Breedlove, Dennis Fund
Awards for Student Botanical Field Experiences

Fiscal Years 2018 – 2022

Report prepared by the University of Tennessee – Knoxville Herbarium (TENN)
Margaret Oliver and Jessica Budke

PhD student Eric Shershen recording field data in the Great Smoky Mountains National Park (photo by Susanna Diamond, Summer 2021).

Contents

Fiscal Year 2018 Awards

Graduate Students

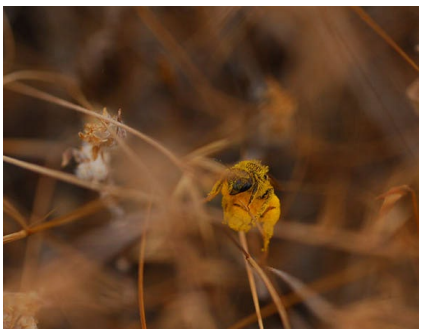
Amanda Benoit

2nd year PhD student in EEB

Summary:

- Objective: Determine how crab spiders affect plant-pollinator interactions, plant reproduction, and phenotypic selection on floral traits of the emblematic west coast endemic *Calochortus luteus* (Liliaceae).
- Conducted pollinator observations of 90 paired plants randomly assigned to a crab spider present or absent treatment.
- Found that pollinators avoided flowers which harbored crab spiders. Plants in the crab spider present treatment received 60% fewer pollinator visits than crab spider-free control plants.
- Pollinators that did visit flowers, which harbored crab spiders, reduced their visit duration by 61%.
- Despite reduced pollinator visitation, plants that harbored crab spiders produced more seeds than crab spider-free plants. This increase in seed set despite reduced frequency and duration of pollinator visits, suggests that crab spiders may mediate self-pollination of *C. luteus* flowers.
- In the field I observed crab spiders with pollen grains on their legs and bodies as well as crab spiders moving across plant stigmas as they hunted. If crab spiders mediate self-pollination, they could cause inbreeding depression and affect plant population genetics.
- I am currently working on a follow-up greenhouse experiment to determine if offspring from crab spider-harboring plants are more inbreed and less fit then offspring of crab spider-free plants.
- This award helped fund the collection of data that will contribute to three chapters of my dissertation, which will be published in peer-reviewed journals.
- These data were also included in the following presentation:

  Benoit, A., and S. Kalisz. 2019. Indirect effects of predators on plant-pollinator interactions, plant reproduction, and phenotypic selection. Ecological Society of America, Louisville, KY.



Jonathan Dickey
1st year PhD student in EEB

Summary:

- Initial research addressed how belowground nutrient based microbiome interactions with *Salvia lyrata* can affect aboveground higher trophic mutualisms, like the association with pollinators, and the plant fitness consequences that may follow.
- Objective: How does soil microbial community dissimilarity associated with *S. lyrata* correlate with population level variation in floral morphology (flower abundance, inflorescence biomass, corolla tube length) and phenology? How does bacterial community richness and abundance correlate with plant fitness?
- Rhizosphere sampling occurred from May-June 2018 in the Cherokee National Forest in Eastern Tennessee.
- Currently analyzing results; however, it's expected that lower microbial functional diversity in the soil rhizosphere will reduce protection from pathogens and limit the availability of vital nutrients causing a negative feedback on aboveground plant fitness and flower phenology.
- Anticipate that with lower concentrations of nitrogen in the form of ammonia or ammonium, available carbon, and potassium in the soil, that a more functionally redundant microbiome community will coexist with *S. lyrata*.
- This research has led to other inquiries regarding the spatial structure of bacterial and fungal richness within the rhizosphere of *S. lyrata*.
- This data supported a poster presentation on the spatial structure of *S. lyrata* at the 2019 Ecological Society of American annual meeting.
- This data is supporting a manuscript titled "Bacterial communities of the rhizosphere explained by spatial structure and sampling grain," which is in review for publication.

Jayne Lampley

4th year PhD Candidate in EEB

Summary:

- Made several field trips over two spring seasons in order to complete the sampling necessary to finish a portion of my study on the phylogenetic relationships and spatial distribution of populations of *Trillium lancifolium* among multiple watersheds of the southeastern US.
    - Included trips in Tennessee, Mississippi, Alabama, and Georgia (Montgomery, AL, Tullahoma, TN, Chattanooga, TN, Hardin Co., TN, S. Pittsburg, TN, Rising Fawn, GA, and Hoover, AL).
- Collected *T. lancifolium* vouchers and made DNA extractions from enough populations of every watershed in which the species occurs in order to make population-level analyses and to compare population relationships among watersheds.

- Collected vouchers of other plant species at *Trillium* population sites both to add to the herbarium and to make record of *Trillium* associates.
- Collected from more *T. cuneatum* populations to enhance the analysis in that part of the study
- Was able to use some of the fresh samples collected during field work to perform microscopic studies to look for clear morphological differences which could be used as field characteristics to separate new species.

- Currently working on manuscripts and finishing up analyses in these projects.
- This award helped support the collection of 67 new herbarium specimens deposited in the TENN herbarium.
- These data were included in the following publications and presentations:

  Missouri Botanical Garden Annual Fall Symposium, October 13, 2018, St. Louis, MO – Jayne Lampley – A phylogenetic and population study of *Trillium lancifolium* (Melanthiaceae) and allies using chloroplast DNA to explore species diversification among watersheds of the southeastern US (Poster).

  Botany 2018, Rochester, MN – Jayne Lampley – Role of river watersheds on diversification and endemism in native plant species: A phylogeographic study of *Trillium lancifolium* (Melanthiaceae) (Talk).

Chloe Lash

3rd year PhD student in EEB

Summary:

- Focuses on the incorporation of microbes into myrmecochory (ant seed dispersal), which has traditionally been viewed as a simple pairwise mutualism.
- Objectives: 1) identify the microbial community of seed-dispersing ant nests; 2) identify changes conferred to the microbial community of seed coats by seed-dispersing ants.
- Collected soil and decaying woody debris samples from active ant nests and control substrate one meter away.
- Extracted DNA from the samples and with the assistance of the UTK Genomics Core, prepared them for Illumina Miseq sequencing.
- Have found that the fungal communities in ant nests are primarily driven by substrate type (soil or decaying woody debris) and that ant activity influences the pathogenic fungal community turnover in the nest, particularly animal pathogens.
- I utilized funds to investigate effects of ant handling on the microbial community on seed coats.
- I collected seeds from 16 of both Bloodroot (*Sanguinaria canadensis*) and Wild Ginger (*Asarum canadense*) fruiting plants and divided seeds into 3 treatments of 0.5 grams of seeds each.
- Treatments included: control seeds with elaiosomes (fleshy seed coat derived appendage), control seeds without elaiosomes (which were sterilely manually removed), and ant handled seeds (ants were allowed to interact with seeds for 4 days). I am currently processing the data.
- This award helped fund the collection of data that will contribute to two chapters of my dissertation, which will be published in peer-reviewed journals.
- These data were also included in the following publications and presentations:

  Lash, C.L., and C. Kwit. 2019. Ants, Plants, and Pathogens: Ant nest provide a safe location with different plant pathogen communities for dispersed seeds. In prep for *Oecologia.*

  Lash, C.L., M. Cregger, and C. Kwit. 2019. Ants alter the seed coat microbiome. In prep for TBD.

  Lash, C.L., and Kwit, C. 2019. Ants, plants and fungi: Active ant nests remain low in plant pathogenic fungi throughout the myrmecochore fruiting season. Entomological Society of America Annual Meeting.

  Lash, C.L., M. Cregger, and C. Kwit. 2020. Ants alter the seed coat microbiome. Ecological Society of America 2020, planned for 2-7 August 2020.

Undergraduate Students

Vanessa 'Rosy' Harpe and Jackson Turner

V. Harpe graduated spring 2019, Biology major – EEB concentration
J. Turner anticipated graduation spring 2021, Biology major – EEB concentration

Summary:

- Surveyed the root-associated fungal communities of five host plants in each of twenty locations in the Great Smoky Mountain National Park (GSMNP) and surrounding urbanized areas in Gatlinburg, TN.
    - Locations ranged in burn severity following the 2016 Chimney Tops II fire, from severely burned to unburned.
- Overall, decomposer fungal abundance in soils decreased as a function of burn severity, with the highest burn severity sites have fewer decomposers than unburned sites.
- Similarly, symbiotic fungal abundance decreased in abundance within plant roots.
- Plant composition shifted following fire and symbiotic fungal abundance varied among plant hosts.
- Symbiotic fungi are likely to respond to fire indirectly via shifts in the abundance of their plant hosts while decomposer fungi are likely to be directly affected by fire decreasing available substrates in the soil.
- This work is of public importance for several reasons: 1) Symbiotic fungi were sensitive to fire suggesting that ecosystem nutrient flows may be disrupted following fires in southeastern temperate forests. 2) Decomposer fungi declined following fire. The decline in abundance of decomposer fungi following fire may lead to lower decomposition rates and thus a higher accumulation of litter to fuel future fires.

Isabella 'Bella' Ritchie

Biology major – EEB concentration
Graduated fall 2019

Summary:

- Surveyed native and non-native plant species of Fort Dickerson (91-acre historical park in Knoxville).
    - Made 12 collecting trips during the spring, summer, and fall of 2018
- Collected 223 specimens, which have been pressed and will be deposited at TENN once the full project is complete.
- Documented new species for Knox County (*Alliaria petiolate, Ligustrum quihoui*) as well as non-native species that are considered invasives (*Albizia julibrissi, Euonymus fortunei, Hedera helix, Ligustrum sinense, Lonicera maackii, Paulownia tomentosa, Pueraria montana*).
- Participated in all aspects of the project: field collection, identification of specimens using dichotomous keys, and pressing plants for voucher specimens.
- This award helped fund the collection of data that will be published in a peer-reviewed journal on the flora of Fort Dickerson.

Fiscal Year 2019 Awards

Graduate Students

Mali Hubert

2nd year PhD student in EEB

Joint award with undergraduate student:

Kaitlyn Meadows

Biology major – EEB concentration

Anticipated graduation: Spring 2022

Summary:

- Objective: address the knowledge gap between the combined effect of urbanization and wildfire on plant communities in the wildland-urban interface [area where houses meet or intermingle with undeveloped vegetation].
    - Particularly the native plant communities across a fire gradient (from low to high severity), in both exurban (Gatlinburg) and natural (Great Smoky Mountains National Park) conditions.
- Addressed the following hypotheses:
    - Hyp. 1) The plant communities after the fire disturbance will have higher plant diversity among lower fire severities and in the natural site locations.
    - Hyp. 2) The fire disturbance generates more diverse patterns of species composition in relationship with lower fire severity in the wildland-urban interface.
    - Hyp. 3) Plant species diversity increases through time across the fire gradient and among the natural and exurban locations.
- Identified a total of 223 species over the 20 sites sampled across a two-year period
- Results suggest that plant community composition and diversity is changing in relation to fire severity and urbanization within the wildland-urban interface.
    - Plant communities are more diverse in areas with low/medium fire severity and in exurban locations, supporting the first portion of Hyp. 1; (ii) plant type is mostly evenly distributed throughout the fire gradient and between the locations, but is variable among the two sampling years, thus rejecting part of Hyp 2; and (iii) plant richness and abundance have been negatively affected through time by the fire severity, supporting Hyp. 3.

Jacob Moutouama
1st year PhD student in EEB

Summary:

- Objective: understand center periphery population dynamics using *Thunbergia atacorensis* (Acanthaceae), an endemic and very rare West-African plant, as a study species.
    - The center periphery population theory assumes that species reach their higher abundance in the center of their range and then decrease in abundance at the periphery.
- Identified 12 natural populations across the distribution of the species.
- Randomly installed five 5x5m plots in every population, collected the species densities, and demographic data.
- Found that densities of *T. atacorensis* were higher at the center of it distribution but also higher at the periphery.
    - *T. atacorensis* does not display the center periphery population dynamics.
    - Species density decreases with an elevation gradient.

Undergraduate Student

Jordan Reed

Biology major – EEB concentration
Anticipated graduation: 2020

Summary:

- Objective: investigate the relative importance of fire disturbance on plant functional plant traits in the *Solidago* species.
- Wildfire that began in the GSMNP in November 2016 presented a rare opportunity to examine how fire affects plant structure and function along a burn gradient in the southeastern U.S., from no fire, to low/medium to high burn severity.
- This study yielded significant differences across sites
    - Unburned site revealed to have the greatest rates of herbivory at 41.4%, when compared to low/medium burn (29.3%) or high burn (27.7%) sites.
    - Low/medium burn site exhibited a 13.7% increase in specific leaf area – a means to estimate growth rates - when compared the unburned and high burn sites, however, leaves collected at the high burn site showed a 40% increase in weight.
- Fire may reduce rates of herbivory, as well as increase aspects of plant growth in the years after fire.

Fiscal Year 2020 Awards

Graduate Students

Alessandra 'Alex' Aromin

Masters in EEB
Graduated 2021

Summary:

- Objective: Examine the tradeoff in structural maternal investments to better understand how different moss species have evolved to protect their offspring using the calyptra (a protective structure that originates from the maternal plant and its main function is to protect the offspring from environmental stress like dehydration).
    - The calyptra is covered in a cuticle, which impacts the overall survival and fitness of the offspring. Therefore, a way to quantify maternal investment is by measuring cuticle thickness.
    - We predict that species with smooth calyptra will have a relatively thick cuticle and species with hairy calyptra will have a relatively thin cuticle.
- Collected species around east Tennessee as well as out of state.
    - Located and collected species that produce shorter offspring, *Orthotrichum anomalum* and *Orthotrichum pusillum* (Cropseyville, New York) and taller offspring, *Polytrichum alpinum* and *Atrichum angustatum* (east Tennessee).
- This award helped support the collection of 8 new non-vascular herbarium specimens and 10 other specimens that will be deposited in the TENN herbarium.
- This award helped fund the collection of data that will contribute to my thesis, which will be published in peer-reviewed journals.

Ben Holt

3rd year PhD student in EEB

Summary:

- Objective: Determine if there is a quantitative relationship between the prevalence of *Hedera helix* (English ivy) and *Euonymus hederaceus* (wintercreeper) and the abundance of the native salamander *Plehodon ventralis* (southern zig-zag salamander)
- Set up 15 paired plots (total of 30 plots) in invaded or non-invaded areas and sampled each plot three times from December 2020 to April 2021. Each plot was surveyed for 10 minutes.
- Salamanders were detected in 12/30 (40%) of the plots, with 6/15 non-invaded plots containing salamanders and 6/15 invaded plots (however, all 12 occupied plots only represented 6/15 pairs). All but two of these twelve plots had salamanders detected in multiple sampling periods. There was no significant difference in the detection or abundance of salamanders captured between plot types. Abiotic characteristics (soil pH, leaf litter depth, temperature, and relative humidity) were also collected at each site, since invasive plants can alter soil physicochemical properties.

- Significant differences were observed in leaf litter depth between invaded and non-invaded plots ($p < 0.01$) and differences in number of cover objects* (*due to trail maintenance, which moved a large number of cover objects in and out of plots, we had to neglect this statistical comparison). Reduction in leaf litter depth and cover objects could shift arthropod communities or reduce suitable habitat, which could limit salamander foraging opportunities or impose locomotory challenges, something that's hoped to be addressed in future studies.
- Results show the presence of invasive groundcover dramatically reduces leaf litter depth compared to adjacent uninvaded plots. However, the failure to detect salamanders in 60% of plots prevents the drawing of definitive conclusions regarding the complex relationship between invasive groundcover and salamander habitat utilization. That said, this study provides critical preliminary information for future studies. This project would not have been possible without the assistance of 7 undergraduate/graduate students.

Eric Shershen

1st year PhD student in EEB

Summary:

- Objective: Revisited biodiversity plots within the spruce-fir zone of the Great Smoky Mountains National Park from a 2008 study in order to examine how the species composition of bryophytes in spruce-fir forests may have changed over time.
- Resampling showed a drastic decline in biodiversity across 38 of 44 of the plots, with four plots increasing slightly in biodiversity
    - Identified specimens collected to species level, which will be deposited in the TENN herbarium with the National Park Service's permission
- Analyzing the change in species composition and evenness of the plots to determine which, if any of the species are in decline or if the decline is indiscriminate.
    - Examine what the physiological tolerances of several species are to UV light, temperature, and moisture to determine what is causing species decline in abundance and percent cover, which will allow land managers to better understand what is required to preserve the mosses, and consequently the biodiversity of the Spruce-Fir zone
- This fieldwork set the foundation for Eric's dissertation

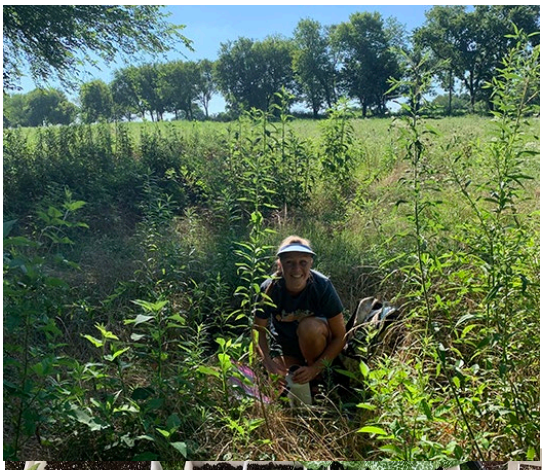
Rachel Swenie
3rd year PhD student in EEB

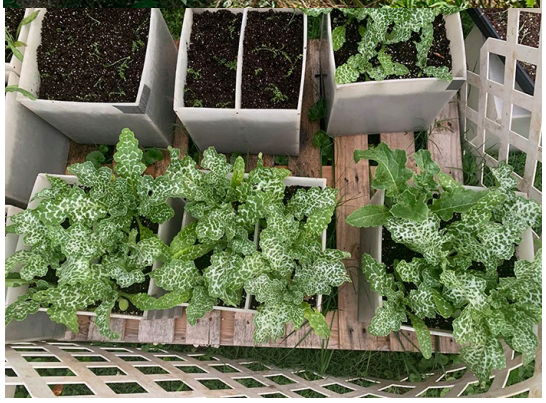
Summary:

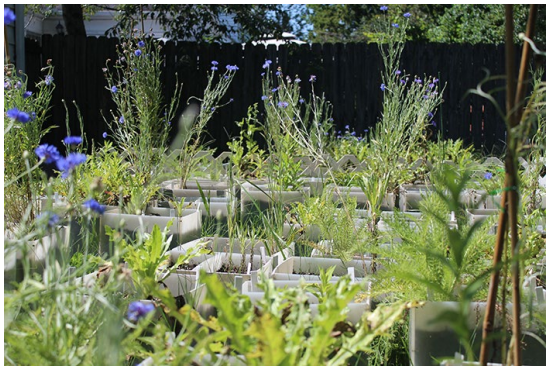
- Objective: With an estimated 2.2–3.8 million species, fewer than 10% of which have been studied and named, fungi are an extremely diverse group of organisms. Rachel's research focuses on the fungal order Cantharellales, which contains approximately 1,000 species, including the popular edible chanterelle mushrooms, as well as crop pathogens, lichenized fungi, and orchid associating fungi.
    - A large but understudied portion of Cantharellales species are corticioid fungi which produce simple, flat reproductive structures on wood and soil
- Objective: Collect specimens of corticioid Cantharellales fungi from across the southern Appalachian Mountains for DNA sequencing
- Collected 49 fungal specimens from field sites in Tennessee, North Carolina, and Virginia
    - All specimens are accessioned and deposited at the TENN herbarium
- Analyzing DNA sequence data from these specimens along with data from other, non-corticioid Cantharellales specimens previously collected to understand which features of these fungi may drive species diversity within the order

Sophia Turner

1st year PhD student in EEB







Summary:

- Objective: Examine the role of direct and indirect multi-species interactions on plant performance by testing how soil microbial communities, pollinators, and herbivore interactions impact plant function of native and invasive species.
    - Examine how non-native species alter the growth and performance of native plants
    - Examine how non-native species indirectly alter the structure and function of the above- and belowground communities associated with a native plant
    - Examine how these simultaneous interactions alter net plant performance
- Originally meant to conduct field surveys of *Cirsium vulgare* in the Oak Ridge National Laboratory's protected area, Freels Bend, and collecting voucher specimens to be deposited in the TENN herbarium, but COVID-19 resulted in necessary adaptations
- May 2020, set up a common garden experiment using the widespread and ecologically important native species Goldenrod and three non-native plants
    - The non-native: Yarrow *(Achillea millefolium)*; a monitored non-native, Blue cornflower *(Centaurea cyanus)*; and a noxious invader, Milk thistle (*Silybum marianum)*
    - Grew Goldenrod with and without each non-native plant and measured plant traits (height, leaf area and aboveground biomass), using divided pots (to impede competition) and non-divided pots (allowing the species to interact and compete)
- Preliminary data show that the relative growth rate of Goldenrod is reduced when growing with non-native species
    - Interestingly, Yarrow grows significantly better in non-divided pots, suggesting it is either able to outcompete Goldenrod, or since it is a naturalized species, has adapted to a local soil microbiome

Undergraduate Students

Keilah Carter

Biology major – EEB concentration
Graduated 2020

Summary:

- Objective: Examine plant species richness, plant species abundance, species evenness, soil pH, and soil nutrient content at riparian zones across an urban to rural gradient of central Tennessee
    - Use a 1 x 1 meter quadrat to count number of species, number of individuals of each species, and collect voucher specimens to confirm identification (deposited at the TENN herbarium)
    - Collect soil temperature, moisture, and soil samples from each site
- Preliminary results indicate differences in community differences across the urban to rural sites
- This research served to give a glimpse into how urbanization may be affecting native Tennessee species locally.
    - "Thanks to the Breedlove, Dennis Fund, this project has prepared me as a recent EEB graduate to develop into professional botanical work and has led to more inquiries on how urbanization effects local ecosystems at small and large scopes."

Joanna Huntoon

Biology major – EEB concentration

Summary:

- Objective: Examine the seed dispersal methods of the winter-fruiting invasive shrubs *Rhamnus davurica* and *Ligustrum sinense* by deploying seed traps within Knoxville's Urban Wilderness areas and collecting bird fecal samples from the traps
- Documented populations of of *R. davurica* and *L. sinense* in Knoxville's Urban Wilderness and deposited several voucher specimens at the UTK Herbarium
- COVID-19 and the subsequent closure of the UTK campus partway through the spring 2020 semester unfortunately disrupted Joanna's project

Fiscal Year 2021 Awards

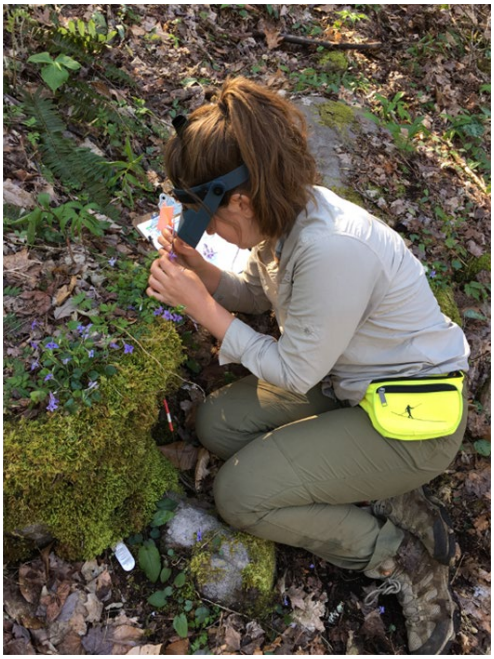
Graduate Students

Alexandra 'Alex' Faidiga

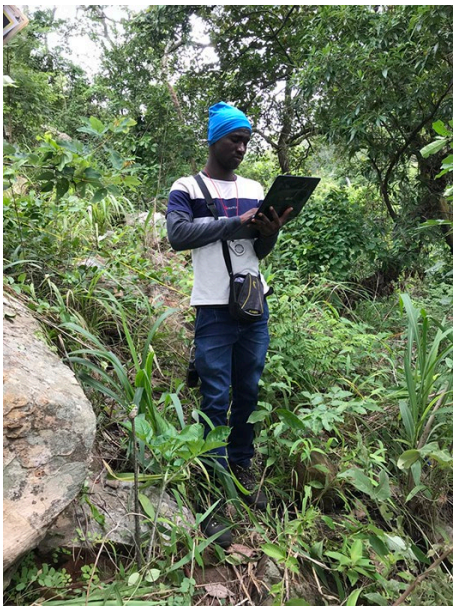
Masters in EEB
Graduated 2021

Summary:

- Objective: Examine whether phenological mismatch among *Viola rostrata*, its pollinators, and overstory canopy leaf out reduces *V. rostrata fruit* and seed set in early spring
- Used photosynthetically active radiation (PAR) and air and soil temperature sensors to monitor abiotic conditions in the understory of field sites in the southern Cherokee National Forest
    - Data used to understand the progression of canopy leaf out across the growing season of *V. rostrata*
    - Provide baseline light and temperature settings for growth chambers in a greenhouse experiment performed by two undergraduate researchers investigating the additive effects of herbivory and rising temperatures on *V. rostrata* reproductive success and physiology
- Results will reveal capacity for this early spring-flowering understory species to adapt to a multitude of stressors associated with global change including drought and heat stress, reduced light availability in early spring, and reduced pollinator visitation as a result of phenological mismatch



Jacob Moutouama
3rd year PhD in EEB



Summary:

- Objective: Understand the effects of insect herbivory on the dynamic *Thunbergia atacorensis*, an endemic perennial herb in West Africa
    - How does insect herbivory vary from center to the periphery of a *Thunbergia* population? How does herbivory variation prevent a *Thunbergia* populations from expanding beyond its range limits?
- Collected demographic data and herbivory rate in 12 natural populations of the species from June to August 2021
    - Identified the two main insect herbivores of *T. atacorensis,* specialist herbivore, *Filodes costivitralis*, and more generalist *Philopona aburiensis*
- Across all populations, most herbivory was a result of the larvae of the specialist *F. costivitralis*
- No significant variation was observed in the herbivory rate between the center and periphery of *T. atacorensis* populations, as a result of the ecological conditions being similar
- Conservation should focus on both peripheral and central populations, since one is not necessarily more vulnerable to herbivory than the other
- Publication: Moutouama, J.K. and O.G. Gaoue. 2022. Altitude-mediated soil properties, not geography or climatic distance, explain the distribution of a tropical endemic herb. *Ecology and Evolution* 12:e8572. https://doi.org/10.1002/ece3.8572

Eric Shershen

2nd year PhD in EEB

Summary:

- Objective: Use iButtons to define the niche of selected species of bryophytes within revisited biodiversity plots in the spruce-fir zone of the Great Smoky Mountains National Park from a 2008 study
    - iButtons are tiny data loggers to measure temperature and humidity
- Deployed iButtons across 20 plots, which logged data through spring 2022
- Mentored and worked with undergraduate Susanna Diamond

Undergraduate Students

Susanna Diamond

Biology major – EEB concentration
Anticipated graduation: Fall 2022

Summary:

- Objective: Examine how tree communities have changed over time by analyzing canopy cover and tree composition of the spruce-fir zone in the Great Smoky Mountains National Park and comparing it to previous studies and herbarium records
    - Visited previously established plots from a 2008 study and followed established methods involving the use of fisheye photos to determine canopy cover percentage
    - Worked in conjunction with PhD student Eric Shershen
- Conducted paired t-tests with 2008 study data and our 2021 data and found no significant difference in canopy cover
- Future analyses:
    - Calculate gap fraction by separating plots into high, medium, and lower elevation zones
    - Determine the underlying community composition of each zone

Fiscal year 2022 Awards

These projects were funded during fiscal year 2022, and are ongoing.

Graduate Students

Caitlin 'Cait' Barnes

1st year PhD student in EEB
Final report due: October 2022

Objective: Understand how changes in aboveground tree diversity affects belowground microbiome function via metabolomics, then determine which facets of biodiversity influence ecosystem functions.

Cait will collect soil samples from two large-scale, experimental manipulations of tree diversity and tree mycorrhizal associations in the BiodiversiTREE and SERC chronosequences plots at the Smithsonian Environmental Reseach Center in Edgewater, Maryland and in the BiodiversiTREE plots at the Smithsonian Conservation Biology Institue in Front Royal, Virginia. She will later sequence the microbiome (fungi and bacteria) and characterize the soil metabolome.

Nicole Lussier

2nd year PhD student in EEB
Final report due: October 2022

Objective: Utilize mutualistic seed dispersal interactions in an ecological network framework to examine what restoration alternatives work to target seed-dispersing animals, and how this improves reforestation outcomes.

Nicole will visit the Fundacion para la Conservacion de los Andes Tropicales (FCAT) in the Choco tropical rainforest of Northwest Ecuador where she will utilize pre-established sampling plots distributed across three categorical habitat types: (1) reforested land; (2) neighboring agricultural land; and (3) mature forest. To create seed dispersal networks, she will use an integrative approach that utilizes both field methodology (camera traps, mist-netting birds and bats to collect intact seeds from scat, vegetation and scat sampling to search for intact seeds in scat) with molecular techniques (DNA barcoding) and computational analysis (network analysis in R). Nicole will also be working alongside and mentoring undergraduate students Colton Adams and Jacob Woodlief.

Chance Noffsinger

3rd year PhD student in EEB
Final report due: November 2022

Objective: Understand how nitrogen deposition and other edaphic factors vary across the spruce-fir ecosystem in the Southern Appalachian Mountains and how this will affect fungal community diversity.

Chance will sample 60 plots in North Carolina and Virginia, which will extend his sampling from summer 2021 to match the geographic distribution of Fraser fir. Between July and September 2022, he will randomly select 60 one-meter square quadrats from all sampling locations. Each quadrat will have soil cores from every corner and the center, which will be combined into one sample. Needles from the closest mature Fraser fir will also be collected from each quadrat.

Eric Shershen

3rd year PhD student in EEB
Final report due: October 2022

Objective: Continue data collection to examine the distribution of bryophytes across time in the spruce-fir zone of the Great Smoky Mountains National Park.

Eric will be visiting his field sites in the Great Smoky Mountains National Park to download data from iButtons he deployed in the field during 2021, replace any iButtons that are missing or destroyed due to wildlife interference, as well as increase his sampling by distributing additional iButtons to more sites.

Undergraduate Students

Colton Adams

Biology major – EEB concentration
Anticipated graduation: Spring 2023
Final report due: October 2022

Objective: Analyze mutualistic interactions generated by frugivorous birds and fruiting plant species in an Ecuadorean forest undergoing various restoration treatments.

Colton will visit the Fundacion para la Conservacion de los Andes Tropicales (FCAT) in the Choco tropical rainforest of Northwest Ecuador with graduate student Nicole Lussier and undergraduate Jacob Woodlief. He will set up study plots in four categorical habitat types in four categorical habitat types: 1) area reforested with a high diversity of tropical hardwood seedlings anchored by frugivore friendly pioneer species; (2) area reforested with a high diversity of tropical hardwood seedlings with wind-dispersed pioneer species; (3) area reforested with balsa, a locally important timber species, with frugivore friendly pioneer species; and (4) area reforested with balsa and wind dispersed pioneer species.

Jacob Woodlief

Biology major – EEB concentration
Anticipated graduation: Spring 2023

Final report due: October 2022

Objective: Examine the effects of different types of land use on species diversity in tropical regions.

Jacob will visit the Fundacion para la Conservacion de los Andes Tropicales (FCAT) in the Choco tropical rainforest of Northwest Ecuador with graduate student Nicole Lussier and undergraduate Colton Adams. He will compare species diversity across the reserve in pre-established plots across four categorical habitats, those being the undisturbed old growth forest, restored agricultural land, restored logged land, and restored residential land.

Herbarium Excursions

Rock Island State Park

Warren County, TN
18 May 2019

Summary:

- *Palamocladium leskeoides* (Hook.) E. Britton is a moss on Tennessee's Rare Plant List (https://www.tn.gov/content/dam/tn/environment/documents/na_rare-plant-list-2016.pdf)
- The last known collection in the state was made by D.K. Smith in 1992 from Savage Garden in Anderson County, TN and this species has not been collected from Rock Island State Park in Warren County since 1979.
    - Todd Crabtree, TN state botanist, relocated a potential population of *P. leskeoides* at Rock Island State Park in 2009, but was unable to confirm the identification in the field.
- Herbarium Director Jessica Budke, Collections Manager Margaret Oliver, and Emeritus Lecturer Ken McFarland accompanied undergraduate student Rosy Harpe and state botanist Todd Crabtree on a trip to Rock Island State Park on May 18, 2019 to relocate the population and collect a couple voucher specimens, if possible.
- We successfully located a single extant population of *P. leskeoides* among large, shaded boulders along the southern edge of the Caney Fork.
    - Ken McFarland confirmed the identification under a microscope at the herbarium.
    - Two voucher specimens from this trip have been deposited in TENN.
- We observed large patches of the invasive plants *Deutzia scabra* and *Euonymus fortunei* growing over boulder surfaces that could otherwise be suitable habitat for *P. leskeoides* and are planning a future collaboration with the state park to assist in removal of these invasive species.
- Jessica Budke gave an oral presentation about our trips and preliminary findings at the annual meeting for the TN Plant Conservation Alliance (TPCA) held in Nashville on 11 February 2020.
- Although field work originally planned for April of 2020 has been postponed due to COVID-19, we still plan to visit two more likely sites for *P. leskeoides*: Savage Gardens near Lake City, TN in Anderson County and along the Sequatchie River in Marion County.

Big South Fork National River and Recreation Area

Rugby, Morgan County and Burnt Mill Bridge, Scott County, TN
22 June 2019

Summary:

- *Boldia* is a genus of freshwater red algae that is primarily found in the southeast United States.
- Amanda Benoit, the herbarium graduate RA for the spring 2019 semester, worked on curating and databasing the TENN macroalgae collection that had gone unused in a taped-shut herbarium cabinet for many years.
- Emeritus professor Ray Holton semi-regularly checks for the occurrence of *Boldia* by the Burnt Mill Bridge in Scott County, TN but has not collected any in a few years.
- Collections Manager Margaret Oliver with undergraduate students Rebecca Atkins, Joanna Huntoon, and Ryan Vichich, graduate student Amanda Benoit, and UTK staff member Daniel Siksay visited Rugby and Burnt Mill Bridge, TN on 22 June 2019 to search for, and potentially collect, *Boldia* from the Clear Fork inside Big South Fork National River and Recreation Area.
- Due to heavy rainfall over the previous days the river ended up being too high to find any of the algae, but we did get a chance to hike several trails and to botanize widely in the field.

Hiwassee River

Reliance, Polk County, TN
15-17 August and 28 September 2019

<u>Summary:</u>

- *Isoetes tennesseensis* (Tennessee or Hiwassee quillwort) is a 'fern ally' that is listed as endangered in the state of Tennessee and has a historic distribution that includes the Little Tennessee, Monroe Co. and Hiwassee River, Polk Co.
    - It has not been observed in the Little Tennessee River since the Tellico Dam was finished in 1979.
    - The last known collections were from the type locality in the Hiwassee River near Reliance, TN in 2001.

- Two trips to Reliance, TN were made towards the end of the summer of 2019:
    - 15-17 August – Herbarium Director Jessica Budke, Collections Manager Margaret Oliver, undergraduate students Joanna Huntoon and Helen Law, and herbarium volunteer Lynne Davis.
    - 28 September – Jessica Budke, Margaret Oliver, and undergraduate students Anna Raney and Ryan Vichich.

- Over both trips we surveyed almost five miles of the Hiwassee River and found 87 individuals of *I. tennesseensis* at various life stages.
    - We collected two voucher specimens, which are now deposited at TENN.
- We made a brief trip to the historical sites in the Little Tennessee River:
    - One is no longer easily accessible due to the construction of a gated community and a boat would be necessary to access the site.
    - The second location is near a public boat ramp, but the water now appears to be too deep due to the impoundment of the Tellico Lake.

We have been unable to conduct herbarium excursions with students since our trips to the Hiwassee River in the first half of fiscal year 2020 due to Covid-19. We are looking forward to being able to responsibly lead students on botanical fieldtrips again in the future.