



Natural Resources Research Institute

NRRI Now

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Growing to Harvest

Like the small but mighty garden our staff planted in the NRRI Duluth backyard, the Natural Resources Research Institute is growing to harvest.

We're adding staff, attracting large grants for impactful projects, and expanding our lab space. From this growth, we expect to harvest meaningful partnerships, develop innovative solutions and expand opportunities for Minnesota and beyond.

And watch your inbox next week for our fiscal year 2024 Annual Report which captures our very fruitful year, including a letter from our Executive Director, Rolf Weberg.

Please share this newsletter with friends and colleagues. Thanks for staying in touch.

June Breneman

Editor, Marketing & Communications Manager

nrriinfo@d.umn.edu



Natural Resources
Research Institute

UNIVERSITY OF MINNESOTA DULUTH
Driven to Discover®

Main: (800) 234-0054 | Website: www.nrri.umn.edu | Email: nrriinfo@d.umn.edu

NRRI Duluth | 5013 Miller Trunk Highway | Duluth, MN 55811 | (218) 788-2694

NRRI Coleraine | One Gayley Ave / PO Box 188 | Coleraine, MN 55722 | (218) 667-4201

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‘Bugs ‘n Birds’ study underscores importance of insects



A tree swallow held in a hand while yellow band is attached to leg.

June Breneman
Oct 7, 2024

NRRI cross-disciplinary research explores availability of food sources for declining species of bug-eating birds.

“They’re understudied and under-appreciated.”

Buzzing, biting or just plain annoying, insects are summer pests to us. But insects are the main course for Minnesota’s flying insectivores. Amber Ulseth, a NRRI aquatic ecologist who helped sift through a year of terrestrial insect data, said there’s just so much more to learn.

“This study has the potential to help us understand just how important these insects are in these landscapes,” Ulseth added.

And for tree swallows – the focus bird species for this research – insects are the entree, the main course and the dessert. Tree swallows were chosen for this study because they’re one of many aerial insectivore species in decline. They’re also nest box dwellers, allowing researchers to place boxes attracting birds to the study areas to track bird activity. Equally important, tree swallows are food “generalists,” meaning they eat what’s available.

NRRI’s Avian Ecology Lab scientists teamed up with NRRI entomologists (scientists who study insects) to launch this unique study to find out if the swallows have enough food sources in western Minnesota to thrive.



Photo left: Avian Researcher Stephen Nelson learned a lot about terrestrial insects for the study.

The researchers monitored 95 nest boxes set up across three study areas: farmland, prairie grasslands and areas with a 50/50 mix of both. The nest boxes were outfitted with microcomputers to collect information from tagged birds flying in and out of the box to measure how often the parents were feeding the young birds. They also collected nestling feces to analyze with eDNA technology to know exactly what the nestlings were eating. Overall, they collected data

on 74 adult tree swallows and 508 nestlings.

“We found that for the tree swallows, at least, there are plenty of insects to support reproduction and productivity,” said Alexis Grinde, NRRRI Avian Ecology team leader. “But we also know there are a lot of birds that specialize in what they can eat and forage for. So this study is an important first step to learn more about aerial insectivores.”

Photo right: Tree swallow held in hand with dragonfly in beak



Results

The two-year study provided some preliminary data that will be used to design a more comprehensive study.

- Breeding was more successful in areas with a higher proportion of grasslands and dense vegetation.
- Nestlings grew fastest in grassland and mixed habitats, suggesting that they had access to higher-quality prey (insects) in those areas.
- Tree Swallows have a diverse diet. Researchers identified 482 different insect genera in the tree swallow diet, including flies, beetles and moths.
- Insect data showed the same abundance patterns as the tree swallow diets, confirming that these birds are generalists and feeding their nestlings the most abundant available food.
- Of the 57 breeding bird species identified in the study areas (13 of which are “Species of Greatest Conservation Need”), grasslands supported the most diverse bird communities, and all species that are of conservation concern were found in grassland habitats.



An important take-away from the study is that grassland habitats are really important to bird biodiversity.

Photo left: Alexis Grinde

“Conservation practices in agricultural lands that promote habitat features and support insect abundance, such as buffer strips, seem to increase food availability for breeding birds,” said Grinde. “Conserving and creating grassland habitat is important and there are opportunities to increase the quality of agricultural lands too; we’re here to help inform those decisions.”

Insect Challenge

There are many challenges to studying terrestrial insects, not the least of which is the sheer number. Minnesota is home to some 700 insect families with an estimated 8,000 to 10,000 species in each family.

And this isn’t lost on picnicking families.

“Insects are not exactly our ‘charismatic megafauna’,” said Ulseth. “It’s harder to sell people and research funders on the important ecosystem services provided by these creatures. Teaming-up with the avian ecology lab was a great opportunity to get baseline data and think about food webs.”

The insect data collected by aerial traps and net sweeps reflected the findings in the eDNA of tree swallow feces. But other bird species need to be studied, like the bobolink, eastern meadowlark and sedge wren.

“Can the other sensitive bird species breed successfully in these habitats? Are there enough insects available during the peak of the breeding season for all birds? How do the extreme weather events and droughts we have been experiencing influence the insects that are available year-to-year?” asked Grinde.

That’s the future direction, to focus on the diets of other species and continue looking at changes in timing of food availability related to weather and climate.”

This preliminary study was funded by the Environment and Natural Resources Trust fund as recommended by the Legislative Citizen Commission on Minnesota Resources (LCCMR) .

Read about the first year of this study here: [What’s buggin’ Minnesota birds? September 2023.](#)

NRRI funds projects internally for research innovations



NRRI leaders listen to researcher Annie Bracey pitch her research proposal.

June Breneman
Oct 7, 2024

Technology Review Board vets proposals via ‘shark tank’ style pitches.

NRRI researchers and staff are innovators. They boldly seek out new ideas, experiment with new technologies and push the envelope in their fields.

In fiscal year 2024, NRRI deployed over \$3 million in internal funding to propel research creativity and productivity by ensuring researchers have the facilities, equipment, and resources they need.



Photo left: Will Bartsch

Researchers can pursue project funding through an internal competitive pitch grant process that was initiated in 2020. In September, five new proposed projects were on stage. The researchers had five minutes to “sell” their colleagues on the need for, and potential impact of, their project.

“NRRI is fairly unique in providing this recurring internal funding opportunity,” explained Will Bartsch, NRRI Research Group Leader, who also organizes the internal funding pitch events. “Our researchers appreciate the opportunity to pursue this funding as it allows them to innovate, push their science forward, and ultimately be more competitive for external funding.”

A rotating panel of senior researchers and research group leaders evaluate the projects’ alignment with NRRI’s strategic goals, breadth of multidisciplinary approach and potential for future external funding.

The September 2024 pitch event included proposals to:

- Use Artificial Intelligence-driven geospatial analysis to better understand water quality dynamics in Minnesota's lakes.
- Evaluate the use of environmental DNA technologies to monitor mercury levels in the threatened common tern.
- Update an existing forest bird database to ensure the data is secure, easily managed, and accessible to NRRRI researchers and partners.
- Understand how dramatic forest changes driven by both invasive and native species impact hydrology and food webs in the spring ponds and streams of Minnesota's northern forests.

A separate finance team considers fund requests for facility and technology upgrades and grant-matching funds. More than \$600,000 of internal funding was deployed in fiscal year 2024.

Since the "Shark Tank" pitches began in the fall of 2022, 23 project proposals have been pitched and 19 have been funded. These internal funds allow researchers to generate new data to support integrated research that can seed larger projects, improve productivity and spur federal investment.

The internal funding has provided a unique training opportunity for early career scientists and testing ground for senior researchers to extend their work in new directions.

"We're really pleased with the success of this program," said NRRRI Executive Director Rolf Weberg. "Ultimately, this investment makes our staff more competitive in the pursuit of external grant funding as we fulfill our mission to the state and nation."

Southern flying squirrels glide north

June Breneman
Oct 7, 2024



Anna Mangan checks a trap with flying squirrel. (Photo credit: Charly Kearns)

Temperatures and habitat changes push species into ‘Zone of Sympatry’ with northern cousins.

If your knowledge of flying squirrels doesn’t extend much beyond Rocky (of the famous [Rocky and Bullwinkle](#) cartoon team), you’re not alone.

They’re small, nocturnal creatures that keep mostly to treetops – though they might glide into your backyard bird feeder on occasion. And, at least here in Minnesota, they’re not well studied. Meanwhile, Wisconsin and Michigan have listed flying squirrels as a “species of concern.”

Photo right: Anna Mangan

“We want to know the status of flying squirrels here,” explained NRRI Wildlife Ecologist and project lead Anna Mangan. “And we have this interesting situation [1:33](#)

where two species are overlapping in their range, so we want to understand how they’re competing for resources or if their populations are doing okay.”



Minnesota’s southern flying squirrels – a smaller, “yippier” species – prefer the deciduous forest landscape, especially for the nuts and acorns, fungi and seeds. The northern flying squirrels prefer the state’s boreal forests with spruce, pine and fir trees aplenty. But the Duluth area is within a sympatric zone – extending west toward Bemidji – where the two species are both present in mixed forest habitat. And it appears the southern species are pushing further north as a warming climate creates more favorable conditions.

Advancing Knowledge

Three graduate students are tackling different research angles to help understand these species. Katie Pfaff, in UMD's Integrated Biosciences Program, is capturing, tagging and attaching tiny radio telemetry tracking collars to the "flyers." She carefully and quickly handles each squirrel to get their weight and health data.

[\[Watch a video of Katie Pfaff](#) collecting flying squirrel data near the UMD campus.]

Working across several sites, the team ear-tagged nearly 100 squirrels and some 44 wearing trackers. Now the team is learning where the squirrels live, what they eat and how far they travel. Camera traps deployed in likely flying squirrel locations, like Jay Cooke Park, are also providing data.

"Katie is gathering data on how both species use their shared spaces," explained Mangan. "What times of year are they most active? How do they use their habitat?"

Anthony Raona, a graduate student at Grand Valley State University in Allendale, Mich., is basing his master's research on an intestinal parasite, *Strongyloides robustus*, found in southern flying squirrels without health impacts. But, studies elsewhere have found it can be detrimental to the northern species.

"It was a study back in the 1960s that found this parasite kills northerns but not southern flyers," Raona explained. "So I'm interested in knowing if *Strongyloides* is moving up north with the squirrels and what that impact might be."



Photo left: Anna Peterson wears insect protection in the field. (Photo: C. Kearns)

Anna Peterson started her second year in UMD's Integrated Biosciences Program this fall. She's gathering data on the distribution of flying squirrels statewide using previously gathered acoustic recordings and teasing out the ultrasonic squirrel sounds.

"The recordings were collected to get bat distribution data, but I can adjust the output for squirrels, which also vocalize in the ultrasonic range," Peterson explained.

And she's coupling that with finer scale distribution data with 100 acoustic survey sites set up in the Chippewa National Forest. She developed a "habitat suitability index" based on canopy cover, stand type, and stand age to determine low, medium and high quality habitat for each species.

"Previous studies have found that the southern and northern species can coexist in the sympatric zone, but southern species are more aggressive and can push northern species out," said Peterson. "But it will be interesting to see if that's happening here."

Squirrel in the Coal Mine

Tracking the changing distributions of flying squirrels is one key to unlocking a better understanding of how Minnesota's forests are changing.

"Both species of flying squirrel are responding to changing conditions," Mangan said. "Understanding their responses gives us clues about what our future forests could look like and how they might function."

And even though flying squirrels are a species not many people see or interact with, they are important to the forest ecosystem.

*Photo right: Flying squirrel trapped for tagging and/or collaring.
(Photo: A. Mangan)*

"They're seed and fungal dispersers, which are both important to forest health. They are also a food source for owls and other wildlife," Mangan explained. "But biodiversity in general is important. Every species is important and flying squirrels are just fascinating."

They're small, fitting in the palm of your hand, with big nocturnal eyes, and use the patagium membrane stretched from hand to foot to glide between branches. Random fun fact: they also fluoresce hot pink in ultraviolet light.



"And although there are some theories, no one knows why," Mangan said. "Someone just discovered this five years ago randomly shining a black light around. It's really fun to study a creature we know so little about."

Information about how each impacts the forests and how they impact each other will help inform forest and wildlife managers at the Department of Natural Resources to determine best practices for Minnesota's flying squirrel populations.

This two-year study will continue into summer 2025. It's funded by the Minnesota Environmental and Natural Resource Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR).

[Read about the NRRI-funded pilot study initiated in 2021: Southern flying squirrels are climate migrants.](#)

One Last Thing



Expanding potential of biochar

Minnesota Public Radio featured NRRI research on engineered biocarbon (biochar) in this story: How biochar -- the 'Swiss Army knife of climate tools' -- is growing in Minnesota.

Photo left: Eric Singaas inspects biocarbon at NRRI Coleraine Biomass Conversion Lab.

[Listen or read here>](#)

NRRI Organization Overview

NRRI was created by the MN Legislature in 1983 to deliver applied research informing environmental stewardship and economic development of the state's natural resources. It is a nationally unique model for integrated research focused on three strategic initiatives: Ecosystem Resilience, Future Forest Industries, and Iron and Minerals of the Future.

As part of the University of Minnesota system research enterprise, NRRI employs over 140 scientists, engineers, technicians, staff and students in two industrial research facilities. Through collaborative partnerships, we deliver the innovative tools and solutions needed to utilize and sustain Minnesota's valuable natural resources.

Find out more: [NRRI website](#) • [Facebook](#) • [X](#) • [Instagram](#) • [YouTube](#) • [LinkedIn](#)

NRRI Facilities Overview

NRRI has extensive laboratory capabilities to discover and deliver at the bench-to-pilot scales, reducing risk inherent in commercializing innovations.

NRRI Duluth has 19 labs that address the needs of land, wildlife, water and minerals research, as well as several technology development labs and the LP Innovation Center, developed in partnership with LP Building Solutions.

NRRI Coleraine, a former U.S. Steel R&D facility, is a 27-acre industrial-scale site that was acquired in 1986. The minerals processing and metallurgy labs provide bench to pilot-scale research to broaden the state's portfolio of ore resources while impacting process efficiencies and improved production of taconite. The engineered biocarbon product development lab tests processes for converting a variety of biomass into fuel and carbon materials up to commercial demonstration scale.

NRRI Fens is a 425-acre property near Zim, Minnesota, was acquired in 1986 to restore its function as a valuable peatland and fens bog after being drained in the 1950s for farmland. Decades of effort have restored the peatland - nature's most effective carbon sequestration solution - and the restoration credits were sold to state agencies. Ongoing research on the site will continue to inform successful peatland restorations across the nation.

NRRI Mission

Deliver integrated research solutions that value our resources, environment and economy for a sustainable and resilient future.

NRRI Vision

Discover the economy of the future.