

We completed landscape delineation of the study area and nest locations. This spatial data will be integral to understanding how landscape features influence habitat use and reproductive outcomes. We are currently in the process of analyzing data from the 2023 and 2024 field seasons. These analyses focus on our three primary objectives: (1) comparing nest success and juvenile survival in young forest and shrubby wetland habitats, (2) assessing habitat use by Golden-winged Warblers during the breeding and post-fledging periods across these habitats, and (3) developing metrics to inform landscape-scale restoration and habitat management strategies that maximize species productivity and conservation. The project is on track for completion.

Activity 1

We completed data QA/QC for the 2024 season and combined with the 2023 dataset. We completed the landscape delineation of the study area and nest locations at multiple spatial scales. We are in the process of completing insect identification and eDNA extraction from the 2024 fledgling fecal samples. Preliminary models have been built to assess nest success and juvenile survival, we are finalizing modeling methods that will be used for the final product.

Activity 2

To further our understanding of juvenile habitat selection, we have completed preliminary analyses of juvenile habitat use using compositional analysis. Additionally, we have conducted used vs. available habitat assessments for the 2023 and 2024 breeding seasons to examine habitat preferences at multiple scales.

Activity 3

We have met with members of the Golden-winged Warbler Working Group to share our preliminary results and discuss how they align with existing conservation recommendations. These conversations focused on how our findings could inform updates to the current guidelines.

Based on the 2023 data and our preliminary 2024 analysis of breeding season habitat use, we have made meaningful progress toward Milestone 2: Compilation and integration of breeding season habitat use. For example, our results clearly highlight the importance of shrubby wetland habitats, and we discussed the potential for incorporating shrub-wetland management techniques (e.g., shearing) to enhance habitat suitability.

Additionally, early findings suggest that nest survival is higher in young forest stands with greater tree retention than currently recommended in the existing guidelines. We also observed that some breeding sites are surrounded by areas with a conifer component. While current recommendations advise avoiding conifer or mixed tree landscapes, our results suggest this guidance may need to be reconsidered or refined based on local conditions.

At this stage, a revised version of the conservation guidelines has not yet been produced. Edits and formal recommendations will be finalized following completion of our full analysis.

Dissemination

A. Grinde presented our findings at the Annual National Forest Breeding Bird Monitoring meeting on March 3, 2025. The preliminary results were also used to inform habitat recommendations for Golden-winged Warblers in the recently released document, "Forestry for Minnesota Birds."

Status Update Reporting

Status Update September 1, 2024

Date Submitted: September 16, 2024

Date Approved: October 18, 2024

Overall Update

We completed the field work for this project. The 2024 field season was conducted on the Mille Lacs WMA. The field season was intense and the worst season yet in terms of overall nest success and juvenile survival. The return of the adults was sporadic due to rainy weather in May and early June, we think nest initiation was prolonged and several first nest attempts may have failed due to weather. Overall, we found a total of 32 nests and only 5 of them fledged young, the high rate of nest failure was related a variety of factors including weather, brown-headed cowbird brood parasitism, and predation of eggs and nestlings. We fitted 15 nestlings with transmitters this year. Unfortunately, fledgling mortality was also high this year due to predation events that largely occurred 1-5 days after leaving the nest and were able to track only 3 birds to our goal of 21 days during the post-fledging period.

Activity 1

There were 4 study sites this year in the Mille Lacs WMA (2 pairs of study sites; 2 in shrubby wetland sites and 2 in recently harvested northern hardwood sites). The dry sites were mostly dominated by high amounts of oak retention with canopy trees generally greater than 20 meters and wetland sites primarily consisted of alder and contained more open wetland than previous years. We found a total of 32 nests. Nests were monitored until fledge or failure, and nest cameras were put on the majority nests to document nest predators. A total of 17 nests were found in dry sites, with only two nests fledging young, and 15 nests were found in wet sites, with only three nests fledging young. Resulting in a total of 15 failed nests in dry sites and 12 failed nests in wet sites. Nests failed for a variety of reasons: weather events, parasitism from Brown-headed Cowbirds, predation and unknown causes. Video footage of nests showed predation events from: garter snakes, black bear, raccoon, deer, chipmunk, and ground squirrel. We obtained 62 nestling measurements and collected fecal samples for diet analysis as they were available. We collected insect samples and are processing.

Activity 2

A total of 18 nestlings were banded and 15 nestlings fitted with transmitters. Mortality for fledglings was unusually high this year, mainly due to predation that occurred the first 5 days after leaving the nest. We were able to track only 3 birds to our goal of 21 days. In total we collected 146 post-fledge veg points (73 detection points, 73 random points). We are currently entering the vegetation data.

Activity 3

We have conducted preliminary analyses of the previous year's data, and will add the 2024 data after QA/QC processes have been completed.

Dissemination

We do not have any dissemination activities to report during this time period.

Status Update Reporting

Status Update March 1, 2024

Date Submitted: March 29, 2024

Date Approved: May 24, 2024

Overall Update

We completed data entry and processing of the 2023 field season data. Specifically, we have conducted preliminary analyses on habitat use, extracted DNA and sent samples to the genomics lab for processing, and are currently completing insect identification. We are in the process of preparing for the second field season, including identifying study sites for the 2024 season, there are four potential areas that will be scouted in May when the birds return to Minnesota.

Activity 1

We completed entry and data QA/QC for the vegetation data and calculated landscape metrics (distance to edge, patch size, etc.) associated with nests found in 2023. We completed preliminary analysis of nest success data, at this point of the study, our results indicated that there is no difference in nest success between young forests and shrub wetlands. Additionally, nest survival was lowest for nests that were close to forest edges and survival was lower for nests that were initiated later in the breeding season. Other activities included DNA extraction from fecal samples, the samples were sent to the UMN genomics center and are currently being summarized.

Activity 2

We completed entry and data QA/QC for the juvenile habitat-use data and also calculated landscape metrics (distance to edge, patch size, etc.) associated with juvenile locations. Preliminary analyses show there is no difference in fledgling survival between young forests and shrub wetland habitats, predation by sciurids, hawks, and mesocarnivores during the nesting period and the post-fledgling period was the most common cause of mortality, and fledgling survival was also lower for birds near forest edges but increased as fledglings aged. Preliminary results from the habitat selection models indicated that fledglings use a variety of habitats and within stands, they select for areas with high shrub/sapling density, canopy cover, and coarse woody debris.

Activity 3

No work associated with this activity has been completed at this point of the project.

Dissemination

Brett Howland presented his Master's research "Influence of habitat type on nest success, fledgling survival, and habitat-use of the Golden-winged Warbler" at the University of Minnesota Duluth's, Biology Seminar on December 8, 2023.

Stephen Nelson presented an overview of the Golden-winged Warbler project at the Sax-Zim Bog in January 2024.

Brett Howland presented "Influence of habitat type on nest success, fledgling survival, and habitat-use of the Golden-winged Warbler" at the Minnesota Chapter of The Wildlife Society on February 29, 2024.

Status Update Reporting

Status Update September 1, 2023

Date Submitted: September 21, 2023

Date Approved: November 20, 2023

Overall Update

We completed our first field season for the project and are currently in the process of data entry and processing. We found and monitored a total of 41 Golden-winged Warbler nests, measured 74 nestlings, and tagged and tracked 30 juveniles this season. Overall, nest success of nests that had one or more eggs was higher than in previous years studying this species (66%) and was similar across habitat types. The majority of failures were associated with partial or full predation events. Juvenile survival to day 21, post-fledge was 40% and the majority of mortality was due to predation that occurred 1-6 days after leaving the nest, this is when the young birds are still learning to fly and are most vulnerable to predators. Additionally, we collected feces for dietary analysis, conducted vegetation surveys to assess habitat needs, and insect surveys to characterize differences in food availability between habitat types. We detected three Brewster's Warblers in our study sites, these are adult birds that are hybrids of Golden-winged Warbler and Blue-winged Warbler.

Activity 1

At the start of the breeding season we tagged a total of 18 females across all study sites to help us find nests. Of these, one tagged female disappeared (she was likely migrating through the area), one was found dead (suspected predation), and we were able to find the nests of the remaining 16 tagged females. Additionally, we found nests by mapping male territories and using behavioral cues to find the remaining nests. Using this combination of methods, we were able to locate and monitor a total of 41 nests across the study areas during the 2023 season, of these 8 were abandoned before laying eggs. We deployed cameras at active nests to monitor predation events and document feeding activity after hatch. Videos showed a wide variety of predators including bear, sharp-shinned hawk, chipmunk, and garter snakes; the feeding behavior is currently being analyzed. After the nests hatched, the nestlings (n= 74) were measured two times, at which time fecal samples were opportunistically collected for dietary analysis.

Activity 2

A total of 30 fledglings (~ 2 individuals from each of the successful nests) were tagged with radio transmitters and tracked until 1.) they were found dead, 2.) the signal lost (40%) could indicate a faulty tag, predation, or the bird left the local area), or 3.) for 21 days.

Fourteen (46%) were predated, 4 (13%) had unknown fates, and 12 (40%) of these birds survived for the 21 day post-fledge period. The majority of fledgling mortality occurred in the first six days after leaving the nest. We conducted vegetation surveys at all fledgling locations (n= 329) and paired "available" locations (n= 329) to assess fine-scale habitat features used by juvenile Golden-winged Warblers. The vegetation data have been entered, error checked, and we are currently in the process of conducting preliminary analyses for this field season. Lastly, we conducted systematic insect surveys to assess differences in insect / food availability between the upland, young forest sites and the shrubby wetland sites. The insect samples will be processed over the winter.

Activity 3

No work associated with this activity has been completed at this point of the project.

Dissemination

We attended the American Ornithological Society and Society of Canadian Ornithologists joint conference in London, Ontario, August 8 - 12, 2023. Brett Howland, a Master's student in the Integrated Biological Sciences Program at the University of Minnesota Duluth, gave an invited talk at the Golden-winged Warbler Working Group Symposium entitled

"Golden-winged Warbler Productivity in Minnesota".

Alexis Grinde was invited to serve on the breeding grounds sub-committee of the Golden-winged Warbler Working Group, an international group of scientists and resources managers working together to conserve Golden-winged Warblers.

Status Update Reporting

Status Update March 1, 2023

Date Submitted: April 7, 2023

Date Approved: April 11, 2023

Overall Update

We have been preparing for the first field season associated with this project, activities include developing methods, identifying study areas, and ordering field supplies.

Activity 1

We have been in the process of identifying study areas and young forest and shrubby wetlands sites. We currently have identified two potential study areas for the 2023 field effort. Our preferred study area is located in Carlton County, we identified a backup study area in Itasca County. We will conduct site visits once they are accessible and monitor the sites starting in May to determine potential habitat suitability and to make sure there is a sufficient number of breeding birds in the areas. Within the Carlton County study area, we have identified four study sites, two young forest sites and two shrubby wetlands sites, these sites have been previously managed by ABC (see attached file "GWWA_2023_Study Areas"). We are in the process of developing SOPs and ordering supplies for the field season.

Activity 2

We have developed methods for assessing juvenile habitat and ordered transmitters for tracking this summer based on previous research projects and published literature. Immature Golden-winged Warblers will be marked as nestlings 8 days after hatching, we will randomly selected 2-3 members of each brood to be fitted with a VHF radio-transmitter (Lotek). Parents split broods shortly after fledging and we want to increase the chance of monitoring separate sub-broods and increasing survival data. We will attach radio transmitters using the figure-8 harness method constructed elastic thread to allow for growth. We will track fledgings daily using a Lotek receiver and Yagi 3-element antenna and visually confirmed its location. We will record the presence and behaviors of siblings and parents to determine fledgling independence until fledgling mortality or radio-transmitter battery failure (~25 days). We are in the process of finalizing habitat and vegetation methods that will be used for the project.

Activity 3

No work associated with this activity has been completed at this point of the project.

Dissemination

We have not disseminated information at this point of the project.