Park Science Colloquium **Schedule**

March 5, 2026 — Turner Building Auditorium, Arrowmont School of Arts and Crafts, Gatlinburg, TN and on Zoom — co-hosted by Great Smoky Mountains National Park and Discover Life in America — free and open to the public — dlia.org/2026-colloquium

9:00	*Meet and greet with coffee and snacks*
9:15	Welcome and introductions — *GRSM & DLiA leadership*
9:25	Accelerating biodiversity discovery in the Smokies with macrophotography, computer vision, and community science — ***Douglas Bruce*** *(amateur naturalist), Melinda Fawver*
9:45	Monitoring Amphibian Diversity in GRSM with Environmental DNA — ***Brendan Reid*** *(Université de Namur, Belgium), Aaron Aunins, Will Kuhn, Erin Canter, Eugenia Naro-Maciel*
10:05	Visitor Perceptions on Campground Light Brightness Levels in GRSM — ***Kristen Caldwell*** *(Penn State), Morgan Crump, Kerrick Taff, Jim Renfro, Adam Beeco, Jeremy White, Kelsey White*
10:25	*15-minute break*
10:40	A Stream Come True: Restoring Fish and Mussels in Abrams Creek — ***Matt Kulp*** *(GRSM), Julianne Geleynse, Caleb Moses*
11:00	Exploring NPS Staff Perceptions of Artificial Light in GRSM: Functionality, Safety, and Conservation — ***Rachel Nelson*** *(Penn State), Derrick Taff, Morgan Crump, Peter Newman, Jim Renfro, Jesse Barber, Adam Beeco, Jeremy White*
11:20	High-resolution digital archiving of two historical structures in GRSM using terrestrial LiDAR — ***Yingkui Li*** *(UTK), Tim Kane, Andrea Potgieter, Casey Shea, Tyler Musante, Collin Davis, Hope Hutchinson*
11:40	Blow Flies (Diptera: Calliphoridae) as a Biological Monitor of Wildlife Pathogens in GRSM — ***Makhali Voss*** *(UTK), Richard Gerhold, Charity Owings*
12:00	*1-hour lunch break (lunch on your own)*
1:00	COI Barcoding as a tool to improve parasitoid wasp taxonomy — ***James Marrin*** *(Farmingdale State College), Carly Tribull*
1:20	Rapid assessment of insect biodiversity in Cades Cove — ***Laura Russo*** *(UTK), Atticus Moore, Will Kuhn*
1:40	From Creek Beds to Confidence: How Experiential Place-Based Professional Learning Expands Teacher Perspectives on Place and Data — ***Amanda Garner*** *(UTK), Joshua Rosenberg*
2:00	*15-minute break*
2:15	Pseudoscorpion biodiversity in the Southern Appalachians — ***Charles Stephen*** *(Georgia State Univ)*
2:35	Microbiota — ***Sharon Bewick*** *(Clemson Univ)*
2:55	Diversity and endemism in some lesser-known litter arthropod groups — ***Michael S. Caterino*** *(Clemson Univ), Ernesto Recuero Gil*
3:15	Conclusions and farewell — *GRSM & DLiA leadership*

Affiliations shown for presenting author; see abstracts below for complete author affiliations. GRSM = Great Smoky Mountains National Park; DLiA = Discover Life in America; UTK = University of Tennessee, Knoxville.

Park Science Colloquium **Abstracts**

Sorted by the last name of the presenting author (in bold).

Microbiota

Sharon Bewick *(sbewick@clemson.edu)*

Clemson University, Georgia

Accelerating biodiversity discovery in the Smokies with macrophotography, computer vision, and community science

Douglas Bruce *(s137@earthlink.net), Melinda Fawver*

Amateur naturalists, Clinton, TN

The All-Taxa Biodiversity Inventory (ATBI) effort in Great Smoky Mountains National Park (GSMNP) has documented over 22,000 species so far, which is perhaps only 20% of the species present. Since Park management decisions depend on understanding the details of the Park's biodiversity, it is desirable to accelerate the discovery of the remaining undocumented species and their distributions. Documentation has traditionally been done by collecting specimens, and there are many advantages to this approach. However, with the growing availability of good digital macrophotography cameras, and the accessibility of expert review via websites like iNaturalist and BugGuide, documentation of some taxa can proceed much more quickly. Such photography can be accomplished even by amateur volunteers.

Visitor Perceptions on Campground Light Brightness Levels in Great Smoky Mountains National Park

Kristen Caldwell *(kmc7138@psu.edu)[1], Morgan Crump[1,2], Derrick Taff[1], Jim Renfro[3], Adam Beeco[4], Jeremy White[4], and Kelsey White[4]*

[1] Department of Recreation, Park, and Tourism Management, Penn State University; [2] Rubenstein School of Environment and Natural Resources, University of Vermont; [3] Air Resources Division, Great Smoky Mountains National Park, National Park Service; [4] Natural Sounds Night Skies Division, National Park Service

Artificial light at night (ALAN) plays a critical role in ensuring safety, comfort, and accessibility to park visitors. However, excessive ALAN, defined as the misdirected or invasive use of artificial light which alters natural nighttime levels can have adverse effects on human health, wildlife, and the ability to see the night sky. Approximately 99% of the continental U.S. population lives under night skies that are above the "polluted" threshold. National parks can provide refuge with some of the last remaining access to pristine, dark night skies. However, park infrastructure, such as campground comfort stations,can still significantly alter nighttime light levels. Modifying, upgrading, or reducing lighting systems can decrease the amount of light that escapes from directed areas, contributing to light pollution.

Great Smoky Mountains National Park, located in Tennessee and North Carolina, is the most visited National Park in the United States. This park offers a fairly dark night sky in the midst of light pollution exuded from nearby cities. Campground comfort stations, or restrooms, in at least two campgrounds in Great Smoky Mountains National Park utilize bright lighting which trespasses through windows and doors, unnecessarily illuminating parts of the campgrounds. Providing light at campground infrastructure can be a critical aspect of a visitor's experience in terms of safety, accessibility, and personal behavior. However, excessive lighting may disrupt camping experiences and diminish opportunities to view the dark night sky. This study aims to determine visitor thresholds for comfort station light brightness levels. Determining thresholds and preferences for light brightness levels in campground infrastructure can inform park managers on how to best balance visitor needs with dark sky protection. Research collection was conducted over summer 2025, across two sampling periods. This study examines visitor perceptions of current

brightness levels, lower intensity light with two dimmer settings, and no light conditions. Questions guiding this research are as follows: What light brightness level do visitors in campgrounds prefer? Do visitor characteristics (age, gender, primary zip code) influence their preference on brightness levels? What is the level of support that visitors have for lighting management decisions? Do levels of support vary by lighting condition experienced? Researchers utilized campground roving to administer surveys to visitors staying at each campground. Surveys evaluated lighting condition preference, feelings of safety, ability to find comfort stations, ease of use, wildlife impacts, management actions, and spillover effects. In conjunction with the visitor surveys, employee and campground host perceptions on lighting brightness levels were measured in August 2025. Data collection was administered with two maintenance staff and two campground hosts at Elkmont Campground and two maintenance staff at Smokemont Campground.

Findings from visitor surveys suggest that dimmer light brightness levels are somewhat preferred, with the no light being rated as the least preferable for visitors. The employee findings suggest that at Elkmont Campground, employees preferred a “middle ground” between the updated high and low settings, with an inclination to give staff the ability to alter lighting as they see fit with maintenance needs. At Smokemont Campground, employees expressed concern that no lighting may not be feasible, thus preferring a similar brightness level to the “middle ground” discovered at Elkmont. Overall, these findings will inform park managers with data to make informed decisions about lighting infrastructure, to best minimize ecological impacts while improving visitor experience.

Diversity and endemism in some lesser-known litter arthropod groups

Michael S. Caterino *(mcateri@clemson.edu)[1], Ernesto Recuero Gil[2]*

[1] Clemson University, Georgia; [2] Universidad Rey Juan Carlos, Spain

The leaf litter arthropod fauna of southern Appalachia is still far from well-known. Over the past several years, members of my lab group have described almost 70 new species, from various beetle families, as well as from some less popular groups, like isopods and millipedes. Our field sampling has emphasized the higher elevations, where cryptic diversity is particularly prevalent. But new discoveries are being made everywhere. In this talk I review some of our discoveries, recent and (hopefully) forthcoming, relevant to the Great Smoky Mountains, with a special focus on taxa that are even more poorly known than beetles.

From Creek Beds to Confidence: How Experiential Place-Based Professional Learning Expands Teacher Perspectives on Place and Data

Amanda Garner *(ahendr21@vols.utk.edu), Joshua Rosenberg*

University of Tennessee, Knoxville

Data plays an ever-growing role in society, shaping policy, influencing marketing, and guiding everyday decisions, making it more important than ever to provide students with opportunities to build data literacy. Place-based education offers a powerful pathway for educational relevance and motivation by grounding data work in local ecosystems and lived experience. However, little research has examined how immersive professional learning (PL) in ecologically diverse environments reshapes teachers’ conceptions of place and data.

This qualitative study investigates a three-day immersive PL experience at Great Smoky Mountains Institute at Tremont, located within Great Smoky Mountains National Park. Seventeen middle and high school teachers engaged in field-based investigations, including stream water analysis and biodiversity documentation, embedded within mountain watersheds and forest systems. Participants collected and analyzed data using field and digital tools. They then worked together to design classroom lessons grounded in their local field experiences. Teachers participated in focus groups before and after the professional learning to discuss their perspectives and confidence in using place-based data investigations. We analyzed the discussions by identifying patterns and themes that emerged from their responses.

Initial findings indicate that the Tremont-based experience expanded teachers' definitions of "place" and broadened their understanding of data to include qualitative evidence alongside quantitative measures. Participants reported increased confidence in leading investigations grounded in local data. Teachers also described two related shifts. First, they began to see data investigations as open-ended rather than culminating events, recognizing that analysis generates new questions rather than final answers. More unexpectedly, this reframing extended to their understanding of science itself. Although the professional learning did not explicitly address the nature of science, teachers began to describe science less as a linear process of "getting it right" and more as iterative and evolving, shaped by ongoing revision. What emerged was not only greater confidence with data, but a view of science that expands through uncertainty and evidence-based updating. Results suggest that immersive, place-based professional learning can strengthen teacher confidence while reshaping how educators conceptualize place, data, and scientific practice.

A Stream Come True: Restoring Fish and Mussels in Abrams Creek

Matt Kulp *(matt_kulp@nps.gov), Julianne Geleynse, Caleb Moses*

Great Smoky Mountains National Park, National Park Service, Gatlinburg, TN

Abrams Creek, a tributary of the Little Tennessee River in Great Smoky Mountains National Park (GRSM), was historically one of the most biodiverse aquatic ecosystems in the park, supporting approximately 50 native fish species and more than a dozen freshwater mussel species. Freshwater mussels are among the most imperiled faunal groups in North America and play a critical role in maintaining aquatic ecosystem health. European settlement of the upper Abrams Creek watershed in Cades Cove, followed by stream channelization, wetland diversion, inadequate riparian protection, and other agricultural practices, led to severe streambank erosion, sedimentation, and water quality degradation in the late 1800s and early 1900s. In 1957, National Park Service (NPS) and U.S. Fish and Wildlife Service (USFWS) biologists applied rotenone to the lower 23.5 km of Abrams Creek to remove non-target fish species and establish a trophy Rainbow Trout fishery in Abrams Creek and the newly impounded Chilhowee Reservoir. This treatment, combined with impoundment of the lower 3.2 km of the creek, resulted in the extirpation of 46 fish species, including four federally listed species, and likely eliminated or severely reduced native mussel populations. Beginning in the 1990s, NPS initiated large-scale restoration efforts. Over 8 km of fencing were installed to exclude cattle from streams, 2 km of riparian buffers were restored, and livestock were ultimately removed from Cades Cove. Between 1986 and 2010, Conservation Fisheries, Inc. and GRSM reintroduced 3,425 Smoky Madtom (*Noturus baileyi*), 1,789 Yellowfin Madtom (*Noturus flavipinnis*), 3,732 Citico Darter (*Etheostoma sitikuense*), and Spotfin Chub (*Erimonax monachus*) to the lower 16 km of Abrams Creek. Additional efforts included translocations of Greenside Darter (*Etheostoma blennioides*) and Banded Sculpin (*Cottus carolinae*), with ongoing reintroduction of Blotchside Logperch (Percina burtoni). With improved habitat conditions, increased water quality and quantity, and the restoration of key host fish species required for mussel reproduction, native mussel reintroduction is now feasible. Using a tiered decision framework based on habitat suitability, host fish availability, proximity to source populations, and restoration feasibility, fourteen candidate mussel species were identified for reintroduction. Tennessee Pigtoe (*Pleuronaia barnesiana*), Spike (*Eurynia dilatata*), and Pocketbook (*Lampsilis ovata*) were prioritized as primary restoration targets. Spike (*Eurynia dilatata*) and Slippershell (*Alasmidonta viridis*) were subsequently tested in situ to evaluate translocation potential. The restoration of Abrams Creek provides a comprehensive roadmap for recovering habitat, fish, and mussel biodiversity and offers a transferable framework for translocation-based restoration in other Appalachian watersheds.

High-resolution digital archiving of two historical structures in Great Smoky Mountains National Park using terrestrial LiDAR

Yingkui Li *(yli32@utk.edu), Tim Kane, Andrea Potgieter, Casey Charles Shea, Tyler Musante, Collin Davis, Hope Hutchinson*

Department of Geography & Sustainability, University of Tennessee, Knoxville

Great Smoky Mountains National Park (GRSM) preserves over 90 historical structures, including houses, cabins, barns, churches, schools, and gristmills. These structures are invaluable records of past communities but remain vulnerable to fires, floods, and environmental decay. In addition to the natural environment, as these structures are intended for guest visitation, they are at considerable risk of defacement, damage or destruction from malicious or accidental actors. Creating detailed digital archives is crucial for their preservation, public engagement, and as digital footprints for potential future reconstruction. In collaboration with GRSM, we conducted a pilot study in documenting two historic structures in Cades Cove, the Becky Cable House and Carter-Shields Cabin, using terrestrial laser scanning and 360° photography. With a total of 40 LiDAR scans, we obtained registered point clouds of approximately 16 GB (>660 million points). After clipping, cleaning, and down-sampling to a 5 mm resolution, we finalized the datasets to 739 MB and 336 MB (~29.8 and 13.6 million points) for these two structures, respectively, and georeferenced them to the NAD 1983 State Plane coordinate system. We also created two virtual tours based on collected 360 photos. The resulting centimeter-level digital archives and virtual tours provide a vital resource for the preservation of these historical structures and a powerful tool for public education and online access.

COI Barcoding as a tool to improve parasitoid wasp taxonomy

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Bethylidae and Dryinidae are families of parasitoid wasps that use many different species of herbivorous insects as hosts. The agricultural and ecological damage caused by their hosts, which include leafhoppers for dryinids and a variety of beetle and moth larvae for bethylids, makes these wasps valuable as potential biocontrols. However, both families are plagued by extreme sexual dimorphism - many species are described from only one sex as it is difficult to collect male and female conspecifics together. This incomplete taxonomic record makes future utilization of these wasps unlikely.

In this study, bethylid and dryinid specimens are provided by Discover Life in America (DLiA) from Great Smoky Mountains National Park. We will select specimens for DNA barcoding to be processed by the Canadian Centre for DNA barcoding. The COI barcoding sequences will then be used to generate phylogenetic trees of the specimens using Maximum Likelihood techniques. These trees will group conspecific males and females in monophyletic groups, allowing us to 1) update taxonomic records with the missing sex for previously described species, 2) describe new species with both sexes, and 3) test the validity of using COI barcoding as a conspecific matching tool for species with both sexes already described.

Exploring NPS Staff Perceptions of Artificial Light in Great Smoky Mountains National Park – Functionality, Safety, and Conservation

Rachel Nelson *(rpn5176@psu.edu)[1], Derrick Taff[1], Morgan Crump[1,2], Peter Newman[2], Jim Renfro[3], Jesse Barber[4], Adam Beeco[5], Jeremy White[5]*

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The National Park Service (NPS) comprises 433 park units, including 63 designated National Parks. Many of these

parks, particularly larger National Parks like Great Smoky Mountains National Park (GRSM), contain extensive maintenance and administrative areas illuminated by traditional nondirectional lights, streetlights, and dual-motion lights. These lighting practices often illuminate wider areas than necessary and cause glare, which can adversely affect wildlife habitats, employee safety and functionality, and disrupt night sky viewing.

This study focuses on two maintenance areas within GRSM: the North District Maintenance Yard and the Elkmont Water Treatment Plant. The primary objective is to evaluate the ecological and practical benefits of transitioning to more targeted lighting practices in these areas—specifically, adjusting direction, color, and brightness—to better serve park staff and wildlife. This presentation will address the social science aspect of this research, which seeks to assess how these changes impact staff perceptions regarding safety, functionality, and values related to the night sky environment.

Research Questions: How does changing existing lighting for ecologically friendly lighting affect the staff and wildlife (insects and bats)? What is the importance of the natural night environment to the staff and how does lighting at night relate to their perceptions of safety, security, and functionality? What do the NPS staff think/value changes in the night sky environment? Do they align with changes in wildlife?

To answer these questions, pre- and post-lighting change surveys, supplemented by focus group interviews with employees from multiple divisions provide insights into the impacts of lighting on work experiences, safety, and interactions with the night environment. While data analysis is on-going, preliminary results indicate staff prefer the more ecologically friendly lighting, particularly regarding updated dual-motion, warmer-colored, and directional lighting.

The aim of this study is to develop evidence-based lighting best practices tailored for NPS sites and other protected areas with similar facilities. Ultimately, the goal is to make these recommendations so balance can be achieved for enhancing employee safety and functionality while protecting ecological integrity.

Environmental DNA surveys for detection of amphibians in Great Smoky Mountains National Park

Brendan Reid *(brendan.reid@unamur.be)[1], Aaron W. Aunins[2], Will Kuhn[3], Erin Canter[4], Eugenia Naro-Maciel[5]*

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Amphibians face threats to their survival from emerging diseases and the cumulative effects of climate change. Great Smoky Mountains National Park (GSMP) is a global hotspot of amphibian diversity, and environmental DNA (eDNA) metabarcoding could represent an efficient method for monitoring the park's amphibian rich amphibian biota. To evaluate the effectiveness of this method, we sampled multiple water bodies in GSMP and extracted DNA from filtered water. We amplified and sequenced two mitochondrial genetic markers, 16S ribosomal RNA and cytochrome oxidase I (COI), from these eDNA samples. These data were subjected to quality control, cleaned, and clustered by sequence similarity. Finally, we assembled a reference database of available sequences for amphibian species known to occur in GSMP and compared the cleaned sequence data against this reference. The 16S marker detected more species, including five frogs (*Anaxyrus fowleri, Dryophytes chrysocoelis, Lithobates sylvaticus, Lithobates clamitans*, and *Pseudacris crucifer*) and three salamanders (*Ambystoma opacum, Ambystoma maculatum,* and *Notophthalmus viridescens*), than COI, which only detected 3 frog species. Wood frogs (*L. sylvaticus*) were the most commonly detected species across all ponds and both genetic markers. The lower efficiency of the COI marker was likely due to its lower specificity, as it also amplified sequences from a large range of vertebrate and invertebrate species. Future work will examine whether eDNA from non-pond breeding species can be detected at lower thresholds and the potential for using eDNA to conduct broader surveys of biodiversity in the park.

Rapid assessment of insect biodiversity in Cades Cove

Laura Russo *(lrusso@utk.edu)[1], Atticus Moore[1], and Will Kuhn[2]*

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For most of the world, we lack the data to demonstrate any long-term declines in insects, which represent a megadiverse group of animals. Significant efforts have been made to document the insect diversity of Great Smoky Mountains National Park, where 10,794 insect species have been recorded. However, the standardized, repeated survey work required to detect changes in abundance and biodiversity is broadly lacking in this diverse and dynamic group. Here, we conducted a survey in Cades Cove over the summer of 2025 designed to pilot and compare four potential insect monitoring methods, and to assess their relative value for longer term monitoring in the National Park, and beyond. We compared traditional Malaise trapping, transect-bound hand netting, and two vehicle-based sampling methods deployed from a vehicle (dubbed the Buzz Buggy) driven around Cades Cove Loop Road: sticky traps and a roof-mounted net. Samples were taken once in May, June, and July 2025. We compared the methods in terms of a) insect biomass collected, b) insect diversity collected, c) processing time invested, d) human expertise required, and e) added insect mortality. We will discuss the results of our sampling effort, the cost-benefit analysis comparing our methods, and the implications of this study for further research of insect decline.

Pseudoscorpion biodiversity in the Southern Appalachians

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Georgia State University

Blow Flies (Diptera: Calliphoridae) as a Biological Monitor of Wildlife Pathogens in Great Smoky Mountains National Park

Makhali S. Voss *(mvoss2@vols.utk.edu), Richard W. Gerhold, Charity G. Owings*

University of Tennessee, Knoxville

Blow flies naturally acquire DNA while interacting with vertebrate resources and can be used to non-invasively monitor vertebrate populations. The ability to use flies as biological sentinels is the next step in tackling emerging wildlife and zoonotic pathogens. However, foundational knowledge of pathogen transmission and detection in blow flies remains limited. This study assesses the feasibility of using wild caught blow flies as biological monitors for wildlife pathogens in the field. Our target organism is the zoonotic cestode *Echinococcus granulosus*, which forms hydatid cysts in intermediate hosts such as elk and other ungulates. These cysts can be fatal if untreated, though diagnosis and treatment are difficult. To indirectly survey parasite presence and prevalence without sampling elk directly, we collected flies in Great Smoky Mountain National Park to search for elk and parasite DNA. Flies were collected using aged chicken liver and aerial sweep nets, then preserved on-site in 85% ethanol. Homogenization and DNA extraction were performed in the author's hotel room using QuickExtract DNA extraction solution, followed by PCR and gel electrophoresis utilizing the BentoLab portable PCR system. Rapid molecular methods using *E. granulosus* primers in fall 2025 provided tentative PCR positive samples from blow flies collected at Hemphill Bald Trail and Cataloochee, though Sanger sequencing results were inconclusive. Fly metagenomes are currently being analyzed to expand information on vertebrate hosts and microbes associated with flies near elk herds. This work will lay the foundation for using blow flies as passive environmental sentinels to assist wildlife disease diagnostics and mass mortality events by exploiting blow fly biology.

Vector art by Kanako Bessho-Uehara, Timothy J. Bartley, Melissa Broussard, Guillaume Dera, Ellen Edmonson, Ludwik Gąsiorowski, Dylan GE Gomes, Christian Jablunovsky, Sam Rogerson, George Starr, and Shyamal via phylopic.org.