

Rocky Mountain Biological Laboratory
Summer Research Experience
2026 Mentors and Projects



For STUDENTS: This booklet has a page for each RMBL mentor with a description of their research, so that you can learn about the types of research projects that will be available for you to participate in at RMBL.

The RMBL Summer Research Experience (Education Program) Application will ask you to select broad topics in biology: plant ecology, insect ecology, aquatic ecology, animal behavior, species interactions, pollination, ecosystems, climate change, etc. It is valuable if you indicate in your application statements if there are specific projects described below that you are particularly interested in exploring. You will be matched with a mentor and project *after* you are admitted to RMBL.

Mentors and projects differ in their topics, organisms, questions and methods/techniques, so be sure to read the *Descriptions*. Projects also involve different sized lab groups and extent of mentor interactions (see *Mentoring* section). Projects may also have *Special Requirements* or expectations for daily or weekly schedule,

level of hiking or other physical activity, and levels of quantitative analyses and modeling. You may also be asked to complete training in ethical research with vertebrate animals or specific technical skills.

After you are accepted into the program, we will ask you to read the statements more thoroughly and select 5-6 projects that interest you, and then RMBL will match you with an appropriate mentor. Students who select a range of projects or indicate the willingness to try a new system or group of organisms are easier to place than those who select only one option. Please do not contact researchers directly, they are not involved at the application stage.

Three sections of the booklet:

Plant evolutionary ecology, plant communities, plant & pollinator interactions, ecosystem and landscape ecology, soils & microbes.

Animal ecology, physiology, and behavior- insects and vertebrates; plant-animal interactions

Aquatic ecology- hydrology/snowmelt, ponds and streams, beaver dams, insects and salamanders



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Israel Borokini, Montana State University Bozeman

Research overview: My research investigates the drivers that generate and maintain plant diversity across time and scales. Using ecology and evolutionary biology tools and methods, we map phylogenetic diversity and identify centers of biodiversity at broad scales, describe phylogenetic structure of plant communities at fine scales, and model and predict species and community responses and resilience to climate change. Read more about my research projects at https://tbisrael.wixsite.com/website



Research at RMBL: My research projects at RMBL with opportunities for research students focus on the comprehensive survey of the flora and functional traits of the legacy Langenheim sites to comparative analysis with surveys conducted in the 1950s and 2014. The Langenheim sites were first surveyed by Dr. Langenheim as part of her PhD dissertation in the 1950's, covering ~200 plots in several transects along elevational gradients. This study will estimate temporal beta diversity among the surveys conducted in 1950s, 2014, and the 2026 data to assess community stability and resilience under changing conditions. Functional traits will also be measured in the flora on these sites to investigate functional homogenization of plant communities under climate change. Finally, open access phylogenetic tree representing the flora in these locations will be used to describe the phylogenetic community structure in the three different time periods and how phylogenetic diversity may have changed over time. DNA sequences will be assembled for species recorded in these sites that are not represented on the tree for a complete phylogeny.

Opportunities for Students: Students will have the opportunity to develop independent research questions related to the described project. This could include but not limited to conducting alpha and beta diversity assessments along elevational gradient, measuring leaf and floral traits in plants to assess functional diversity, and investigating phylogenetic signal in functional diversity across different plant communities, among others. Fellows benefit by expanding their knowledge of the local flora, experience field survey designs, and gain statistical skills in R.

Mentoring plan: Students will work with me, Prof. Charles Williams (RMBL Herbarium curator), field assistants, and my PhD student for field surveys, plant identification, and trait measurements. There is also the potential to work with Prof. Brian Enquist on his long-term monitoring sites as well. Students will develop their research objectives with me and other team members and design a plan, and indicators of success that will guide their RMBL program.

Requirements: Students should be prepared for hiking moderately steep terrains (~2 miles, with beautiful alpine and horizon views) with equipment that may weigh up to 20 lb. Typical working hours is 8-5 Monday to Friday, with occasional breaks for processing voucher specimens in the herbarium or lab-based trait measurements. These alpine sites may have higher than expected UV exposure and abundant flies.

Ian Breckheimer, Research Scientist, RMBL



My group's research uses approaches from landscape ecology, remote sensing, GIS, and computer science to understand the responses of plant and animal communities to environmental change. Students will receive intensive training in field botany, as well as ecological study design, and the implementation of imagery-based scientific workflows including remote UAV piloting, flight design, data management, and GIS. Students will perform independent research related to three major ongoing collaborative projects:

(1) a project to understand forest water use and how it responds to drought. This project will involve combining data from tree cores, field measurements, and drone-based thermal data. This Department of Energy-funded work is in collaboration with Lara Kueppers at UC Berkeley, Christopher Still at Oregon State University, and Erica Silura-Woodburne at Lawrence Berkeley National Lab.

(2) a long-term study of plant community change in the alpine funded by the National Science Foundation, in collaboration with Benjamin Blonder at UC Berkeley and Rob Salguero-Gomez at Oxford University.

(3) the Colorado Headwaters Ecological Spectroscopy Study, a project to understand how plant communities are changing in response to long-term drought stress using field data collected in concert with airborne hyperspectral imagery. This project is in collaboration with Ken Williams at Lawrence Berkeley National Lab, Dana Chadwick at NASA Jet Propulsion Lab, and Dave Gochis at Airborne Snow Observatories, Inc.

A wide variety of independent research projects are possible including 1) Relating field-based measurements of plant communities to drone imagery. 2) Understanding the controls on plant species and functional diversity across elevation gradients. 3) Relating microclimate measurements to the structure of plant communities.

Mentoring: I welcome students with diverse backgrounds and skills, particularly those who are underrepresented in ecology. Students will join a small, passionate research team embarking on an ambitious set of field projects. Students will work closely with me and my collaborators to move the larger project goals forward while developing novel independent research questions. I am particularly interested in working with students who are interested in taking independent projects back to their home institutions for further work, such as incorporating it into a thesis or independent study.

Special Requirements: No previous experience with drones is necessary, but to participate, students must complete FAA drone pilot certification before the start of the project. This involves passing an FAA knowledge test and an online form (detail at https://www.faa.gov/uas/commercial_operators/become_a_drone_pilot/). The student will be reimbursed for costs associated with FAA certification.

The workday schedule is typically 8-5 pm, M-F. Students spend most days in the field with the research team, transportation to sites is provided. Fieldwork includes both moderate and strenuous walking and hiking, on and off trails, and at elevations up to 13,000 ft. A significant amount of time is also spent on spatial data analysis. Students should be available for the project timeframe- early June to August. I can accommodate students arriving earlier than the regular program dates.

Berry Brosi, University of Washington

Assessing the structure and functioning of pollination networks

Research Overview:

Our research generally explores the effects of environmental change (including climate change and species losses) on ecological communities and interactions. Projects are most suited for students interested in community ecology, ecological networks, pollination biology, and insect or plant ecology. Specifically, at RMBL we are investigating several aspects of pollination networks, including how to quantify interactions and how to identify which ecological processes (e.g., adaptive foraging, functional responses, benefit accrual) are necessary for understanding the response of species-rich plant-pollinator systems to perturbations. In our quantitative network project, we aim to accurately measure quantitative network structure (i.e. intensity of interactions), comparing network structure and function across several years. Many of our projects utilize observation of pollination interactions as well as molecular and microscopic analysis of insect pollen loads in order to build highly resolved pollination networks.

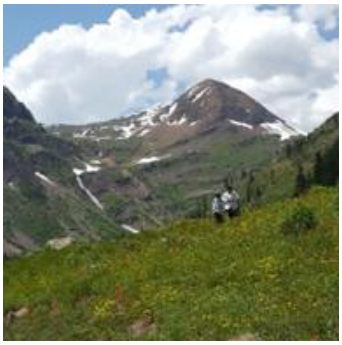
Mentoring:

Our lab group is typically comprised of 4-6 people, including 2-3 undergraduates and 2-3 graduate students. Our fieldwork involves observation of plant-pollinator networks, insect sampling and processing, plant and insect identification. Students will work directly with a grad student/postdoc to develop a research project. The graduate student/postdoc will meet with students at least weekly, more frequently during project development in June. We are a highly collaborative lab and students that work with us will assist with multiple lab projects. We also strive to foster a sense of community and have occasional dinners/hikes/game nights etc. as a lab group!



Special requirements: Fieldwork involves moderate activity (walking) to strenuous activity (hiking to high elevation sites). Our most strenuous hike takes approximately 2 hours with an elevation gain of ~1700 ft, but we will never visit this site multiple days in a row. Students spend most days in the field working with the lab group, though some work occurs in the lab (microscopy, computer/network analyses). The workday schedule is typically 8-5 pm., M-F.

Diane Campbell, Univ. of California Irvine



My lab examines mechanisms of evolution in natural plant populations, and how these processes are likely to respond to global change. Our current research is focused on two areas: effects of climate change on natural selection and adaptation, and responses of animals such as pollinators to combinations of flower scent and other traits. Two potential projects are described below.

1) How will climate change alter evolution? Our long-term research program addresses how changes in climate influence natural selection and population growth through adaptive evolutionary change. Predicting evolution in response to temporal change has taken on new urgency with climate change. One way that a population can avoid extinction is through rapid evolutionary adaptation to the new conditions. We are testing these ideas with an experiment that manipulates snowmelt date and by following natural populations over decades. In both cases we examine the association between water availability and patterns of natural selection in wildflowers of the genus *Ipomopsis*. One hypothesis is that natural selection for traits correlates with annual water availability, and that these traits also have direct environmental responses (or plasticity) to water that are adaptive. A student could choose a trait (e.g. specific leaf area, leaf hair density, flower shape, nectar production) and, taking advantage of our long-term data, examine how the trait responds to water changes over decades. Adding measurements of fitness based on survival of tagged plants from the previous year would allow examining how natural selection on traits differs with water availability. This project would be conducted mostly in the field.

2) The sweet smell of flowers. Flowers produce a wide variety of volatile organic compounds that give them characteristic scents. These chemical compounds help to attract pollinators and deter herbivores. Our lab is interested in how these scents are altered by environmental conditions and how the scents influence the behavior of insects. A potential project would capitalize on an experiment manipulating water availability. It examines how soil water influences expression of floral volatiles and other floral traits, how insect pollinators respond to those changes, and effects on seed production. The student would learn to sample floral scent emissions in the field and analyze scent samples using gas chromatography - mass spectrometry. This research would be appropriate for a student with interests in plant-animal interactions or plant chemistry.

Mentoring: My lab group is typically comprised of myself, one visiting faculty member, 1 graduate student, and 2 or 3 undergraduates. Students work directly with me to develop a research project. I meet with students at least twice a week and often go in the field for the day with them. Students do most of their field work together with other members of the lab team. We are a highly collaborative group and try to build a sense of community through lab group dinners and hikes.

Special Requirements: Students will be encouraged to participate in all ongoing lab projects including field work that requires hiking to more distant field sites (6 miles round trip up to an elevation of 10,700 feet). Some sites are also a short walk away. The workday schedule is typically 8-5 pm, M-F but on a few occasions, we sample floral volatiles at night (8-11 pm).

Paul CaraDonna, Chicago Botanic Garden & Northwestern University

Research in the CaraDonna lab investigates the importance of species interactions for the population and community ecology. We ask general ecological questions using plants, pollinators, and their interactions as a model system with the goal of understanding how nature works, but also with the goal of improving conservation efforts considering various global changes (pollinator declines, climate change, etc).



Our ongoing research projects at the RMBL with opportunities for students includes:

Population and community ecology of wild bumble bees

Plant-pollinator networks

Demographic consequences of pollinator declines for plants

Spatial and temporal ecology of the floral resource landscape

Pollinator nutritional ecology

Classic pollination ecology

Mentoring:

Students work with me and my graduate students to develop research questions. I am happy to be as involved or as 'hands-off' as students desire, as this depends on each individual student. I often work in collaboration with Dr. Amy Iler and her students, as we aim to create a lively, open, and friendly research environment. I can accommodate students arriving earlier and/or leaving later than the regular program dates.

Special Requirements:

Most student time will be spent in the field (vs. the lab). Field sites are accessible with moderate hiking. The workday schedule is typically 8-5 pm, M-F.

Lauren Carley, The University of Chicago



Overview: My lab's research focuses on understanding how natural genetic variation and trait variation arises and is maintained in wild populations. How does evolution by natural selection shape the extent of genetic and phenotypic variation within and across populations? How does variation in genes and traits influence species interactions (e.g. competition, facilitation, and trophic interactions)? How and why do population dynamics vary across environments? At RMBL, I address these research questions using the study system *Boechera stricta*, a short-lived perennial wildflower in the mustard family. Because this species is closely related to the primary model organism in plant biology research, *B. stricta* is a tractable experimental tool for asking questions about genetics, ecology, and evolution in natural settings. For more info, check out https://carleylab.uchicago.edu/research/

Mentorship: We aim to recruit two undergraduate researchers in summer 2026. Both students will be immersed in a collaborative field team and will interact frequently with all members of the lab, including the PI, PhD students, postdocs, and research assistant(s). I will be the primary mentor for one undergraduate project exploring the effects of drought stress on plant-insect interactions, co-advised with Carol Boggs (University of South Carolina). Postdoc Elsa Godtfredsen and PhD student Greta Thoresen will be the primary co-mentors of the second student. Both students will work closely with their mentors to develop, plan, and implement an independent research project. When you arrive, we'll discuss your interests and goals and assess how they overlap with resources, infrastructure, and other ongoing projects in my research group. We will then work together to identify a project that is of interest to you and can be addressed robustly in our study system and in the broader context of my group's fieldwork. You can expect to do data collection in a team setting; in other words, you will not be expected to travel to research sites or conduct fieldwork solo. For any non-field portions of your work (e.g. lab work, data analysis, writing) you will receive training from me and/or other team members so that you build toward independence in these skill sets.

Potential student projects:

- Project 1: The project co-advised by Lauren Carley and Carol Boggs will focus on the effects of drought stress on plant defense expression and how this shapes plant-insect interactions like oviposition, herbivory, and caterpillar development.
- Project 2: The project co-advised by Elsa Godtfredsen and Greta Thoresen is more flexible in scope, and could address one of the following topics or something different, depending on the student's interests. (A) Do competitive and facilitative interactions between focal plants and neighbor plants vary across gradients of elevation and aridity? (B) What environmental drivers predict variation across populations in demographic rates like survival and reproduction? (C) How does variation in nectar traits influence plant-insect interactions in species that do not require insect pollination to reproduce?

Special requirements: Most study locations require a short, moderate hike (.1-.5 mi) from a roadside to the field site. A few locations require longer and/or more strenuous hikes (1-3 mi) to access. We carry in equipment for data collection and experimentation, which can mean carrying ~10-20lb in a backpack while hiking. Hiking fast is not necessary, especially at the more strenuous access sites, and we allow all team members to go at their own pace. We welcome students with all backgrounds and experience levels, including beginners with no prior experience to fieldwork or hiking! Our typical field schedule is approximately 8:30am-5:30pm with a lunch break taken in the field. We work 5 days per week, usually Monday-Friday, but with some exceptions depending on scheduling constraints.

Josh Grinath, Community and Global Change Ecology Lab, Idaho State University

I am an ecologist who studies communities of plants and animals, and how these communities are responding to drivers of global change. In particular, my current research at RMBL focuses on the community-level repercussions of 1) predators, such as bears that eat ants, and 2) long-term atmospheric nitrogen pollution. My work primarily occurs in sagebrush steppe ecosystems, and students with interests in community ecology and interactions among plants, herbivores, and predators would be most suited to work with me. Students interested in the projects below must be able to hike to field sites and take meticulous measurements.

I work directly with students to develop their projects, from conception to completion. These projects will primarily be based in the field and will require a fair amount of hiking. Field activities may include measuring plant and insect abundances and traits, ant nests, bear damage to ant nests, and insect behavior. In addition, projects may include some work in the lab, such as measuring plant and insect traits, pinning and identifying insects, and preparing samples for chemical analyses. After data collection, I will assist students in analyzing their data and sharing their results in written and oral presentations. Potential projects may include:

Cascading effects of ants and bears on aspen. In many western US forests, aspen trees are dying and organisms from neighboring sagebrush steppe ecosystems are expanding into these areas, including insects such as the Western Thatch Ant. This and other ant species comprise a third of the annual diet of Black Bears in Colorado, and this predation causes cascading effects that impact plants through ant interactions with herbivorous insects, such as aphids. Ants commonly interact with aphids and other herbivores on aspen, especially seedling and sapling aspen, but the consequences of these relationships for aspen performance are unclear. The goal of this project is to evaluate how aphids, ants and bears may impact aspen performance, particularly that aspen that resprout following the death of mature trees. The student will manipulate aphids and ants on aspen, and measure plant traits, aphid and ant abundances, and bear damage to ant nests.

Nitrogen enrichment effects on food-for-protection mutualisms. Human activities have greatly increased the amount of nitrogen available for plant growth, much of which is falling out of the sky as atmospheric nitrogen deposition. This pollution is fertilizing entire landscapes that are adapted to low nitrogen availability and is altering competition between plants. However, animal responses to nitrogen deposition are poorly understood, particularly for animals in higher trophic levels. The goal of this project is to investigate how nitrogen pollution may influence the behaviors of ants that protect sapsucking insects against predators in return for food in the form of sugary 'honeydew' excretions. This project will be based in a sagebrush community where I have manipulated nitrogen availability for the past 16 years. The student will work with me to measure ant behaviors near their mutualist partners to evaluate whether they differ in ambient versus enriched nitrogen conditions.



Jacob Heiling, Western Carolina University

Title: Understanding the elevational cline in *Lupinus argenteus* floral scent

Questions/approaches: I use field experiments and observational studies of plant-animal interactions, paired with chemical analysis and reproductive fitness estimates to investigate the ecological and evolutionary significance of floral traits in a multi-species context.



Study system: My ongoing research at RMBL is focused on an elevation-based cline in the scent chemistry of the perennial forb *Lupinus argenteus*. I am particularly interested in the possible feedbacks between this variation and interactions between *L. argenteus* and its pollinators, herbivores, and the co-flowering plant community.

In 2026, much of the work on this project will be focused on an observational study of plant-insect interactions, paired with floral scent sampling. There is the possibility of conducting a field experiment for an especially motivated student.

Mentoring: I am available to mentor students with interests in plant-insect interactions, plant reproduction, natural history, and evolutionary ecology. I anticipate being absent from Gothic for part of the Summer 2026 season. Although we will meet regularly over Zoom, and as frequently as possible in-person, any students working with me this year will need to be able to perform much of their project in my absence. Mentorship may include collaboration with a co-adviser.

Special requirements: Work in this system is primarily field based and involves regular trips to multiple distant field sites. Daily travel time may exceed two hours, and many site visits will entail **strenuous** hiking. Transportation to field sites will be provided when I am present, but other arrangements will be necessary when I am away. Work takes place in sites with high UV exposure and abundant biting flies. However, due to the nature of our work, we are often unable to use sunscreen and are never able to use insect-repellant. A willingness to use physical barriers against UV and tolerate nuisance insects is essential. Field work usually takes place between 9am and 5pm.

Melanie Kazenel, Earlham College

Research: My research group studies species interactions and how they shape ecological communities. In particular, we aim to understand the consequences of climate change for plants, insect pollinators, and their interactions. Much of our work focuses on elucidating the drivers of plant and pollinator community shifts across space and time, aiming to provide frameworks for projecting the future of pollination.

Among factors hypothesized to play a role in maintaining insect pollinator biodiversity, small-scale environmental variation may be particularly important but has been relatively little studied. Such environmental variation creates a diversity of microclimate conditions, which can in turn structure plant community composition and phenology, creating resource niche diversity for pollinators (i.e., a greater diversity of flowers from which to collect nectar and pollen). Importantly, microclimate variation has the potential to buffer pollinators and plants against climate change. But microclimate conditions, plant diversity and phenology, and plant-pollinator interactions have rarely been considered in the same study.

In this context, my current work at RMBL aims to elucidate relationships between microclimate diversity and plant-pollinator interaction diversity, making use of transects representing high and low levels of microclimate heterogeneity in sub-alpine meadows. We conduct plant surveys and pollinator visitation observations that allow us to characterize how microclimate conditions relate to pollinator, plant, and plant-pollinator interaction diversity and abundance. Students are invited to complete independent research that builds on or complements this project.



Mentoring: I aim to create a welcoming, supportive, and collaborative research environment for people of all backgrounds and identities. My goal is to empower each research team member to authentically contribute their unique ideas and skills. I help each mentee identify personal goals, and with them co-create a summer experience that builds skills in field research, statistical analysis, writing, and critical thinking. In addition, I aim to create a team environment in which we actively support one another through challenges and celebrate accomplishments large and small. I hope that all team members emerge from their experience with strengthened identity as a scientist and excitement for continuing to study the natural world.

Special requirements: Our team typically works Monday-Friday, 8am-5pm. Most days involve fieldwork outdoors, with a minority of days spent in the lab. Reaching field sites requires moderate hiking.

Will Petry, North Carolina State University

Forecasting the fates of plant populations and ranges under changing climate

Questions/approaches: Our lab studies how populations grow, decline, or go extinct when the environment they live in changes across landscape scales. These questions are especially rich for species in which individuals have different environmental optima because of differences in age, life stage, sex, or genotype. On one hand, these differences can help buffer populations because a bad year for one type of individual may be tolerated by other individuals. On the other hand, each step in a life cycle presents a potential vulnerability, and a break at *any* point will condemn the whole population to extinction. We track the demographic performance of individuals in the field and compare populations to understand how climate impacts each part of the life cycle, then we use mathematical models to project how current and changing climate will reshuffle plant populations. Students with an interest in learning how to use math to model biological processes and familiarity with basic statistical analyses like ANOVA/regression will find the most options for potential projects. Past students have used these interests/skills as a foundation to develop timeseries analyses, to work with GPS/spatial data, and to construct demographic models as part of their projects.



Study system: Our focal study species is the long-lived plant *Valeriana edulis*, which has a life cycle that includes many kinds of individuals—differing in size, sex, and reproductive status. Previous research has shown that these types of individuals respond differently to changing climate in ways that reshape the growth rate and composition of populations. We are excited to apply what we've learned over the 10+ year-long duration of this project (i) to make and assess plant population forecasts, (ii) to explore how well our understanding of local population dynamics transfers to other populations across the entire species range, (iii) to understand the effects of plant-plant competition on plant performance, and (iv) to understand how binary thinking about plant sex may be limiting our understanding of plant life history and population dynamics.

Mentoring: Our field crew this summer will consist of 1-2 undergraduate students working on research projects and 1-2 seasonal field assistants (post-baccalaureate and/or graduate students). Early on, I work closely with students on project development and side-by-side in the field. As the project questions and methods come into focus and the student becomes more comfortable working independently, I gradually shift to a supporting role tailored to each student's needs to make their project a success. The normal program dates generally fit best with the timingof *Valeriana*'s growing season, though it may also be possible to accommodate later arrivals/departures.

Special Requirements: A typical day in the field focuses on collecting data from tagged individual plants in one of our many focal populations distributed across Gunnison County. Some are drive-up, but some require very strenuous hiking up to elevations >12,000'. Many of these populations are very remote (>1 hour from cell service or facilities). We provide extra safety training and equipment as part of our group's commitment to field safety. Depending on the scope of the student's project, they will accompany the field team to some or all our study populations, collecting their own data and helping with the long-term dataset (a rich trove of information fully available to support the student's project). The typical workday is 8-5 pm, but this can vary based on the travel time to the site.

Alden Sears, North Carolina State University



My research: I am a community ecologist studying how plant species interact through shared resources, pollinators, and herbivores, ultimately with the goal of understanding how species coexist in diverse communities. My research approach uses manipulative field experiments and natural history to measure the competitive and facilitative interactions that occur between plants. These measurements inform mathematical models that predict the consequences of each interaction type on how species can coexist in natural communities. This research integrates across several different areas, with project opportunities for students who are excited about plant-insect interactions, pollination ecology, plant biology, and ecological modeling.

I focus on several iconic members of the sunflower family (Asteraceae) and the diverse guild of insect pollinators and seed-eating herbivores they attract. I map plants with precision GPS and selectively clip flowers around focal plants to change their floral neighborhood, then measure the impact of neighborhood species on the focal plant's pollination, seed production, and seed consumption.

Potential student projects:

1) Exploring how pollinator behavior is indirectly affected by seed-predating flies that cause damage to shared floral targets.
2) Investigating how plant traits (such as flower size, seed mass, timing of flowering) affect the incidence of predation or parasitism.
3) Examining the natural history, host preferences, and seed-protecting effect of parasitoid wasps that attack seed-eating herbivores.
4) Testing how pollinators adjust their floral visitation patterns in response to floral density and species composition.

Mentoring:

Students who join me will be co-advised by my research advisor (**Dr. Will Petry**) and will have opportunities to experience related projects alongside research team members who are studying perennial plant population biology and pollination impacts on plant fitness. I am interested in advising students at any career stage—those just dipping their toes into ecological research as well as those with previous experience. Through regular meetings to discuss science writing, progress, analyses, and research skills, I will help students acquire the tools and external support necessary to pursue their career goals. Accessing the field site for this project requires a challenging hike, but we work up to it and get spectacular views enroute.

Dylan Simpson, Chicago Botanic Garden & Northwestern University

General interests and keywords: Plant ecology; population ecology; pollination and plant-insect interactions; statistics and quantitative ecology



Background: My research broadly focuses on how population dynamics are shaped by the environment. Increasingly, I approach this question through the lenses of demography and life history, and in the context of anthropogenic environmental change. I am also really interested in the process of science itself, the methods we use, and how our choices in study design and method choice can influence our results.

I am a postdoc working with Amy Iler, and our research at RMBL focuses on the effects of climate change on populations of perennial wildflowers. In the subalpine, a key symptom of climate change is earlier snowmelt, and our project uses a snowmelt experiment to study the effects of snowmelt timing on plants across their life cycle.

Opportunities: Students can develop their own projects or work within the broader umbrella of our phenology-demography experiment. Potential project ideas include:

Demographic effects of earlier snowmelt. Early snowmelt means earlier phenology and could be good or bad or both. Here we're asking how early snowmelt affects different aspects of the plant life cycle (survival, growth, reproduction). Could it also affect tradeoffs among these vital rates, or interactions with plant pathogens?

Life history of the enigmatic Geum triflorum. Prairie smoke (G. triflorum) is one of the focal species of our phenology experiment, which we've come to realize has a very curious life history. Its pollination is a mystery and it also reproduces clonally, both of which have implications for its population ecology. Who pollinates Geum? Can they be pollinated with pollen from their clones? How large are these clones and how long do they stay connected?

The role of detection in plant surveys. John Harper (1977) once said, "Plants stand still and wait to be counted." Maybe so, but do we find them? In wildlife ecology, it is well recognized that researchers often miss the things they're looking for, which has consequences for how studies are designed and how data are analyzed. In the plant world, though, we don't think about this much. I'd be interested in studying how people study plants – how effective we are, how often we miss things, and whether methods from wildlife ecology might help us.

Mentorship style I am happy to be as hands-on or hands-off as needed (within reason). I strive to establish clear communication, to check in frequently, and to be flexible. We will establish expectations early but can revisit as needed. I also see it as part of my job to help you get what you want out of this experience.

Nora Underwood and Brian Inouye, Florida State University

Overview: In response to early snowmelt, some flowering species are shifting bloom time (flowering phenology). Phenotypic selection on flowering phenology may vary from year to yeardepending on abiotic and biotic conditions. For example, if selection by the environment, such asspring frost events, and seed-predators occurs in opposite directions, the optimal flowering timefor a species may be a compromise between last frost date and avoidance of seed predators.

However, we have limited knowledge about the relationship between flowering phenology and lifetime fitness, which would allow us to accurately quantify selection on flowering time. Ultimately, we want to determine how selection on flowering time will influence overallpopulation growth in long-lived perennials.

The student will work on a multi-year study to understand the evolutionary and ecological consequences of phenological shifts in a subalpine flowering community. The student will therefore be a part of a larger, collaborative study into the future. The student will mark individualplants adjacent to long-term flowering phenology plots. Throughout the summer, the student will assess flowering time, plant fitness, and other plant traits depending on interest. We could supportindependent research projects on related topics.



Mentor style

We are committed to creating a research experience where all students are respected, engaged with the scientific community, and invested in their science. Our summer lab group will be comprised of three faculty, one postdoc, one field assistant, one K-12 science teacher(RET), and up to two undergraduate researchers. Each student will have one individual meeting per week with either the postdoc or faculty to discuss their research project. In addition to individual student meetings, we will have weekly group meetings to share our research projects, read scientific papers, and learn data analysis skills. We are excited for any student to apply, regardless of previous experience in plant ecology.

Rick Williams, Idaho Museum of Natural History, Idaho State University & RMBL Herbarium

My current research projects at RMBL use historical and contemporary data on plant distribution and abundance to examine long-term shifts in plant community composition and flowering phenology. I use historical data from the RMBL Herbarium and other herbaria as a baseline to resurvey and examine change at sites near RMBL that have been documented in collections since 1929. This project includes identification and collection of plant specimens for the RMBL Herbarium and observations made in iNaturalist. In addition to field work, students will learn plant curation and identification skills in the RMBL Herbarium and the use and development of digital collections resources.



Mentoring: My small lab group usually includes myself and 1-2 undergraduates conducting independent research. Students work directly with me to develop a research question. Students conduct research projects mostly in the field, with significant time spent in the herbarium. I meet with students at least weekly and often more frequently depending on the nature of the project. Students are expected to work independently and often on their own rather than as a part of a larger field team, although we often work cooperatively with other lab groups on plant collection and identification. For example, my students and I have collaborated with Jordan Argrett (U. of Georgia) investigating effects of root hemiparasitism by various paintbrush (*Castilleja*) species on plant community diversity and productivity. We have also worked with Dr. Ken Whitney (U. of New Mexico) to investigate the biotic and abiotic factors affecting floral color variation in various plant communities and different pollinator guilds.



Special Requirements: The Natural History Collections/Herbarium is within the RMBL townsite and is accessible by a path. Minimal activity required. Field data collection can be moderately to extremely strenuous, depending on project goals and location of resurvey sites. The typical workday is M-F, 8-5 pm.

Kaysee Arrowsmith, University of Texas



My research explores patterns and drivers of variation in plant-pollinator interactions. In prior work at RMBL, I have examined broad-scale variation in pollinator visitation patterns across a spatial gradient and fine-scale variation in interaction patterns over the course of individual days. **My current work at RMBL is focused on integrating fine-scale measurements of pollen and nectar resources into understanding bumble bee foraging patterns.** To do this, I take pollen from bumble bees and from flowers ("being a very large, very mediocre bee" – PJ Jones). I do this work in close collaboration with the Brosi lab at the University of Washington, namely the aforementioned PJ. Students working with me will be expected to contribute to the collection of these data and will be supported in developing an independent research project utilizing these and related datasets. Students will gain substantial experience in identifying and manipulating bumble bees and Rocky Mountain flora. They will also be supported in improving skills in teamwork, science communication, and statistical analysis.



Mentorship: **I strive to create a research environment in which all team members can authentically, safely, and enthusiastically participate in science**. I have been involved in field research for over ten years and in that time, I have experienced the multi-faceted ways in which an individual's identity shapes their experience of science. I am a cisgender, Asian woman who experiences challenges related to mental and physical health, some of which make field work particularly difficult. Being in a remote field setting often exacerbate these challenges. I am excited to work with students from diverse backgrounds and will collaboratively build a research environment with my team in which every member is able to contribute to research and become better scientists. This generally involved regular check-ins to discuss mental and physical well-being, in addition to weekly meetings to discuss research goals and progress. I will collaboratively work with students to develop an independent research project that fits their interests while also remaining within the logistical confines of existing research activities.

Special Requirements: My fieldwork involves light hiking (usually less than 15 minutes) and spending the majority of the day outdoors (generally M–F, 8am–4pm).

Dan Blumstein, UCLA



Marmot research. Current work focuses on yellow-bellied marmots in Colorado to better understand the evolution of alarm calling and social variation, antipredator behavior, as well as how alpine animals respond to climate change. The behavior and population biology of the marmots of RMBL have been continuously studied since 1962. Exciting new research directions focus on the consequences of social relationships, and the importance of 'stress' in reproduction, health and longevity. We are also deploying novel biolo biologging technology to track the marmots' behavior remotely and are looking for students to help in this exciting endeavor. We can develop other studies based on student interest and lab resources which I gauge based on talking with provisionally accepted students who express an interest in joining the lab. It's most likely that studies will capitalize on archival data and combine new data collection with analysis of archival data.

Mentoring:

My lab group is large, typically 8-9 people work out of my lab at one time. All students will work directly with me to develop a research project. Because animal care protocols are approved well in advance of summer, the experiments are already determined. My students conduct research projects almost entirely in the field. Statistical analyses require significant computer time during the second half of the summer. I or my graduate students meet with students at least weekly, and usually much more frequently. Students working with marmots will spend time working with the larger lab group, comprised of myself, graduate students, and RAs. Other students may work more independently in the field.

Special Requirements: All students must complete training on the ethical treatment of live vertebrate animals in research before they arrive. Students should be in good physical condition and be able to safely hike and ride a bicycle on dirt roads. Students will need to arrive in late May or early June, before RMBL facilities are fully available for students and should expect to prepare their own meals because the dining hall is not open. It is possible that the road may not be open to vehicles and students will have to walk in. Field work is strenuous, carrying equipment off-trail on steep slopes in rocky terrain. Safety is a priority! Access to most sites is on dirt roads by bicycle, although some sites are within walking distance of RMBL. Typical workday trapping and observing marmots is 7 AM-noon and then again 3-7 pm (depending on weather and marmot abundance and activity). Those setting traps start their day earlier. Data entry and analyses occur during the midday fieldwork break time. Field trapping and observations may be scheduled 6 days/week or as necessary for research projects. Students must be flexible since plans are changed regularly to account for marmot activity and behavior. In a line: work is physically intense, requires mental focus, and we're looking for fun people who are excited to work hard and learn a lot! Most of our previous fellows view their marmot research as transformative.

Special 2026 Marmot Project: Dr. Camille Testard, Harvard University

Special project for 2026 season with mentoring from collaborator Dr. Camille Testard from Harvard University: This project offers a hands-on opportunity to support the deployment and use of animal-borne collars to monitor marmot behavior in a field setting. The student will assist with setting up the monitoring system, fitting and overseeing collared animals, and ensuring animal safety (our top priority). The work will involve video-recording animals to validate collar-derived logger data by comparing it with observed behavioral patterns. Over the course of a ~1-month test period, the student will help collect and manage social and behavioral metrics from the collars alongside physiological measurements from the same individuals. Dr. Camille Testard will be on site for approximately 3–4 weeks; ideally, the student will be able to continue data collection independently after this period. Outcomes from this project are 1. Validation study of animal-borne collars in yellow bellied marmots and 2. Relating physiological measures taken on individuals during the study period with behavioral measurements derived from the collars.



Carol Boggs, University of South Carolina



The Boggs lab addresses broad ecological and evolutionary questions about resource allocation, behavior, population dynamics, life history evolution, and constraints on local adaptation in changing habitats. We use butterflies as our study organism. There are three projects available for independent research.

1. *Speyeria mormonia*, the Mormon Fritillary, is the subject of long-term studies concerning allocation of nutrients to reproduction and survival and the impact on population dynamics. We have data from two years in the 1980s concerning adult behavioral time budgets for activities in the field – flying, sitting, crawling, feeding. Such behaviors are likely dependent on temperature as well as nectar availability, with rainfall and floral number as proxies. Climate change has affected temperature at RMBL between then and now. An undergraduate repeated the time budget study in 2023, finding dramatic changes from the 1980s. However, 2023 was also characterized by a severe drought, so we need an additional year of data before publication. The project addresses how temperature, rainfall and floral availability interact to affect changes in behavioral time budgets in the face of climate change.

2. Mud puddling behavior by adult Lepidoptera. Young males of many lepidopteran species feed at mud, dung or carrion, gathering sodium, which is passed to the female at mating in at least one species. This behavior represents a division of labor between males and females. Puddling is a social behavior, with males attracted to areas already occupied by other males. But what attracts the first male? There are multiple possible hypotheses/ experiments that could be done to address this question.

3. A joint project with Lauren Carley's lab group. This project will focus on the effects of drought stress on plant defense expression and how this shapes plant-insect interactions like oviposition, herbivory, and caterpillar development.



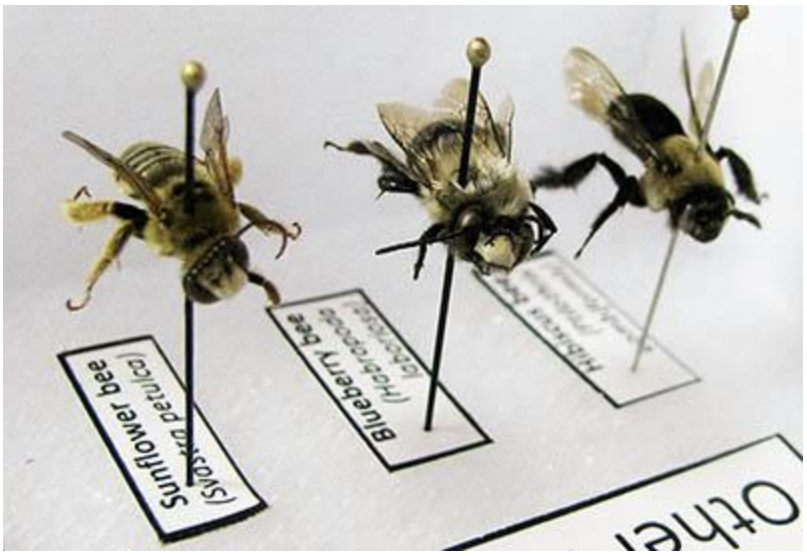
Mentoring: The lab will consist of Dr. Carol Boggs, 3 doctoral students, and 2-3 undergraduate students. We work closely with students in a Socratic manner to develop research questions, experimental design, and data analysis, with meetings frequently throughout the summer. Undergraduates in the lab can broaden their experience by helping with our other research projects and participating in our long-term monitoring projects in the field.



Special Requirements: Field work is moderately strenuous, with walking and hiking on and off trails. Sites are within walking distance of RMBL. Workdays are typically 9-5 pm, 5 days a week, although not necessarily M-F. We don't work in the field when it's raining. The first project will require a student to be able to stay at RMBL until at least mid-August.

Rebecca Irwin, North Carolina State University

We study the ecology and evolution of plant-pollinator and plant-herbivore interactions. Students interested in plant ecology, bee ecology, bee taxonomy, and/or invasive species would be mostsuited to the proposed projects.



Flowers, solitary bees, and climate change in subalpine Colorado. Solitary bees are important and diverse pollinators worldwide, but the factors that affect the distribution and abundance of solitary bees are not well explored, and it is not well known how solitary bees will respond to climate change. The goal of this study is to test whether there is a relationship between flowering phenology and abundance and solitary bee phenology and abundance, and how those relationships will change as the environment changes. The study will use pan traps and netting to assess the phenology and abundance of solitary bees. Students interested in this project will have the opportunity to add to a growing database of bee phenology and abundance and to examine changes in patterns over time. There is also the opportunity to continue long-term monitoring of social bumble bees, and to develop questions around bumble bees. Students interested in this project must be physically fit and able to hike to field sites and then spend all day walking throughmeadows to catch bees.

Mentoring: My lab group is comprised of myself, one or more graduate students, and a research technician, in addition to multiple undergraduates conducting independent research. Students work directly with me to develop a research question and sometimes with co-mentorship from graduate students or the technician. The bee survey research is about three-quarters time in the field, collecting and surveying bees and plants, and about one-quarter time in the lab,pinning and identifying bees.

Special Requirements: The bee survey research is best suited to a detail-oriented student who is also a strong hiker. Students with strong quantitative skills may especially enjoy the bee survey work as we now have 15 years of data available for analyses for some questions. Typical workday is 8-5 pm, M-F.

Nick Dabagia, University of Arizona

My research: I'm a PhD student and community ecologist interested in the interactions between plants and pollinators and how these interactions will fare in the face of environmental change. I am currently working on a project with a fellow RMBL scientist, Josh Grinath, to assess how long term nitrogen deposition at his sites in Almont Triangle, close to RMBL, is impacting plant-pollinator communities and interactions. Students will work with me on this project, and we will collaborate to build out a project of their own to fit their interests. There are also opportunities to develop skills identifying pollinator taxa both in the field and in the lab, in collaboration with my field research advisor, Dr. Becky Irwin. Fieldwork may include measuring plant and insect abundances and traits, and insect behavior. In addition, projects may include some work in the lab, such as measuring plant and insect traits, and pinning and identifying insects. After data collection, I will assist students in analyzing their data and sharing their results in written and oral presentations.

Some potential project questions: 1. Do specific focal plant species interact with the same pollinator species under nitrogen addition? 2. How do plant physiology and traits change under nitrogen addition? 3. How do visitation rates change under nitrogen addition? 4. Does flowering phenology change under nitrogen addition?

Prospective students need not do any special training in order to succeed. Standard work days will be M-F, 8am-5pm, at the latest. Our field sites are ~45 minutes driving from RMBL, 90% on paved road. I will provide transportation to and from the field. Mentoring: While students working with me will be primarily advised by me, they will have the opportunity to collaborate with my research advisor, Becky Irwin, and the technicians and undergraduate students on her team as well. I am eager to mentor students at any stage in ecological research, whether they are just getting started or are already established. I will work with students to understand their needs, and develop a mentorship plan that meets these needs and expectations

Rosemary Smith, Idaho State University & RMBL

My research is in the field of behavioral ecology. Projects generally focus on habitat selection, anti-

predator behaviors, competition, and reproductive strategies. My main research project is on burying beetle ecology and behaviors, but I also work with students who want to pursue studies ofsmall mammals and observational projects with large mammals or birds.



The burying beetle project focuses on the behavior and ecology of a very interesting, large, colorful, and stinky beetle. The burying beetle belongs to a family of beetles that breed on small vertebrate carrion and have parental care. I have three long-term (>20 year) census plots, where our research team will carry out mark-recapture studies for population estimates of both the beetles and their reproductive resource, small mammals. Possible student projects with burying beetles include ecological and behavioral projects, including parental care, competition, mutualisms, and ecosystem effects on soil nutrients. Experiments can include both a field and a captive beetle/lab component.



Small mammal studies include live-trapping, observations, and camera-trapping to understand thevariables that influence behaviors, habitat selection, abundance, and species diversity. Students may design projects on mammal or bird activity using non-live trapping techniques such as GIS habitat occupancy modeling, hair tubes, tracking plates, and camera traps. A student with strong quantitative skills might pursue analyses of historical datasets, species or population models.

Mentoring: My lab group is comprised of me and 1-3 undergraduates. Students work directly with me to design and conduct their projects. I meet with students nearly every day to work on the experiments or analyses. Typically, we all conduct the long-term censuses of small mammals and beetles together and everyone is expected to help each other during critical and busy stages of our experiments.

I work to create a friendly, safe, and supportive research environment in which every person is empowered to grow as a scientist. I expect that everyone on my team will treat others with kindness and respect and strive to create a community where we can express the joy of living and conducting research at RMBL.

Special Requirements: All students must complete training on the ethical treatment of live vertebrate animals in research. The training is online and there is no fee. Transportation to distant sites is provided. For closer sites, it's helpful if a student can bike on a dirt road, although walking is an alternative. At each site there is some moderate hiking both on and off trail. Small mammal live-trapping requires opening traps in the evening at dark and checking traps to handle and release animals before dawn. On trapping days expect to start at 5:30 AM, return to Gothic for breakfast by 7:30 AM, and resume the day at 10 AM or so. Expect adjustments to an 8-5, M-F schedule depending on the projects and conditions.

Savannah Troy, Faculty, RMBL



My research combines approaches from community ecology and landscape ecology to understand the responses of birds, insects, and humans to a changing climate in the high elevation ecosystems of the Rocky Mountains. Students in my lab will receive training in bird and insect community survey methods, ecological study design, and data analysis, and will learn scientific background surrounding climate change and phenological shift issues in montane systems. Students will perform independent research related to any of the major questions listed below.

Research background: One way species adapt to changing environmental conditions is by shifting phenology, or the timing of life history events. This is a common trend seen across taxa including birds, insects, amphibians, fish, and plants: among 677 studied species, 62% displayed a shift in phenology towards initiating spring events earlier, as predicted under climate change. But what happens when species that historically have important interactions with each other shift their phenology inconsistently, creating a phenological mismatch that transforms their communities? An important community interaction that may be at risk of phenological mismatch is the predator-prey relationship between insects and breeding birds in high elevation systems. While insect species can directly track local climate conditions such as snowmelt timing, migratory birds cannot because they are away in tropical wintering grounds. The possibility of breeding birds mistiming reproduction and missing the peak of insect prey availability is expected to have negative consequences for bird populations.

Question 1: How does the demand for insect prey by birds change over the course of the summer breeding season in montane wet meadows? This project will involve using model caterpillars to monitor rates of bird foraging and surveying bird community diversity.

Question 2: How does human recreation impact breeding bird communities? This project will involve surveying bird community diversity and rates of human activity in montane wet meadow breeding habitat.

Question 3: Does insect emergence timing (phenology) change with elevation? This project will involve surveying insect community diversity over the course of the summer breeding season in montane wet meadows across elevations.

Mentorship: My research group is small, meaning student researchers will receive highly personalized mentorship throughout the completion of their independent research project. Motivated students will be encouraged to publish their work in peer-reviewed scientific journals with my continued support after the RMBL program ends.

Special requirements: No previous research experience of any kind is necessary, but students must be able to demonstrate a strong work ethic, willingness to learn, and ability to pay attention to detail. Because research questions pertain to variation across elevations, students will be required to hike to remote study sites up to 12,000 ft above sea level. Strenuous hiking may occur up to 3 times per week. Days involving bird community surveys will require students to work from sunrise – 2pm. Other research duties may be conducted from 9am-5pm. This project can accommodate students with an earlier start or later departure.

Caitlin Wells and Dirk VanVuren, Colorado State University and UC Davis



The goal of the project is to determine extrinsic and intrinsic causes of variation in the demography of golden-mantled ground squirrels. The golden-mantled ground squirrels at the Rocky Mountain Biological Laboratory spend most of the year hibernating to save energy during the long, cold winter. Once squirrels emerge in spring, they only have a few months in which to consume enough calories for hibernation, avoid predation, and reproduce. Mammals living in high-altitude environments must time their reproduction carefully so that offspring are born when food is available.

Students will learn to safely live-trap and handle small mammals (ground squirrels); collect morphometric, genetic, and physiological samples; and conduct behavioral observations.

Potential projects include

-Identifying new ground squirrel populations in the valley

-Pup growth rates and foraging behavior under different climatic conditions

-Seasonal changes in ground squirrel diets

Mentoring: The GMGS team consists of Wells and VanVuren, 1-2 Graduate Students or Research Assistants, and two undergraduate students. We encourage students to participate in the ongoing project, including the live-trapping and observations of the golden mantled ground squirrel population at RMBL. We will work with students to develop their own research questions related to the ecology of ground squirrels. Depending on interest, a student may also develop a project with bird observations.

Special requirements: Students will be required to complete training on the ethical conduct of research on vertebrate animals. Students will learn to safely live-trap and handle small mammals (ground squirrels). The project sites are all within the Gothic (RMBL) townsite, accessible via flat or moderate trails. The typical workday reflects the activity period of the ground squirrels: early morning, break at midday, and early evening. Students can expect to work on the ground squirrel project 5-6 days/week.



Mick Demi, Allegheny College

Overview: My lab's research focuses on understanding how environmental change affects freshwater organisms and ecosystems. I am particularly interested in how global climate change affects aquatic systems from the scale of individual responses (e.g. temperature effects on growth, metabolism and development) to community organization (e.g. aquatic insect diversity and food web structure) and ecosystem processes (e.g. detritus breakdown and nutrient cycling). I conduct fieldwork in a variety of habitats around RMBL including rivers and streams of various sizes and wetland pond ecosystems and on a variety of organisms, including insects and fish. I am happy to work with prospective students to develop independent research projects that align around common interests in freshwater systems.

Examples of prior student projects:

1. The role of algae and phosphorus in the feeding preferences of detritivorous caddisflies (link).
2. Temporal patterns of terrestrial invertebrate inputs to the East River in Gothic, CO, a potential food resource for trout.
3. Comparing rates of detritus breakdown by common pond detritivores (link).
4. Investigating the role of nitrogen and phosphorus limitation in detritus breakdown along a pond hydroperiod gradient.
5. Does phosphorus limitation drive cannibalistic behavior in a pond detritivore?



Mentoring: Students can work in a collaborative and supportive environment while interacting with other researchers (including undergraduate and graduate students) studying freshwater ecosystems. Students will receive ample guidance and support throughout their project, from the development of research questions to field sampling, to data analysis and interpretation. However, students may be asked to work independently sometimes to complete various tasks related to their project. My aim is for students to have an experience that is memorable for being scientifically rigorous and fun! RMBL is a special place to work and I will strive to create a safe, welcoming, and supportive environment to facilitate positive experiences.

Special requirements: Students must be motivated to conduct research that might require rigorous physical exertion from time to time, including hiking long distances (up to several miles) at high altitude, occasionally through snow, and sometimes unpredictable weather conditions. A normal work schedule would be 8-5 Monday through Friday.



Amanda Klemmer, University of Maine

My lab's research focuses on cross-ecosystem resource fluxes between terrestrial and aquatic ecosystems and how they connect/affect food webs. This project is ideal for students interested in food webs, connections between ecosystems, aquatic invertebrates, terrestrial invertebrates, and/or birds. The ideal student also needs to be motivated to conduct independent field research (visiting sites alone) that involves multi-mile, strenuous hikes to field sites.

Hydrology affecting terrestrial/aquatic connections: My group is working to understand how pond hydrology (timing of pond drying) affects the connections between ponds and the surrounding terrestrial ecosystems. These connections include terrestrial plant matter and invertebrates falling into pond ecosystems, with the reciprocal flow being aquatic invertebrates entering the terrestrial food web through emergence or stranded organisms after ponds dry. To further understand these connections, we will be placing multiple traps in the aquatic/terrestrial ecosystems to capture the movement of these organisms, as well as observations on mobile terrestrial predators, such as birds.

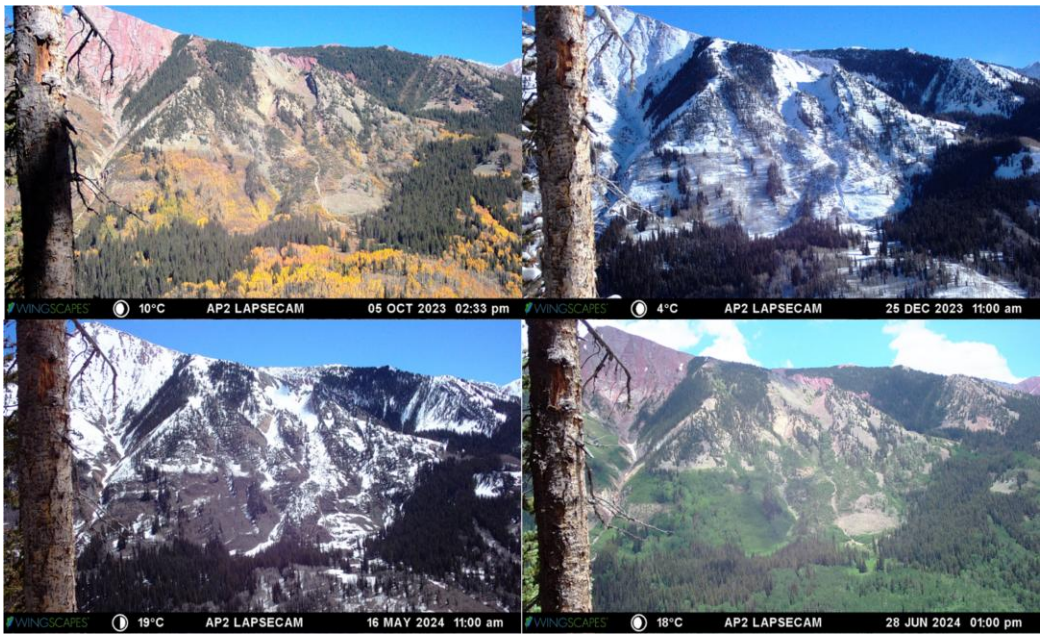
Range-shifting caddisfly species: My group is working to understand effects of a range-shifting caddisfly species on food-web interactions and ecosystem functions (including detritus breakdown and aquatic emergence to the terrestrial ecosystem). Research over the summer on this question will involve surveys of ponds, invertebrates, and invertebrate emergence. In addition, there will be multiple large and small experiments taking place to work out food web interaction strength between different organisms.

As a part of this project, the student would be working with a group of researchers and students studying freshwater pond ecosystems at the Mexican Cut Nature Preserve, as well as with stream researchers around Gothic on the East River. Besides the project mentioned above, this opportunity includes experiences on projects investigating freshwater ecosystem function, community ecology, as well as invertebrate life histories.

Hamish Greig, University of Maine

One of the most often reported outcomes of climate change is the expansion of low-land species into higher elevation habitats. Despite the common occurrence of these range shifts, scientists stillhave a poor understanding of why some species move and not others, and what are the consequences of range shifts for the functioning of ecosystems. Researchers at RMBL have observed these distributional changes in a suite of species, including the caddisflies that perform important ecological functions in high elevation ponds. This project focusses on measuring the variation in within and between species of caddisflies across their elevational range to 1) understand what might enable some species to move and not others, and 2) understand how these movements influence the role caddisflies play in cycling nutrients and energy in pond ecosystems. This research serves as a model for understanding how changes in species distribution that result from a changing climate can impact ecosystem functions that translate into provision of ecosystemgoods and services (food, fiber, clean water, waste recycling) to societies.

Jessica Lundquist. University of Washington



Project Title: Seasonal Cycles Unravel Mysteries of Missing Mountain Water

Overview: Since 2000, the Colorado River has delivered less water than expected based on snow and precipitation. We are investigating the question of where does mountain water go: streamflow, subsurface storage, or evapotranspiration? To understand this question, we are looking at snow distributions, snowmelt patterns, nested streamflow measurements, and patterns of vegetation green up and dry down. We are also investigating microclimates of temperature, relative humidity, and soil temperature along gradients of elevation with different degrees of solar exposure. Scan this QR code so see a short video about the project:

Mentoring: Either the project PI (Lundquist), a co-PI (Rosemary Carroll or Ethan Gutmann), or a project graduate student will be on site throughout the summer, so the undergraduate will likely have the opportunity to work with different people at different times, learning multiple perspectives.

Special Requirements: Many research sites are off trail and require the ability to hike all day (with a typical workday 8-5 pm). Field sites can be reached by a combination of bike and hiking from the RMBL townsite.

Sam Pierce, Stanford University

Project Title: Beaver dam influence on floodplain hydro-biogeochemistry

Research Description: My graduate research focuses broadly on floodplain hydrology and biogeochemistry in beaver-impacted river systems. I look at how surface and groundwater hydrology impact carbon and metal repartitioning within the riverscape.



Background: North American beaver (*Castor canadensis*) play an outsized role in modifying the watersheds they inhabit. Prior to the fur trapping era, beaver once dammed most waterways in North America. The near elimination of beaver fundamentally changed how rivers flow and how freshwater is stored across the continent. Without beavers to maintain their dams, millions of structures they had built eventually blew out, causing rivers to scour the land and lose hydrologic connectivity with their adjacent floodplains. Ultimately, many rivers and wetlands continent-wide became degraded, having simplified function and, most importantly, much less water retention. We need to understand the biogeochemical processes that occur within beaver-impacted wetlands to help predict changes to watershed function as restoration work proliferates and as beavers reinhabit historic range. River restoration using beaver dam analogs (BDAs) is occurring at a rate that far outpaces the research to understand its impacts. While most restoration work is aimed at increasing water quantity, little attention is given to water quality.

I seek to better understand the biogeochemical cycling of carbon and metals that occurs within beaver-impacted rivers and wetlands. This involves studying intact natural beaver pond systems as well as restoration sites treated with beaver dam analogs (BDAs). Facets of my fieldwork include measuring surface/groundwater quality (total metals, organic/inorganic carbon, etc.), gauging stream flow, monitoring water table depth, and collecting soil samples.

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Mentoring: I work 1-on-1 with students to develop research questions and experimental design. I encourage students to be self-driven and genuinely curious about conducting research.

Special Requirements: I'm typically in the field 3-4 days/week (M-F) from 9 am - 4 pm, sometimes earlier, sometimes later. Roughly 1-2 days/week are spent in the lab prepping materials or processing samples. My fieldwork often requires heavy lifting and hiking with a weighted backpack. I work in flooded areas and measure stream flow, so I frequently wade rivers and traverse uneven, hazardous terrain. Students should expect a high level of physical activity. Overnight camping at sites in Taylor Park may be required. A strong background in chemistry is highly recommended but not required.

Brad Taylor, North Carolina State University

About 0.02% of the water on Earth is found in rivers and lakes, and most of the human population lives near these freshwater ecosystems, and rivers and lakes have been gems for ecological and evolutionary studies for centuries. At RMBL we use rivers and small ponds as study systems to discover how a species, such as predatory fish or stalk- producing algae, affect the 1) phenotypic traits (e.g., growth, morphology and behavior) of other species, 2) community interactions, and 3) ecosystem functions, such as carbon flow and nutrient cycling. Most of these studies also include strong linkages to environmental changes, such as climate-induced advances in the timing of stream runoff and shifts in pond hydroperiod. Currently we are seeking students interested in the following projects:



What is the relative contribution of cattle feces versus nutrient release from pond sediments by cattle bioturbation to high-elevation pond eutrophication?

Does nutrient limitation of algae differ across a pond hydroperiod permanence gradient?

What are the relative impacts of fish predator chemical cues versus food resource quality on mayfly growth, development rate, and emergence success?

Do the impacts of animal detritivores on carbon processing depend on the supply rate of detritus?

Are the temporal dynamics of rock snot blooms (*Didymosphenia geminata*) linked to abiotic or biotic factors?

Mentoring: Students will interact with myself, undergraduates, graduate students, and postdoctoral scholars, as well as one or more collaborators and their students. Students will often be co-mentored by myself and either a graduate student, postdoctoral scholar, or both; however, students should be prepared to do a large portion of field and lab work independently.

Special Requirements: If working with fish, the student must complete training on the ethical treatment of live vertebrate animals in research. The research projects will be conducted in the field at remote high elevation stream or pond sites and/or in streamside flow-through tanks. Access to sites requires moderate to strenuous effort, mostly on trails. Fieldwork includes entering streams and ponds. The typical workday is 8 am to 5 pm, however a student may need to adjust their schedule depending on their project type and scope.

Scott Thomas, Hiram College



I focus on the factors that drive variation in tiger salamander populations and their traits, and how these factors vary in space and time. The core of salamander research at RMBL is a 37+ year ongoing study of tiger salamanders at Mexican Cut Nature Preserve. This study intensively samples salamanders from the many ponds of the preserve to tag and measure, providing data at the individual and population levels through time. This study has provided insights into the drivers of population fluctuations at this site, but this is just one site among many in the region that each have their own unique environment. To build on our ability to take insights from these data and apply them across space and time, I also focus on how this environmental variation affects salamander populations and traits. Cannibalism happens to be one of the main traits that I study. Salamanders will eat anything that they can get in their mouths, and hatchlings are an easy target for older individuals, causing cohorts to fail when many adults are around and thrive when adults die out. Since 2018, I have used the Mexican Cut database along with experiments and field observations to examine how factors such as nutrient availability influence the frequency of cannibalism.

Students working with me would have the opportunity to focus on any aspect of the salamander research at RMBL. The salamander group is a large and diverse group of principal investigators (Howard Whiteman, Kelsey Reider) and students (~10 people in total) that provides a safe and supportive environment for our members and their ideas. We also collaborate closely with other RMBL aquatics researchers that focus on invertebrate communities and ecosystem factors. Working within this group will quickly expose students to myriad aspects of salamander ecology and research techniques to serve as fodder for project ideas, along with great logistical support and flexibility. As a corollary, I will also expect students to help with the various other projects in progress when available. Accessing some of our study sites, including Mexican Cut, does require hiking moderately strenuous trails at whatever pace is comfortable.

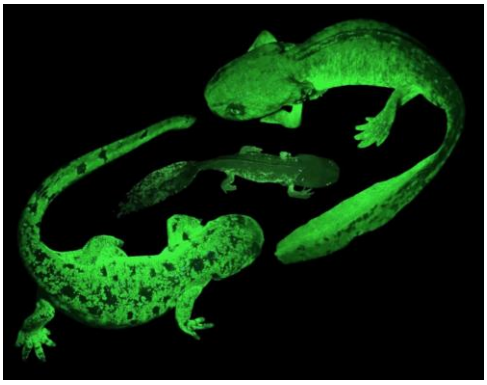
Howard Whiteman, Murray State University



I have been working at RMBL and the nearby Mexican Cut Nature Preserve for over three decades. My research focuses on population ecology (e.g., understanding long-term fluctuations in the number of salamanders in the population), life history evolution (e.g., testing hypotheses about the ecological and evolutionary mechanisms that allow some salamanders to have two different developmental endpoints: adult salamanders can either become terrestrial or retain some larval characteristics and remain in ponds throughout their lives), and, most recently, how climate change may be affecting each of these topics. We have also begun a project experimentally restoring endangered Boreal Toads and following the restored population's dynamics and health.

Student Research

I encourage students to participate in all ongoing projects including the annual sampling of the salamander population at the Mexican Cut Nature Preserve. I will work with students to develop their own research questions related to the ecology of salamanders.



Beyond the research listed above, possible student projects include 1) understanding how salamander diets and life history have shifted with a climate-driven caddisfly invasion and 2) studying the impact of invasive caddisflies on salamander egg survival; 3) understanding the mechanisms of production and ecological and conservation implications of biofluorescence in salamanders. Together, these projects will improve predictions of how geographic variation and climate change affect salamanders through biotic and abiotic interactions.

Mentoring: Student researchers will be directly mentored by Dr. Whiteman. I encourage students to bring their whole selves – including their culture – with them to RMBL and I will work with students with any amount of prior research experience. I will develop an individualized mentoring and research plan with student mentees. I expect direct interactions with student mentees almost every day during the field season because we will spend so much of our time working together. I would like students to be able to continue their research after the end of the program (e.g., as part of a senior/honors thesis, presentations, and journal article). I expect to continue mentoring students after the end of the program as they navigate these next steps, graduate school, etc.

Special Requirements: All students must complete training on the ethical treatment of live vertebrate animals in research. The location of our research sites requires us to work with students who can can hike several miles at and above 11,000 feet with significant elevation gain daily. You will be happiest working on the project if you work well both in a group and independently under challenging field conditions including being hot, cold, wet, and enduring the occasional biting insect. Typical field days are long: we depart early in the morning and sometimes return after dark. My research can accommodate students during the regular program dates, as well as students arriving later in June and leaving later in August, although I am usually on site from mid-June through early August.