



Mountain Lake *Echoes*

UNIVERSITY of VIRGINIA

Produced by the University of Virginia's Mountain Lake Biological Station mlbs.org



Why Reach Overseas?

Many of our country's most important inland biological field stations, as they were once called, came into being quite intentionally during the middle of the last century. Most were designed to serve as regional platforms for college courses, collecting forays, or land management efforts. During the 1960s and 70s some took on themed research missions – hydrology, ecosystem dynamics, forest ecology, agriculture, lake processes, prairie dynamics, population biology, animal behavior, etc.

Field research is now a globe-trotting industry with graduate students choosing systems and questions independent of local biology, or field stations. Today's field stations must play host to biologists from around the world, and are learning how to support and retain international scientists who face special challenges, including time zones, travel costs and time, language, culture, academic schedules, funding disparities, rules and regulations in two countries, and immigration and visa complexities. To attract international users, field stations must remove barriers, e.g., program schedules designed to align only with US calendars, or excessive permitting requirements. If stations can do this, they and their host institutions will reap the benefits of bringing

together scientists with different training, perspectives, conceptual tools, and ways of thinking.

Dr. Adriana Herrera Montes is primarily interested in how human disturbance, specifically human environmental engineering, impacts biodiversity and vertebrate ecosystem services. She started her research at MLBS in 2016. A Colombian, Adriana completed her PhD at the University of Puerto Rico on anuran and reptile assemblages in human-modified landscapes. Her work follows a long tradition at UPR of interest in the ecology and biodiversity of environments with strong human impacts (e.g. "urban ecology"). One also sees this tradition, for example, in the passion of UPR undergraduate students who show up and voice their concerns for environmental issues on campus.

In the past eight years, ten undergraduates from Puerto Rico have participated in the MLBS REU program (three mentored by Adriana). Many of them pursued conservation, biodiversity, or ecosystem services projects. This focus on human-impacted landscapes contrasts with an affinity here on the U.S. mainland for "natural" biological research in "human-free," or at least highly protected, environments.

Adriana is challenging all of us at MLBS to think outside our box, and outside our forest, for answers to questions that are becoming more relevant, and more important, every day. Reaching out to Puerto Rico has enriched our research, and our lives, at Mountain Lake. - by MLBS Staff

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(Left to right) Julieanna Keclik (REU, Florida State University), Pamela Martínez-Oquendo (REU, Pontifical University of Puerto Rico), and Adriana Herrera Montes.

From the Director

Summer 2018 was our busiest season in memory. Classes were full, and Lewis Hall was overflowing with research groups; at times we literally had no room for overnights. We hated to have to turn users away, but were excited that so many people wanted to do their work at MLBS. It is a challenge to accommodate so many Mountain Lakers, but we wouldn't want it any other way. Be sure to make your reservations early to secure space for next season.

One of the factors contributing to our bursting residency was a new effort in offering short workshop programs. In 2018, we offered our first in this series – a grant-writing workshop led by Leslie Rissler of NSF. By all accounts it was a huge success and participants are already clamoring for a repeat. The workshop lasted seven days and included 11 scholars across a range of professional levels, each of whom developed their own grant pitch, wrote a proposal, and participated in a mock panel to learn the ins and outs of the process.

Our second short workshop will take place in 2019 (dates to be determined). New UVA faculty member Amanda Gibson will team with Curt Lively and Lynda Delph of Indiana University to offer Evolutionary Biology in the Appalachians. This will be a graduate course modeled after the popular European style summer schools, where students work in groups to develop research hypotheses, design ways of testing those hypotheses, write and present a proposal, and receive critiques. Faculty facilitators serve as guides who help students explore ideas on their own. The goal of the workshop is to provide students an opportunity to participate in real-world development of research ideas in a collaborative context, building professional networks along the way.



Butch Brodie

Meet the Beetlearies!

by Robin Costello, University of Virginia



Robin Costello
PhD Candidate, Brodie Lab
Department of Biology
University of Virginia

Welcome the latest addition to MLBS: aviaries for beetles. Big enough to house birds, the beetlearies instead hold millimeters-long forked fungus beetles. Why the excessive size? Each enclosure houses a population of beetles living on an artificial log. In the wild, forked fungus beetles live on fungi that grow on rotting logs. In the beetlearies, beetles live on farmed fungi that grow from bags of sawdust.

We began construction on the beetlearies in summer 2017. A year later, after learning how to use table saws, nail guns, drills, and staple guns, we completed building twelve 4ft x 8ft enclosures with wooden frames and screened walls. After

construction, we seeded each enclosure with fungi farmed in the lab and beetles collected from the wild.

The Brodie and Formica labs have long studied social interactions in wild populations of forked fungus beetles at MLBS. With the construction of the beetlearies, we can now use experimental manipulations in controlled populations to ask directed questions about social behavior in these beetles. This past summer, I used the beetlearies to investigate whether the dispersion of fungi structures social interactions in forked fungus beetles. I manipulated the dispersion of the fungi across the artificial log. In half the enclosures, the fungi were dispersed evenly across the artificial log; in the other half, the fungi were clumped.

And does resource spatial structure influence patterns of social interactions? Preliminary results from Rachel Thoms's REU project suggest that the dispersion of fungi does influence social interactions and that a difference in how beetles use space in the two dispersion treatments drives this effect. We look forward to using the beetlearies to explore a range of questions about forked fungus beetle social interactions for years to come.



The beetleary construction team in spring 2018. From left to right: Robin Costello, Malcolm Augat, Catherine Debban, and Liza Mitchem. Not pictured: Phoebe Cook, Eileen Butterfield, Fisher Brodie, Butch Brodie.

Student Corner

by Maura Davis, University of Virginia



"Summer Camp for Bio Nerds" is how Butch Brodie described MLBS to his Evolution and Ecology class last spring. Even if I hadn't already been strongly encouraged to pursue coursework there by Butch and my older

brother, though, I also came across MLBS as a site for my research with Jess Manson. The combination of the two experiences shaped an incredibly memorable summer!

The first couple of days of Field Herpetology, Christian Cox flew through so much phylogenetic material that I was convinced I should have packed more notebooks. Shortly afterwards, however, all of the lecturing was behind us as we embarked on "herping" expeditions, beginning around MLBS property and expanding across Virginia, the Carolinas, and Georgia. Never before would I have even considered the possibility of catching snakes, much less with bare hands, but long after the class was over, I found myself flipping snake boards and salamander condos in my free time.

Once the last, research-filled week of Field Herpetology came to a close, although I was sad to see my friends leave and would miss the camaraderie and nightly volleyball matches, I also was excited to start my own research, meet the incoming Disease Ecology class, and further develop friendships with the REUs. Researching in the field was an incredible opportunity - Jess and I daily treated and sampled milkweed around Station property or sites down the mountain, yet I still had enough time to explore the trails at MLBS and the neighboring lodge in my free time!

There might be a variety of summer options for college students, but I would recommend at least one summer at MLBS to anyone with an interest in a collaborative, immersive, field-based experience of biology!



2018 Field Herpetology Class

Research Spotlight

by Chloé Lahondère, Virginia Tech



Chloé Lahondère
Research Assistant Professor
Department of Biochemistry
Virginia Tech.

When you think about mosquitoes, the first things that probably come to your mind are “annoying,” “pest,” and “can we just get rid of them all please?” I definitely get it: if there is one mosquito in a room, it will most likely come after me. Mosquitoes have been ranked by the WHO to be the deadliest animal on earth due to the terrible diseases they transmit to humans and other animals (e.g. malaria, dengue, Zika). They cause more than one million deaths per year worldwide.

Studying mosquitoes is more important than ever. Indeed, control strategies are starting to fail due to resistance to insecticides that have been observed in several populations. To develop efficient tools to control mosquitoes, it is essential to have a good understanding of their basic biology and ecology. And this is, in part, the focus of our work at MLBS.

The very first time I visited MLBS at the end of winter this year, I thought “This is such a perfect place to conduct field work!” Apparently there were not a lot of mosquitoes seen around the station or bothering people. But among the 3500 existing mosquito species, only 38 are blood feeders and they don’t always feed on humans, so we gave it a shot and found what we came for: mosquitoes!

Since May, we have been collecting mosquitoes weekly with Elizabeth Bose and Sarah Tartabini, both undergraduate researchers, and Joanna Reinhold, PhD student in my lab at Virginia Tech. We have been using different techniques to collect these mosquitoes. Indeed, we found that most species at MLBS are not really interested in the commonly used carbon dioxide traps. We thus started collecting larvae in ponds in containers, placed oviposition traps and cups in tree holes, and hand caught adults. This allowed us to target a larger spectrum of species that occupy different ecological niches and make an inventory of the mosquitoes present at this quite high elevation location, a first important step before starting our experiments. So far, we have found more than 10 different species from 4 genera, including an invasive species, *Ochlerotatus japonicus*. Some of these mosquitoes specialize on birds and humans while others bite preferentially frogs, annelids, or snakes. We are currently working on three different projects involving mosquitoes from MLBS.

This spring, we obtained a grant from the Eppley Foundation for research to study the sugar feeding behavior of invasive mosquito species in Virginia. Indeed, mosquitoes are not only feeding on blood but need sugars to survive. For this project, we compare mosquito sugar feeding and access to nectar at MLBS where native plants are present, with urban areas where ornamental plants are abundant. The main aim of this project is to understand how invasive species adapt to local plants and see if we might contribute to the establishment of invasive species with ornamental plants in urban areas by providing them sugar resources.

A second project, in collaboration with Luis Escobar from Virginia Tech, consists of using the data collected this year (e.g. abundance, type of species) to study the evolution of mosquito populations at the station, and build predictive models to

estimate population changes over the next few decades. The goal is to determine what is likely to happen in the context of climate change.

Finally, while identifying mosquitoes from MLBS, one species especially caught our attention: *Culex territans*. This species feeds primarily on amphibians and reptiles and can transmit several pathogens to these animals. We have started working with David McLeod, James Madison University, who was studying amphibians at MLBS this Summer, to investigate the relationship between these mosquitoes and local frogs and identify the factors mediating these interactions.

This first field work season has been really awesome so far, and we are looking forward to pursuing our work at MLBS once the mosquitoes return next spring!



Uranotaenia sapphirina



Sarah Tartabini collecting larvae and pupae at the Sylvatica pond on a very foggy day.



Culex territans mosquitoes, larvae, pupae, and adults collected at the Sylvatica pond.



Elizabeth Bose and Joanna Reinhold placing oviposition cups in tree holes.

News & Notes

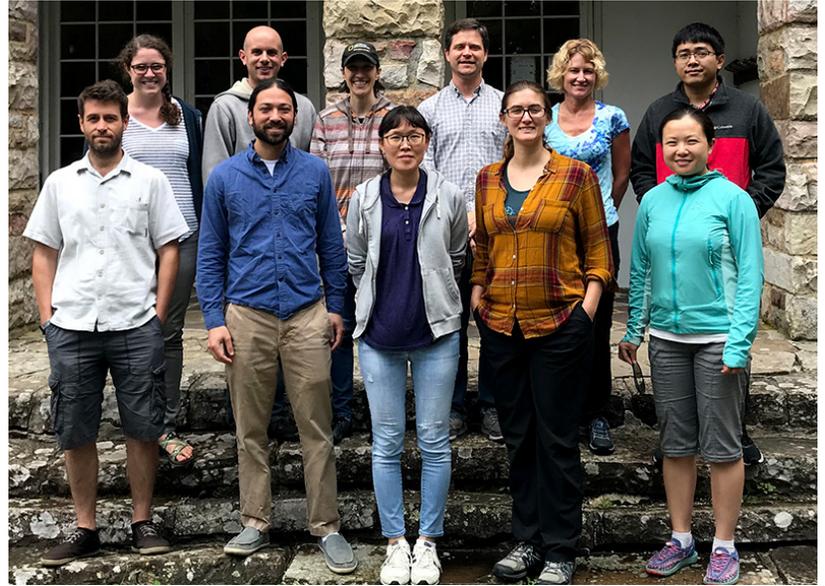
Grant Writing Workshop

How do you craft your brilliant scientific ideas into a well-written, understandable, and exciting research proposal, certain to capture the attention and enthusiasm of reviewers, panelists, and a funding agency? The 6-day hands-on Grant Writing Workshop led by NSF Program Director Dr. Leslie Rissler gave participants a chance to try their best at figuring this out. An additional goal of the workshop was to demystify the NSF and answer questions like "How do I figure out what program or solicitation I should apply to," "What are good broader impacts," or "What's implicit bias"? Needless to say, lots of things were discussed atop Salt Pond Mountain.

MLBS was a perfect place to hold the workshop. The isolation and tranquility of being on top of a mountain, combined with the beauty of nature and the accessibility of many trails was ideal for concentrated thinking and writing, and hiking! It's hard to believe but by the end of the workshop, all 10 students (spanning grad students, postdocs, and junior faculty from a total of 7 different states) had written a complete research proposal, reviewed each other's proposals, and participated in a full-blown panel! They even got the chance to be program directors and discuss portfolio balance of the recommended proposals. This was a ton of fun and challenging too because the conceptual foci of participants ranged from the physics of moisture conservation in termite mounds to the systematics of Caryophyllales and the macroevolution of complex characters to the evolutionary genetics of recombination rates and genetic architecture in *Drosophila*. Participants also wrote their proposals to particular solicitations like NSF's LTREB (long-term research in environmental biology), SESYNC's (National Socio-environmental Synthesis Center) postdoctoral fellowship, or to the core solicitation in one of the divisions of the Directorate of Biological Sciences at the NSF. This provided students with an opportunity

to learn about these diverse programs and wrestle with trying to effectively evaluate very different kinds of science.

Perhaps the most valuable experience of the class was having the time and space to think and write about science, and what better place to do that than MLBS? - by Leslie Rissler



Grant Writing Workshop attendees: (Front) Hunter King, Justin Kitzes, Eunbi Kwon, Sarah Lower, and Ya Yang. (Back) Abby Kimmitt, Nicholas Lewis, Kelly Siman, Adam Fudickar, Leslie Rissler, and Xinde Ji.



ArtLab

Our summer ArtLab program is 6 years old. We have hosted 41 artists and as many UVA Art students, each bringing their insights and creativity to MLBS. In 2019 we hope to see even more diversity in discipline and representation as we start taking direct applications to the program. Watch for that announcement!





VA Tech Wildlife Class

For the 14th consecutive year, the Wildlife Field Techniques Course from Virginia Tech came up to MLBS for their 10-day intensive in August. This is a required course for all Wildlife Sciences majors at VT. This major has grown in recent years and thus two instructors, two grad student teaching assistants, and four undergraduate teaching assistants kept track of 50 students conducting research projects in and around MLBS. Two projects focus on salamanders by conducting area-constrained quadrat searches for salamander abundance, body condition, and habitat associations. Two projects conduct small mammal trapping to estimate abundance, sex ratios, and determine habitat preferences. One project uses remote cameras for mid to large mammals while another uses acoustic detectors for bats to estimate trap rates and activity indices to link to habitat features. A final project focuses on four target bird species using variable radius point counts to estimate bird density and determine habitat associations. Students learn a lot about capture and handling, data collection and analysis, and presenting their work in written and oral formats. They work hard and have a great time. Thanks for hosting us, MLBS! - by Marcella Kelly, Virginia Tech



iNaturalist App

The smart phone app *iNaturalist* is a way to build your own species observation catalog as well as contribute to the species list at MLBS. 501 species have been added to the MLBS project in the past two years. Download *iNaturalist* and join the Mountain Lake Biological Station project today!



SEPEEG

MLBS hosted the 44th annual SouthEastern Population Ecology and Evolutionary Genetics Conference (SEPEEG), October 5-7. We were overflowing with 104 attendees representing 25 institutions from across the southeast. Samantha Price (Clemson University) gave the Emerging Leader talk. Awards went to: Michael Hague (best graduate student talk), Angela Hornsby (best postdoc talk), Robin Costello (best lightning talk), Jordan Lewis (best graduate student poster), and Rachel Keener (best undergraduate student talk).



Open House

This July the Station held its largest Open House yet. MLBS researchers and students spent an afternoon welcoming, teaching, entertaining, hosting, and conversing with about 280 guests! Visitors enjoyed displays and activities, open labs, art exhibits and live performances, nature walks, pond exploration, microscope demonstrations, and more. Thank you to everyone who attended, as well as those of you who volunteered to help make this event a big success!



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A Look Back at the 2018 Season October 1, 2017 - September 30, 2018

Snapshot

4 summer courses
 3 internship and professional programs
 11 REU program participants
 675 station users
 68 institutions represented
 14 visiting courses and programs
 7 station activities
 6 facility projects
 \$28,875 in fellowships awarded
 \$26,518 in donations received
 65 research programs
 51 journal publications



Summer Courses

- Field Biology of Fishes
- Field Herpetology
- Wildlife Disease Ecology
- Stream Ecology

Internship and Professional Programs

- Research Experiences for Undergraduates program
- Grant Writing workshop
- ArtLab artist residency

REU Participants

Jamie Albert	Julieanna Keclik
Louis Bubrig	Pamela Martínez-Oquendo
Austin Davis	Deanna Payne
Linnea Fraser	India Stankovic
Daisy Horr	Rachel Thoms
Sharon Hueston	

Station Users

8,865 user days

675 individuals from 68 institutions:

- 7 artists
- 167 researchers
- 181 undergraduate students
- 109 graduate students
- 18 k-12 educators

Visiting Courses and Programs

- Women Professors Writing Group Retreat, Virginia Tech
- Dendrology Class field trip, Davidson College
- Chesapeake Bay Watershed Biodiversity Course, Hampton University
- Herpetology Class, Hanover College
- Wilderness First Aid Certification Course, SOLO Wilderness Medical School
- Biology Department Retreat, University of Virginia
- VCU Internal Medicine Immersion Experience in Comparative Physiology, Virginia Commonwealth University
- Diversity of Freshwater Fishes of Southwestern Virginia, Virginia Institute of Marine Science, College of William and Mary
- Birdwatching and data collection for Virginia Breeding Bird Atlas, New River Valley Bird club
- Philadelphia Zoo CREW Field Trip, Virginia Tech
- Wildlife Field Techniques Class, Virginia Tech
- CNRE Leadership Institute Retreat, Virginia Tech
- MLBS 1980s Reunion
- Evolution Education Teacher Workshop, University of Virginia

Station Activities

- Annual Open House
- July 4th Festivities
- Team Triathlon
- Volleyball Tournament
- Walton Lecture and Reception
- Square Dance
- Gourmet S'more Cookoff

Facility Projects

- New biosafety cabinet in Wilbur Lab
- Electrical overhaul in Wilbur Lab
- Buried electrical lines
- New range hood in Jefferson Dining Hall
- Invasive plant removal
- Burns Garden improvements, including completion of new fence
- Wireless upgrade planning
- Continued chimney renovations

Financial

Fellowships Awarded \$28,875:

- 7 summer course students \$8,890
- 12 researchers \$19,985

Donations Received \$26,518:

- Walton Lecture \$525
- Grad Students \$2,075
- Undergrad Students \$1,375
- Friend of MLBS \$22,543



Support MLBS

Click to support the programs at Mountain Lake Biological Station by donating online. All donations are tax-deductible.

Research Programs

- Anthropogenic impacts on biodiversity and vertebrate ecosystem services
- Biology and evolution of bryophyte-feeding insects
- Chemical ecology of multispecies interactions
- Chemicals and microbes in myrmecochory
- Co-infection and disease tolerance
- Coevolutionary arms races driven by conflict: A test in social amoeba
- Combining NEON and remotely sensed habitats to determine climate impacts of community dynamics
- Comparative analysis of salamander limb regeneration
- Cooperation and population structure in *Polistes* paper wasps
- Dispersal dynamics and multilevel selection in the forked fungus beetle
- Ecological study of emergent novel ecosystems in the Mountain Lake region and its implication for conservation of biodiversity
- Ecology of mutualism and parasitism in the legume *Medicago lupulina*
- Ecosystems in four dimensions: Measuring changes to forest structure and function in the Anthropocene
- Environment as a selective force on plant reproductive traits
- Evaluating the contribution of symbiotic microbes to reproductive isolation of vertebrate populations
- Evolution of social behavior in *Bolitotherus cornutus* (forked fungus beetle)
- Evolutionary plasticity in *Daphnia*
- Flora of Mountain Lake Biological Station
- Foliar traits and terrestrial ecosystem variability across NEON domains
- Forked fungus beetle behavioral research
- Global change impacts on microbiome mediated plant pollinator interactions
- Hormaphidine and Pemphigine aphids
- How multigenerational demography can elucidate mechanisms of local adaptation
- Infection and co-infection in *Peromyscus* mice
- Insect physiology
- Integrative and evolutionary biology of the dark-eyed junco
- Integrative taxonomic studies reveal four evolutionary species in Virginia populations of *Viola subsinuata*
- Investigating latitudinal trends in specialist and generalist strategies in the legume-rhizobia mutualism
- Juvenile hormone activity in young nymphs of *Cryptocercus punctulatus*
- Landscape genomics of American chestnut: Conserving genetic diversity for climate change resiliency
- Male strategic allocation in sperm and ejaculate in response to energetic constraints and female quality in harvestmen
- Maternal behaviors as drivers of family-level response to selection
- Maternal effects and mating system evolution in American bellflower
- Mating system evolution in *Leiobunine* harvestmen
- Measuring intra-locus sexual conflict across the genome
- Measuring pre-copulatory behaviors in forked fungus beetles
- Mechanistic Niche Modeling and Physiological Evolution of Plethodontid Salamanders
- Molecular correlates of Sin Nombre Virus tolerance in co-infected hosts
- Multispecies interactions in an *Asclepias* hybrid zone: Trade-offs between attraction and defense
- Multispecies interactions: Milkweeds, pollinators and herbivores
- National Ecological Observatory Network
- Peer effects in STEM
- Phenological LAI and multitemporal forest ecosystem physiology
- Phylogenetic relationships within *Monotropa*: Is *M. brittonii* distinct?
- Phylogeography and species delimitation in North American *Castanea*
- Pine bark adelgid on red spruce and white pine
- Pollination biology of *Rhododendron viscosum*
- Population genetics of the northern gray-cheeked salamander (*Plethodon montanus*)
- Population variation in overwintering success of gypsy moth
- Proactive risk assessment to the next amphibian threat: Understanding salamander susceptibility to Bsal
- Redescription of the water bear species *Echiniscus virginicus Riggins* with an assessment of genetic and morphological variation
- Redirecting directed dispersal in a myrmecochory hotspot
- Relationship between skin chemistry and microbiome diversity in Appalachian salamanders
- Reproductive ecology of flame and swamp azaleas
- Role of prezygotic reproductive isolation in secondary contact of *Campanula americana*
- Seasonal and elevational differences in prevalence of vectors and pathogens associated with a sedentary population of juncos
- Sex steroid negative feedback variation in resident and migrant dark-eyed juncos
- Smithsonian BISON GGI project
- Soil respiration in various overstory and understory communities
- Sugar feeding ecology of mosquitoes
- Survey of Allegheny woodrat in Virginia
- Taxonomic studies of violets in the Appalachian Mountain region
- Updating, curating and promoting biological collections at MLBS
- Using natural history collections to understand the herpetofaunal diversity of MLBS and the surrounding region
- *Vaccinium*, *Ribes*, *Rubus*, and *Fragaria* germplasm research

A list of publications related to MLBS are housed in a searchable [RefWorks database](#).