Rochester Academy of Science™

BULLETIN

"An organization of people in the Natural Sciences"

June 2023; Vol. 77, #6

President's Message

Annual Meeting

Our Annual Meeting was held on April 26, and I thank all of you who gave a vote of confidence in your Board of Directors and Academy Officers. You elected a new treasurer–Tim Tatakis, and a new Director–Theodore Lechman, and I am very happy to have both of these members in these positions. I am very sorry to have William Hallahan retire from the Treasurer position after serving us all in that role for the past 38 years. He has left us on a sound financial footing with greatly increased capabilities. We all owe him our gratitude. You have also reelected your other officers and two directors. Thank you. I look forward to continuing to work with your Board and Officers to deliver on the important programs of the Academy.

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2023 Eclipse Watch

On May 31, it will be just 312 days until the total solar eclipse that should be visible from Rochester on Monday, April 8, 2024.

I want to recognize the strong roles that many of our ASRAS members have undertaken. The Rochester Museum and Science Center (RMSC) is leading the community outreach on the eclipse and one of their initiatives is the ***RMSC Community Eclipse Ambassador Program***.

Ambassadors are trained in eclipse education, basic astronomy, and eclipse viewing safety. They will be outfitted with equipment including a telescope with a solar viewing filter, educational materials, solar viewing glasses, and other materials.

Organizations throughout the nine-county region have signed up to be Ambassadors. They include City of Rochester Recreation, Cornell Cooperative Extension, Finger Lakes Museum, Ganondagan, Eastman Museum, Girl Scouts, Scouts BSA, and 45 other groups. The whole current list is at rochestereclipse2024.org/rmsc-community-eclipse-ambassadors/.

You might be surprised to see that RAS is NOT on the list, but for a very good reason. ASRAS volunteers are working with RMSC staff to TRAIN the Ambassadors. So, they are the Ambassadors TO the Ambassadors. Thank you to all members that are helping with this community outreach effort and especially to Mark Minarich for leading it.

Eclipse Glasses – Help Needed!

The **ONLY** safe way to look directly at the Sun is through special-purpose solar filters, such as "eclipse glasses" or handheld specially-made solar viewers. *Any other device you have heard of is hare-brained and will damage your eyes!*

I ask members to consider donating towards the costs of glasses for ALL members. I have already made a donation myself. To donate with Credit or Debit card or PayPal, simply go to rasny.org, scroll to the bottom, and use the Donate button to make a contribution. Then email Timothy Tatakis (our Treasurer) at ttatakis@monroecc.edu and tell him that the donation is for the eclipse glasses fund. If you prefer, you can send a donation check to our regular mailing address (see the last page).

To ensure that we in the Academy have enough glasses, we have arranged to acquire 15,000 pairs of glasses. ASRAS is getting 5,000 for training Ambassadors and has arranged to purchase 5,000 more and the RAS Board voted to also purchase 5,000 glasses. Every member will get enough for the family and friends in their viewing party and may get more for doing outreach with the public wherever they might plan to be going to view the eclipse.

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The 24th Annual **ADK Outdoor Expo** is featured on our calendar on page 3 for Saturday, June 10 in Mendon Ponds Park, Pittsford. Presented by the Genesee Valley Chapter of the Adirondack Mountain Club and Monroe County Parks, the Outdoor Expo is a celebration of the great outdoors. They will have scores of workshops and demos — and three of them are from the Academy. Our Astronomy, Fossil, and Mineral Sections will set up equipment and tables and give away educational materials and specimens.

I would love to see you there helping with this—it is good fun—but I would be just as happy to see you there as a

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visitor. Try out a kayak or canoe on 100-Acre Pond, go for a short hike on the park's beautiful trails, visit the Wild Wings birds of prey facility and the Mendon Ponds Park Nature Center, explore canoeing, kayaking, backpacking, camping, bicycling and bike repair, crafts, the Petting zoo, live music by the Golden Link Folk Singing Society, many other events and displays, and food/ice cream for purchase from Dave's Sidewalk Café and Molly V's. For the full schedule of events, visit their website: https://adk-gvc.org/play/outdoor-expo-before/

Follow the path and you will find us under a couple of white pop-ups. Courtesy ADK.

This event is free, open to the public, and fun for the entire family. *Get Outside… It's for Everyone!*

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Volunteers Needed

One of our most important annual programs is the awarding of under-graduate student grants. This takes place at the end of the year with results published in the February RAS Bulletin. Applications are reviewed by a committee of RAS members who choose the projects worthiest of an award. A grant award by the RAS is considered prestigious, will be on the student's resume, on their grad school applications, and are frequently publicized by their school.

Currently, due to retirements, we only have four active committee members and could use two more. This is an enjoyable experience, is intellectually rewarding, requires no meetings, occurs over the December to January holiday break, and it is fun to give away someone else's money. *If interested in discussing this, get in touch with me.* We are also seeking a coordinator who will receive applications and distribute them to the committee.

Classified Advertisement

⬇ Employment Opportunity ⬇

Grant Application Assessor

Rochester Academy of Science, Rochester, NY. Part-time volunteer to review & grade grant proposals from undergrad science students. Requires multi-disciplinary science background, critical eye, ability to apply standard criteria in scoring, ability to separate high from low performing candidates, & teamwork to achieve consensus in awarding cash grants. Send note of interest to mgrenier@frontiernet.net.

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Annual Spring Lecture Available for Viewing on Website

At our annual meeting in April, Dr. Paul D. Curtis of Cornell University gave a lecture on "*Living with Black Bears in New York State*." In this presentation, Dr. Curtis—a specialist in this subject— discussed bear biology, behavior, and ways to reduce potential human-bear conflicts. Did you know that there are 8,000 black bears in New York and that they are frequently seen in the Rochester area? The Rochester Democrat and Chronicle recently reported (June 15, 2020) that "It's common for bears to stroll through Monroe County each June, when they're mating and one year-old bears leave the sleuth. Some of the yearlings tend to wander to areas they wouldn't normally inhabit." Yes, they are in our "neigh**bear**hood". This fascinating lecture was recorded and is on the RAS website publications page at https://rasny.org/publications. Learn all about black bear biology and behavior, how to avoid attracting them, how they are studied and managed, and what to do if encountering one.

Radio-collaring a Bear (courtesy of Dr. Paul Curtis)

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Michael Grenier, RAS President

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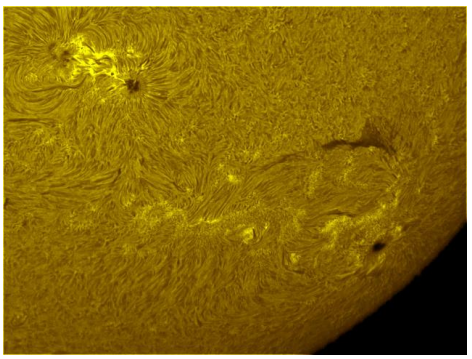
RAS Member Photo



Solar sunspots taken May 28, 2023 by Douglas Kostyk. 2024 is expected to be a year of peak sunspot activity.

Events for June 2023

2 Fri: Astronomy Members Meeting
7:30 p.m. – 10:00 p.m. Education building at the Ionia Farash Observatory site. Speaker: Bob McGovern. Topic: *The Benefits of ASRAS Membership and Review of Farash Center Telescopes*. Contact: Anthony Golumbeck at semp@use.startmail.com.

4 Sun: Astronomy Open House
Open House: 12:00 p.m. - 3:00 p.m. Observatory tours and work parties. Members may bring guests. Come out and learn to use some of the equipment available at the Farash Center! Farash Center for Observational Astronomy, 8355 County Road 14, Ionia, NY 14475. For weather related cancellations or changes contact site manager Roger McDonough at rdmcdogz@aol.com.

6 Tue: Joint Fossil and Mineral Section Picnic and Meeting
6:00 p.m. After the picnic, David Bishop will present his *Astronomy Year in Review* lecture. Picnic and meeting to be held at the Wolk Educational building at the Marian and Max Farash Center for Observational Astronomy in Ionia NY. Attendees are asked to bring a dish to pass as well as a beverage. If attending, contact Dan Krisher at (585)698.3147 or DLKFossil@gmail.com no later than Monday, June 5, 2023.

7 Wed: Astronomy Board Meeting
7:00 p.m. Farash Center in Ionia. ASRAS members are welcome. Contact: Anthony Golumbeck at semp@use.startmail.com.

14 Wed: Life Sciences - Herbarium Workshop
1 p.m. – 4:00 p.m. The Life Sciences section will hold a workshop at the RAS Herbarium, located in the basement of the Rochester Museum and Science Center (RMSC). We will be continuing to organize plant specimens in preparation for digitization, hopefully later this year. At RMSC go to the front desk to meet other participants. If you plan to attend, please send RSVP or any inquiries to Elizabeth Pixley, herbarium curator, at eypixley@gmail.com, or call (585) 334-0977.

17 Sat: Fossil Section Field Trip
Little Beard's Creek: This is a large shale exposure of Windom Member of Moscow Formation in a stream near Geneseo. For details, see the latest RAS *FossiLetter* or contact Dan Krisher at (585)698.3147 or DLKFossil@gmail.com .

17 Sat: Astronomy Members Observing Dusk till? Weather permitting. Watch ASRAS emails for details.

21 Wed: RAS Board Meeting
6:00 p.m. Picnic and facility tour. Wolk educational building at the Farash Center for Observational Astronomy in Ionia, NY. Meeting at 7PM, also on Zoom. For details, contact Michael Grenier at mgrenier@frontiernet.net.

Outside RAS Events

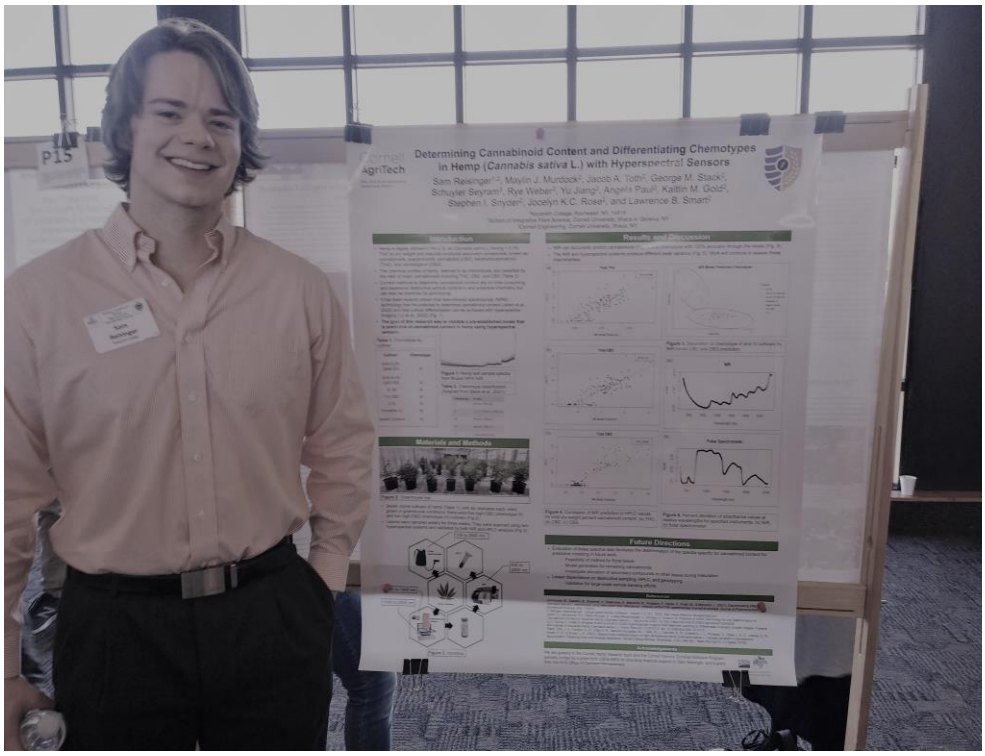
10 Sat: ADK Outdoor Expo
9:30 a.m. – 3:30 p.m. Mendon Ponds Beach Area. RAS will be represented by Astronomy, Fossil, & Mineral Sections. Volunteers needed at the RAS booth! Questions? Contact your section leaders.

RAS 2022 Fall Paper Session

Sam Reisinger, Schuyler Seyram, Maylin Murdock, Jacob A. Toth, Rye Weber, Yu Jiang, Ph.D., Angela Paul, Katie Gold, Ph.D., Stephen I. Snyder, Jocelyn K.C. Rose, Ph.D., and Lawrence B. Smart, Ph.D., School of Integrative Plant Science, Cornell University.

Determining cannabinoid content and differentiating chemotypes in hemp (cannabis sativa l.) with hyperspectral sensors.

Abstract
Hemp (*Cannabis sativa* L. legally defined in the U.S. as having < 0.3% THC by dry weight) naturally produces secondary compounds, known as cannabinoids, predominantly cannabidiol (CBD), tetrahydrocannabinol (THC), and cannabigerol (CBG). The chemical



Sam Reisinger at the October 29, 2022 RAS Fall Paper Session at the Rochester Museum and Science Center.

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profiles of hemp, referred to as chemotypes, are classified mainly on the ratio of THC to CBD. Current methods to determine cannabinoid content rely on time-consuming and expensive destructive sample collection, and analytical chemistry, but can also be predicted by genotyping. It has been recently shown that near-infrared spectroscopy (NIRS) technology has the potential to determine cannabinoid content and that cultivar differentiation can be achieved with hyperspectral imaging. Thus, the goal of this research was to characterize and develop a model that is predictive of cannabinoid content in hemp using hyperspectral sensors. Seven clonal cultivars of high-cannabinoid hemp were grown in greenhouse conditions and leaves were sampled weekly for three weeks. They were scanned using two hyperspectral systems with a spectral range up to 2500 nm and validated by both NIR and HPLC analysis. Evaluation of these spectral data facilitates the determination of the spectra specific for cannabinoid content for predictive modeling and the accuracy of hyperspectral sensors in differentiating cannabinoid content for chemotype determination. Further, the findings from this research enable the development of methods to non-destructively quantify cannabinoid content for high throughput chemotyping in future work.

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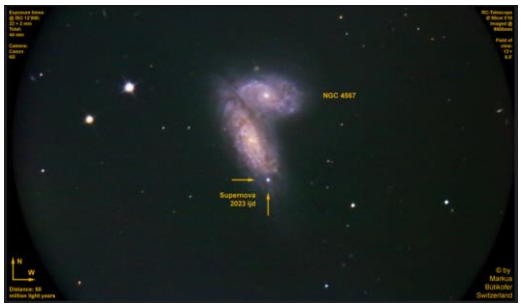
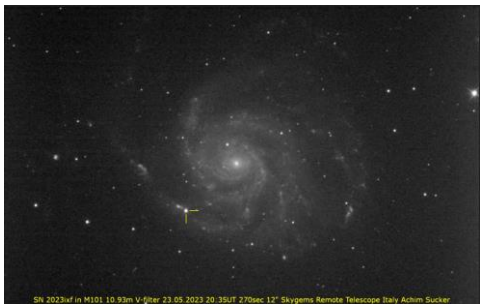


[Supernova 2023ijd](#)

Recent Supernova discoveries. Courtesy David Bishop

A complete list of supernovae discovered so far in 2023 can be found at: https://www.rochesterastronomy.org/sn2023/



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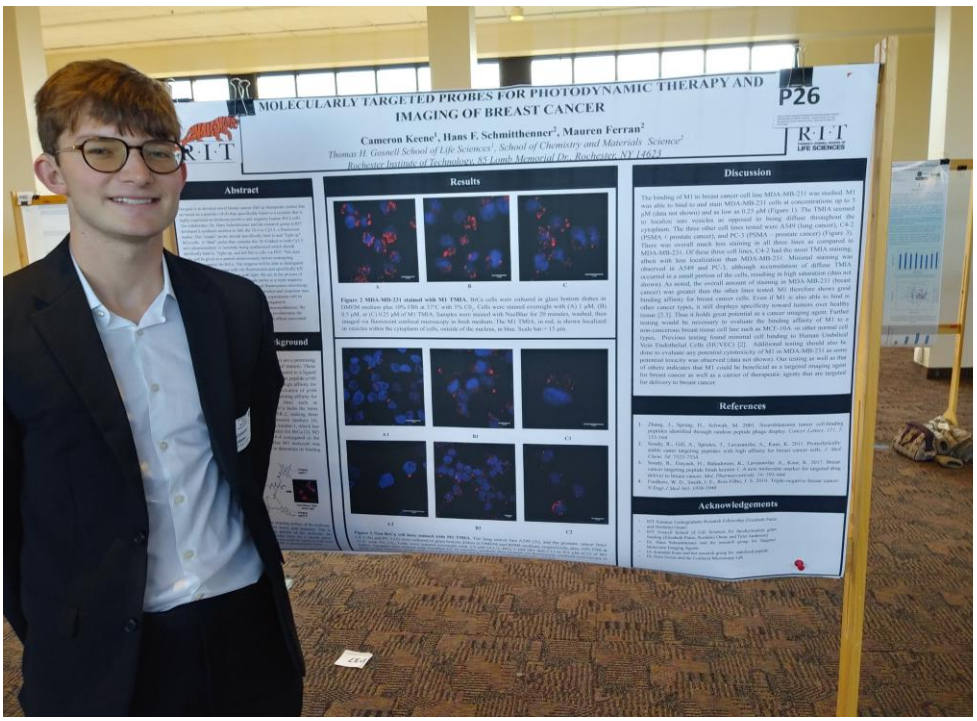
RAS 2022 Fall Paper Session

Cameron Keene, Hans Schmittenner, Ph.D., and Maureen Ferran, Ph.D., Rochester Institute of Technology.

Molecularly targeted probes for photodynamic therapy and imaging of breast cancer.

Abstract

Our goal is to develop novel breast cancer (BrCa) therapeutic probes that are based on a peptide (18-4) that specifically binds to a receptor that is highly expressed on hormone positive and negative human BrCa cells. Our collaborator, Dr. Hans Schmittenner and his research group at RIT developed a synthesis method to link the 18-4 to Cy5.5, a fluorescent marker. This "single" probe should specifically bind to and "light up" BrCa cells. A "dual" probe that contains the 18-4 linked to both Cy5.5 and a photosensitizer is currently being synthesized which should specifically bind to, "light up, and kill BrCa cells via PDT. This dual probe will be given to a patient intravenously before undergoing lumpectomy surgery for BrCa. The surgeon will be able to distinguish healthy tissue vs cancerous cells via fluorescence and specifically kill diseased cells by treating the area with light. We are in the process of evaluating the binding affinity of the single probe to a triple negative BrCa cell line (MDA-MB-231) using confocal fluorescence microscopy.



Cameron Keene at the October 29, 2022 RAS Paper Session at the Rochester Museum and Science Center.

2022-2023 Undergraduate Student Research Grant Award Winner

Characterizing variation in gut microbiome composition and diet from breeding through molt in the migratory black-throated blue warbler.

Amaya Bechler and Sara Kaiser, Ph.D., Research Ecologist; Director, Hubbard Brook Field Ornithology Program

Amaya Bechler, Cornell University

Abstract

The microbial communities of the intestinal tract, or gut microbiome, influences host phenotypes by affecting host physiology. Migratory birds experience significant energetic and physiological challenges over their annual cycle, and adaptively modulate their physiology. A few compelling studies indicate that gut microbiomes of migratory birds are flexible and exhibit functional variation in microbiota both within and between individuals, between breeding and wintering habitats, and over phases of migration. Over the short breeding season, migratory birds must defend territories, raise young, and replace all their feathers before autumn migration. I hypothesize that the gut microbiome and diet can be modulated to meet the energetic demands of reproduction and molt. However, the gut microbiome and diet have not been studied during molt when endogenous body stores and energy reserves are severely depleted. To test this hypothesis, I propose to characterize changes in the composition and function of the gut microbiome and diet over the breeding season and during molt in an insectivorous, migratory songbird, the Black-throated Blue Warbler (*Setophaga caerulescens*) at the Hubbard Brook Experimental Forest, NH. From May-Aug 2023, I will collect fecal samples from 10 adults per breeding stage (building/egg laying, incubation, nestling) and over molt to augment samples collected from 2021-2022 (10 adults x 4 stages x 3 years: n = 120 fecal samples). I will use amplicon sequencing to identify microbial taxa and DNA metabarcoding to identify prey taxa present in fecal samples. I will examine differences across breeding stages and molt in (1) relative abundance and diversity of microbiota and (2) frequency of occurrence and diversity of prey taxa in diets and investigate microbial functions associated with physiological pathways and diets. Determining the relationship between changes in the gut microbiome and diet with changes in host physiology is important for understanding differences in host adaptive capacity and fitness of migratory birds.

Background and Rationale for Hypotheses

Host-microbe interactions are essential to animals, with microbial communities influencing nutrient uptake, immunity, and behavior of their host (Trevelline and Kohl 2022; Pearce et al. 2017; Stevens and Hume 1998). The study of microbiomes in wild animals is an emerging field, with the majority of research focused on mammals (Colston and Jackson 2016). Mammals have microbiomes specific to their host taxon, due to taxon-specific diets (Muegge et al. 2011). In contrast, birds exhibit more individual and temporal variation in the composition of their gut microbiomes (Skeen et al. 2021; Wu et al. 2018). However, studies of the microbiome in wild birds has so far been limited, and most of the causes and consequences of microbiome variation have yet to be fully investigated.

Long-distance migratory birds experience significant energetic and physiological challenges over the course of their annual cycle (Buehler and Piersma 2008). During migration, birds repeatedly deposit fat and protein to sustain metabolic energy during flight, followed by depletion of energy reserves, refueling of fat stores, and recovery of muscle and organ tissue (McWilliams and Karasov, 2001). During the breeding season, birds undergo physiological, metabolic, energetic, and hormonal changes to support reproduction from seasonal gonadal development, through egg laying and incubation, to chick rearing (Williams 2012). The microbial composition of the gut is expected to change over time because of seasonal changes in host physiology and energetic demands and the known functions of the microbiome in regulating the immune system and nutrient uptake. For example, in some migratory songbirds, migration results in the loss of microbial diversity and abundance; more heterogeneity between individuals; and the uptake of environmental microbes from stopover locations (Skeen et al. 2021; Turjeman et al. 2020; Wu et al. 2018; Risely et al. 2017). Upon arrival on the breeding grounds, birds may recover some diversity with varying degrees of resilience.

During the breeding season, birds experience pressures that may influence the diversity and abundance of gut microbes. Cloacal contact during copulation can increase the cloacal microbiome diversity and also increase transmission of pathogens between individuals (Escallón, Belden, and Moore 2019). Conversely, energetic stress due to the costs of reproduction could suppress the microbial diversity during the breeding

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season (Noguera et al., 2018). Due to the many environmental and intrinsic variables involved, it is difficult to predict patterns in diversity and abundance over time. However, insectivorous songbirds show consistent bacterial phyla overall; their microbiomes are dominated by Bacteroidetes, Firmicutes, Actinobacteria, and Proteobacteria (Dewar et al. 2014; Skeen et al. 2021). Over the breeding season, these groups change in their abundances and within-phylum diversity.

The onset of the prebasic molt marks a transition from the demands of reproduction to preparation for autumn migration (de la Hera, Pérez-Tris, and Tellería 2009). Energetic costs are associated with the loss and growth of new feathers, but the molting period remains a relatively understudied period of the bird annual cycle (Bridge 2011). To our knowledge, no study has examined the microbiome during the molting period of wild birds. Potentially, the limited mobility and nutritional demands during molt might influence the composition of the gut microbiome as birds replace their feathers.

I propose to characterize changes in the composition and function of the gut microbiome and diet in an insectivorous, migratory songbird from breeding through molt. I hypothesize that the gut microbiome and diet can be modulated to meet the energetic demands of reproduction and molt. I hypothesize that the events of the breeding season lead to changes in the abundance and diversity of gut microbes. Additionally, I hypothesize that the onset of molt is accompanied by changes in the composition of the gut microbiome. I predict significant differences in the abundance and diversity of gut microbes between breeding stages, early and late season samples from the same individual, and among individuals that are in the initial or advanced stages of molt or have not begun to molt. Microbiome analysis will be supplemented by diet analysis to better understand how diet might influence the microbiome.

Research Procedures

***Suitability of Study System*.** I propose to study the gut microbiome and diet of Black-throated Blue Warblers (*Setophaga caerulescens*) by collecting fecal samples from adults captured from May-Aug, 2021-2023 at the Hubbard Brook Experimental Forest, NH. My work will be conducted as part of a long-term demographic study of this population wherein all individuals within a 330 ha study area are individually marked and their nest attempts are found and monitored (Holmes et al. 2020). Males arrive at the breeding grounds the first week of May and establish territories one week before females arrive. Pairs begin nest building in mid to late May. Females build open cup nests in the shrub layer, lay one egg per day (mean clutch size = 4), and incubate their clutches for 12 days. Both females and males will provision nestlings for 9 days and split their broods to provision fledglings for 3 weeks until independence. Females will continue to renest following nest failures to fledge at least one brood, with 30% of females attempting a second brood. Adults initiate molting between mid-July and August; molt duration is two weeks. Adults are insectivorous during the breeding season and primarily forage on foliage in the shrub and lower canopy layer of the forest for Lepidoptera larvae and adults, diptera, and spiders (Robinson and Holmes 1982; Rodenhouse and Holmes 1992).

***Fecal Sample Collection*.** I will capture males by luring them into a 6-m mist net with song playback and a male decoy and capture females by flushing them off their nests into a mist net placed in front of their nest. I will place birds in a paper bag for a maximum of 10 min, during which time they usually defecate. The fecal sample will be collected off the paper bag into sterile 2 mL tubes containing 1 ml DNA/RNA Shield and stored at room temperature until transferred to a -20°C freezer at the end of the season. During each breeding season, I will collect fecal samples from 10 adults per breeding stage (building/egg laying, incubation, nestling) and over molt (10 samples x 4 stages x 3 years: n = 120). In 2023, I will attempt to recapture individuals to collect fecal samples from the same birds both early and late in the breeding season.

***Molt Scores*.** For birds that are actively molting, I will record the extent of feather loss and growth using a standardized molt scoring system (Bensch and Grahn 1993). Body feather tract growth will be classified on a scale of 0-3. The length of each flight feather will be recorded using a scale of 0-5, where 0 is an old feather, and 1-5 represents the length of a new, growing feather. I will use molt scores to classify birds into molt progress categories (1) pre-molt, (2) initial stage of molt, and (3) advanced stage of molt.

***Amplicon Sequencing and DNA metabarcoding*.** I will extract DNA from fecal samples using a Zymo fecal DNA extraction kit. To identify microbial taxa, I will use PCR to amplify the V4 region of 16S microbial small subunit ribosomal RNA gene using the Earth Microbiome Project 515F/806R primers (Caporaso et al. 2011). To identify arthropod taxa, I will use PCR to amplify a 200 base pair sequence of the mitochondrial gene, cytochrome oxidase C subunit 1 (COI) using the ANML primers (Jusino et al. 2019). I will sequence reads on the Illumina NovaSeq and process amplified sequences for both microbes and arthropods using QIIME2 (Bolyen et al. 2019). I will examine differences across breeding stages and molt in (1) relative abundance and diversity of microbiota and (2) frequency of occurrence and diversity of prey taxa and investigate microbial functions associated with physiological pathways and diets.

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Timeline and Expected Outcomes

The diet analysis of 2021 fecal samples are complete. In Spring 2023, I was trained in bioinformatics for identifying microbial taxa. I will conduct DNA extractions of 2022 samples and conduct microbiome analysis of 2021-2022 samples and diet analysis of 2022 samples. From May-Aug 2023, I will collect fecal samples at the Hubbard Brook Experimental Forest, NH to augment samples collected from 2021-2022. In Fall 2023, I will conduct DNA extractions, microbiome and diet analyses of 2023 samples. In Spring 2024, I will conduct statistical analyses and begin manuscript preparation to submit for publication in Summer 2024 in advance of presenting my honors thesis in Spring 2025.

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The Academy postal address is P.O. Box 92642, Rochester NY 14692-0642.

ROCHESTER ACADEMY OF SCIENCE CONTACTS

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