Emory University
Herbarium
Supporting Botanical Research and Education

Botanical Research Symposium & Celebration

Emory University

September 21, 2018

Scientific Program and Abstracts

A Celebration of Botanical Scholarship at Emory

Thanks to the support of our philanthropic sponsors, the Community Foundation for Greater Atlanta, Emory University Office of the President, Dean of the College of Arts and Sciences, Dean of the School of Medicine and many volunteers from Emory and the broader community, we have successfully digitized 20,000 specimens from the Emory Herbarium Collection! Our oldest specimen dates back to 1872 from France. While most of our specimens were collected in the southeast USA, we also have historic and current collections from the Caribbean, Australia, the Balkans, Asia, and the Mediterranean. In addition to our specialized collection of wild medicinal and food plants, the herbarium is also home to one of the largest collections of granite rock outcrop species, and these were critical in the process to gain Arabia Mountain designation as a protected national heritage site.

The digitization process involves the careful repair and annotation of specimens, databasing of collection information, and specimen imaging. These digitized specimens are now available for viewing via the SERNEC portal and will be used by students at Emory and beyond in research, education and outreach initiatives.

To celebrate this milestone, we have organized our first ever Botanical Research Symposium and Celebration at Emory University. The research symposium will feature talks of Emory faculty and researchers and will highlight the role of plants across the sciences and humanities, taking perspectives from art, literature, ecology, history, medicine, nutrition, sustainability and more. In the evening, we will celebrate with a social event and poster session to feature plant research across campus. We'll hold a fundraiser raffle during the celebration and all funds received will be dedicated to supporting student research with the Emory Herbarium collection in the form of small research grants and summer stipends.

During the celebration, we will also recognize our volunteers and student researchers that have made such a tremendous contribution to the development of this resource – collectively dedicating *more than 6,300* hours to these efforts! Thank you for attending and joining us in celebrating Emory's own historic treasure trove of botanical diversity!

Sincerely,

Cassandra L. Quave, PhD
Curator of the Emory University Herbarium (2012-present)

Contents

Thank you to our event sponsors & organizers!

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Cassandra Quave, PhD
Tharanga Samarakoon, PhD
Sandeep Voleti
Loy Xingwen

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Recognition of Our Volunteers

Since reopening the Emory University Herbarium in 2012, our volunteers have made a tremendous impact on the collection in their efforts to repair, database and image specimens. Collectively, they have dedicated thousands of hours towards these efforts. Thank you all for your dedication and service! We salute you!

Platinum Tier (150+ hours)

Deula Santhoshkumar
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Chengcheng Qiu
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Amber Feng
Luis Freddy
Minzhen Liu (Nancy)
Carol Clark
Camelle Steger

Schedule of Events

9:00-11:30 AM	Open Tours of the Emory University Herbarium Tharanga Samarakoon, PhD, Collections Manager of the Emory Herbarium Location: 1462 Building, Room 102 (Old Dental School Bldg)
	Research Symposium Schedule Location: PAIS 290, Time: 2:00-5:30 PM
2:00-2:10 PM	**Welcome and Opening Remarks** Cassandra Quave, PhD, Assistant Professor of Dermatology & Human Health, Curator of Emory Herbarium
2:10-2:30 PM	**Herbarium: Live Plants or Dead Plants?** Tharanga Samarakoon, PhD, Collections Manager of the Emory Herbarium
2:30-2:50 PM	**Botanicals in Integrative Oncology** Omer Kucuk, MD, Professor of Hematology-Oncology and Urology
2:50-3:10 PM	**Thinking, Dwelling, Planting. Dried Gardens and Natural Philosophy in 16th-Century Europe** María M. Carrión, PhD, Professor, Departments of Comparative Literature and Religion
3:10-3:30 PM	**Monarch butterflies use medicinal plants to treat parasite infections** Jaap de Roode, PhD, Associate Professor of Biology
3:30-3:50 PM	**Using Ethnobotany and Pharmacognosy for Novel Drug Discovery** James T. Lyles, PhD, Associate Academic Scientist, Quave Research Group, CSHH
3:50-4:10 PM	**Transcriptional Regulation in Plant Genomes** Roger Deal, PhD, Associate Professor, Department of Biology, Emory University
4:10-4:30 PM	**Theriomorphic (Plant-Human) Beings in Ancient American Art** Rebecca R. Stone, PhD, Professor, Department of Art History, Emory University
4:30-4:50 PM	**'Fresh and Fragrant Flowers': Emory's Herbarium and Shakespeare** Sheila T. Cavanagh, PhD, Professor of English
4:50-5:10 PM	**Pollination and Plant Reproduction in Diverse Plant-Pollinator Communities** Berry Brosi, PhD, Winship Distinguished Associate Professor of Environmental Sciences
5:10-5:30 PM	**Conservation of Imperiled Plants across the Southeastern United States - How Botanical Gardens Can Guide in Situ and Ex Situ Efforts** Emily Coffey, PhD, Vice Pres. of Conservation & Research, Atlanta Botanical Garden
5:30-5:35 PM	**Closing Remarks** Cassandra Quave, PhD
	Celebration of Botanical Research at Emory Location: Cox Hall Ballroom, Time: 6:00-9:00 PM
6:00-6:30 PM	**Welcome and Opening Remarks** President Sterk, Emory University Recognition of Herbarium Volunteers & Presentation of Herbaria Art to Leadership
6:30- 8:00 PM	**Poster Session**
8:30 PM	**Raffle Ticket Drawings**
9:00 PM	**Closing Remarks** Cassandra Quave, PhD

Research Symposium Speaker Biographies

Cassandra Quave, PhD is Curator of the Emory University Herbarium and Assistant Professor of Dermatology and Human Health at Emory University, where she leads antibiotic drug discovery research initiatives and teaches undergraduate courses on medicinal plants, food and health. She obtained her B.S. in Biology and Anthropology & Human Biology at Emory University in 2000 and her PhD in Biology from Florida International University in 2008. Trained as a medical ethnobotanist, her research focuses on the documentation and biochemical analysis of botanical remedies used in the traditional treatment of infectious and inflammatory skin disease. To date, she has authored more than 60 publications, 2 edited books and 3 patents. She is a Past President of the President of the Society for Economic Botany, an international society with the mission of fostering research and education on the past, present, and future uses of plants by people. Her work has been profiled in the *New York Times Magazine*, *BBC Focus, Brigitte Magazin* and National Geographic Channel, and featured on NPR, *National Geographic Magazine* and several major news outlets including the *Washington Post*, *The Telegraph*, *CBS News*, and *NBC News*.

Tharanga Samarakoon, PhD is the Collections Manager of the Emory Herbarium. She grew up in Sri Lanka and received her bachelor's degree in botany from the University of Peradeniya, Sri Lanka, in 2004. She completed her Ph.D. at the University of Southern Mississippi in 2015. Her graduate research was on a study of the phylogenetic relationships of the family Samydaceae- tropical relatives of willows, poplars, and cottonwoods, which are formerly placed in the heterogeneous family Flacourtiaceae and the preparation of a monograph of the genus *Casearia* in south-central Asia. Dr. Samarakoon's research incorporates plant systematics and floristics. In systematics, her research focuses on delimiting and describing species, working out the nomenclature, and inferring relationships using phylogenetic techniques with data obtained from morphology, phytochemistry, anatomy, and DNA sequences. She has several years of experience in herbarium work and a broad knowledge of Old and New World tropical plants and temperate plants and her floristic studies focuses on mainly Southeastern Coastal plain and Piedmont floristic region.

Omer Kucuk, MD is Professor and Correll Chair in Genitourinary Cancer, Hematology and Medical Oncology, and Urology at Emory University School of Medicine. His research focuses on investigating the modulation of genetic and epigenetic pathways of cancer development and progression by nutritional interventions, with emphasis on soy isoflavones and lycopene. His expertise is in the area of chemoprevention, nutrition and cancer, particularly in the area of genitourinary cancers with a focus on prostate cancer. He conducts translational research investigating the potential use of natural compounds, including lycopene and soy isoflavones, in the prevention and treatment of cancer. He conducted the first clinical trials with lycopene and soy isoflavones in prostate cancer patients and discovered that they are potent anti-cancer agents.

María M. Carrión, PhD is Professor of Comparative Literature and Religion at Emory University. She teaches courses on comparative media and cultural history of Spain and Latin America. Her publications focus on representations of sexualities, dramatic literature and performance, Law, architecture, and natural history and philosophy of early modern Spain and Latin America. Her work, invested in reading and understanding latinidad and other cultures comparatively, also analyzes the literature and culture of the Hispanic Caribbean, focusing particularly on theatre, music, and poetry from Cuba and Puerto Rico. She is currently completing a digital monograph on the correspondences of 16th-century European dried gardens (collections of books in which naturalists dried and glued plants for various purposes) and the development of modern natural philosophy and botany. For that

purpose, she has conducted archival research in Leiden, The Netherlands; Kassel, Germany; Basel, Switzerland; Bologna, Florence, Padova, Salerno, and Rome, Italy; and Valencia, and El Escorial, near Madrid, Spain, where she grew up. She has published a number of essays on, among others, film, television, marriage, transvestism, violence and tragedy, theatrical costume and movement, transconfessional devotion, iconography, and, more recently, ruins and historical memory, gardens in mystical discourse, gardens as laboratories, and a comparative theology of water. She is the author of two books: *Arquitectura y cuerpo en la figura autorial de Teresa de Jesús* (Barcelona: Anthropos, 1994) and *Subject Stages. Marriage, Theatre, and the Law in Early Modern Spain* (Toronto: The U of Toronto P, 2010).

Jaap de Roode, PhD is Associate Professor of Biology. He completed his PhD in Evolution and Ecology at the University of Edinburgh. Prior to joining the faculty at Emory in 2008, he held postdoctoral positions at Emory University and the University of Georgia. His primary research focus is the ecology and evolution of host-parasite interactions, including the study of self-medication in monarch butterflies, virulence evolution in honeybee parasites and drug resistance in human malaria. In 2011 he was elected by Popular Science Magazine as part of their yearly round-up of the most promising scientists in the US under 40. De Roode teaches introductory biology, ecology, evolution and insect biology, and he was named an Emory Williams Distinguished Teaching Award recipient in 2017.

James Lyles, PhD is an Associate Academic Research Scientist in Human Health at Emory. His expertise is in bioactivity-guided fractionation and structural elucidation of natural products and other small molecules using classical pharmacognosy, modern analytical chemistry, and spectroscopic methods; including high performance liquid chromatography (HPLC), mass spectroscopy (MS), and nuclear magnetic resonance (NMR) spectroscopy. He earned his doctorate in 2011 in Plant Sciences from The City University of New York's joint program with the New York Botanical Garden, where he studied natural products chemistry, pharmacognosy, botany, systematics, and field collection. He explores the chemistry of medicinal plants in efforts to identify unique bioactive molecules for drug development.

Roger Deal, PhD has been at Emory since 2012 and is currently an associate professor of Biology. Previously he earned a BS degree from the University of South Carolina, a Ph.D. from the University of Georgia, and conducted postdoctoral work at the Fred Hutchinson Cancer Research Center in Seattle. He has been fascinated by plants since he first watched a seed germinate when I was 6 years old, and has been studying them ever since.

Rebecca R. Stone, PhD holds a doctorate in the History of Art from Yale University. She has taught at the Johns Hopkins University (1987-188) and Emory University (1988-present), attaining the rank of Professor and retiring as of September 2018. Stone was also the Faculty Curator of the Art of the Americas at Emory's Michael C. Carlos Museum and curated numerous exhibitions and reinstallations there, plus the 1992 Columbus Quincentennial show at the Museum of Fine Arts, Boston (authoring its catalogue, To Weave for the Sun: Andean Textiles from the Museum of Fine Arts, Boston). Subsequent publications include: Art of the Andes from Chavín to Inca (1995, 2002, 2012), Seeing with New Eyes: Highlights of the Michael C. Carlos Museum Collection of Art of the Ancient Americas (2002), The Jaguar Within: Shamanic Trance in Ancient Central and South

American Art (2011), and Threads of Time: Tradition and Change in Indigenous American Textiles (2017).

Sheila T. Cavanagh, PhD Professor of English at Emory University and served as Fulbright/Global Shakespeare Distinguished Chair in the UK (2016-2017). She is founding director of the World Shakespeare Project (www.worldshakespeareproject.org) and the Emory Women Writers Resource Project (http://womenwriters.digitalscholarship.emory.edu/) and was Director of Emory's Year of Shakespeare (2016-2017). She also held the Masse-Martin/NEH Distinguished Teaching Professorship. Author of *Wanton Eyes and Chaste Desires: Female Sexuality in the Faerie Queene* and *Cherished Torment: the Emotional Geography of Lady Mary Wroth's Urania*, she has published widely in the fields of pedagogy and of Renaissance literature.

Berry Brosi, PhD is Winship Distinguished Associate Professor in the Department of Environmental Sciences, Emory University. He is an ecologist whose research program is focused on multi-species biological communities, with a particular interest in how biodiversity and the structure of ecological interaction networks affect the stability and functioning of ecosystems. His work primarily focuses on pollination as a model ecological interaction and ecosystem function. Dr. Brosi was one of 75 lead authors globally, and one of five from the US, on a UN intergovernmental panel on pollinator declines. His research has been funded by the NSF, NIH, USDA, and US Army Research Office among other sources. Dr. Brosi earned a BA from Wesleyan University; a Master of Environmental Science degree from Yale University; and his Ph.D. in Biology from Stanford University.

Emily Coffey, PhD is VP for Science and Conservation at the Atlanta Botanical Garden. Coffey joined the Garden in 2017 to lead the Conservation and Research Department where she leads and collaborates with a team of conservation scientist and horticulturists to expand the activities in conservation research, propagating and growing rare plants, and developing conservation initiatives for plants and ecosystems. She received a B.S. (Hons) in Biology from University of Missouri – St. Louis, a M.S. with Distinction in Biodiversity, Conservation, and Management from University of Oxford – UK, and Ph.D. in long-term ecology and conservation biology from the University of Oxford –UK at The Biodiversity Institute. She conduced her Post-Doctoral work at University of Oxford in The Biodiversity Institute. Before joining ABG, she was a faculty member of Biology at the University of North Carolina Asheville. Dr. Coffey has broad botanical knowledge and experience with ex situ and in situ conservation, restoration ecology, community ecology, and biogeography. She is familiar with ecological processes and flora of many geographical settings including Appalachian Mountain Fens/Bogs, Carolina Bay region, Missouri sandstone glades, Canary Island laurel forests, and Galápagos Islands. In the latter, she examined ecological baseline conditions for the humid highlands of Santa Cruz Island in order to distinguish temporal vegetation transitions, identify potential drivers of the transitions, and evaluate their importance for conservation and management practices. Findings from her research have been published in numerous journals including Science, Ecology, and Journal of Biogeography. Research conducted with at UNCA included identifying historical fire regime patterns across the Appalachian Mountain bog/fen habitats aimed at providing land managers a framework for restoring fire as an ecological process. Additional, current appointments include Research Professor at the University of North Carolina - Asheville and Adjunct Assistant Professor at Georgia Technical Institute, Atlanta

Herbarium: Live Plants or Dead Plants?

Tharanga Samarakoon, PhD

A herbarium is a plant museum with a collection of dried plants arranged systematically for long-term study. All of these specimens are important to plant taxonomists, ecologists, and others who need the information such collections possess. Herbaria are becoming more valuable because their specimens are often old enough to aid in documenting climate change and environmental degradation. Emory herbarium houses more than 23,000 specimens. The collection grows steadily through continuous fieldwork. Researchers at Emory, especially those involved with plant-based research, deposit their voucher sets for their projects at the Herbarium. Those specimens are digitized and made more widely available; the significance of these collections is becoming better known not only to the Emory community but also to the global community.

Botanicals in Prostate Cancer Prevention and Treatment

Omer Kucuk, MD

Botanical compounds have been found to modulate genetic and epigenetic pathways of cancer development and progression. We have studied nutritional interventions, with emphasis on soy isoflavones and lycopene. Preclinical and clinical translational research have been conducted investigating the potential use of natural compounds, particularly lycopene and soy isoflavones, in the prevention and treatment of cancer. Clinical trials with lycopene and soy isoflavones in prostate cancer patients have shown that they are potent anti-cancer agents that may be useful in preventing and slowing the progression of prostate cancer. Soy isoflavones and lycopene could also prevent chemotherapy and radiation therapy toxicities. Furthermore, soy isoflavones may enhance the efficacy of chemotherapy and radiation therapy in patients with prostate cancer.

Soy food intake has been associated with a low risk of several cancers. In addition, soy food consumption during cancer treatment may result in better outcomes and longer survival. These observations led to in vitro and in vivo mechanistic studies to elucidate the biological actions of various compounds in soybeans. Soy isoflavones have been found to have profound biological effects and modulate many of the pathways involved in cancer development and progression. In addition to their selective estrogen receptor modulatory effects, these compounds have anti-oxidant, anti-inflammatory and epigenetic effects, which may explain their potential role in cancer prevention and treatment. Soy foods and soy isoflavones can be easily taken together with conventional cancer treatments such as surgery, radiation, chemotherapy, hormone therapy, targeted agents and immunotherapeutic agents. They may enhance the efficacy and reduce the toxicities of radiation therapy, chemotherapy, hormone therapy and other conventional cancer treatments. Natural products such as soy isoflavones could be used to improve treatment effects and quality of life of patients. Soy isoflavones should be investigated in symptom control, quality of life, palliative care and survivorship research.

Thinking, Dwelling, Planting. Dried Gardens and Natural Philosophy in 16th-Century Europe

María M. Carrión, PhD

European dried gardens from the 16th century have been traditionally associated with either the traditional genre of pharmacopeias or with the emergence of early modern botany. This paper reviews a sample of the 37 known exemplars of these bound collections of books, and argues that the design and development of these orti sicci or herbaria, as they were also known, reveal a broader set of questions on and about nature, and about the relationships of humans with the natural world. Based on the evidence of a diverse corpus of dried gardens (some richly bound, others composed over recycled paper, some with copious annotations, others with a seemingly random layout and distribution of plants), this paper argues for a comparative reading of these books as a corpus of early modern natural philosophy.

Monarch butterflies use medicinal plants to treat parasite infections

Jaap de Roode, PhD

Although long thought to be the exclusive realm of humans, many animals are experts at treating their infectious diseases with medication. Recent studies have shown that even monarch butterflies and other insects can use medicinal plants. Studying animal medication may ultimately help humans in discovering new effective medicines.

Using Ethnobotany and Pharmacognosy for Novel Drug Discovery

James T. Lyles, PhD

Natural products have been used to treat human illness for as long as humans have attempted to treat disease and alleviate suffering. Small molecules were the original pharmaceutical drugs and every society has developed a tradition of healing based around utilizing these compounds from their local environment. Many of these ancient traditions are well known even today, such as: Traditional Chinese Medicine, Ayurvedic Medicine, Sowa-Rigpa (Traditional Tibetan Medicine), and Western Herbalism. Natural Products derived medicines are not only a historical note. Rather many of the prescription drugs in the United States are either small molecule natural products or derivatives of these molecules. In fact, 49% of all currently approved cancer pharmaceuticals and 49% of all currently approved antibacterial pharmaceuticals are either natural products or a derivative of a naturally occurring small molecule.

The study of human traditional plant use is ethnobotany; the exploration of medicinal compounds with natural origins is pharmacognosy. This talk will review many of the pharmaceuticals commonly used today and their natural origins to demonstrate how botany touches everyone daily, and then explore the intersection of ethnobotany and pharmacognosy, as it pertains specifically to plants, for the identification of novel bioactive molecules that can serve as new pharmaceutical drug leads.

Transcriptional Regulation in Plant Genomes

Roger Deal, PhD

The transcriptional regulatory structure of plant genomes remains poorly defined relative to animals. It is unclear how many cis-regulatory elements exist, where these elements lie relative to promoters, and how these features are conserved across plant species. We employed the Assay for Transposase-Accessible Chromatin (ATAC-seq) in four plant species (Arabidopsis thaliana, Medicago truncatula, Solanum lycopersicum, and Oryza sativa) to delineate accessible chromatin regions and transcription factor (TF) binding sites across each genome. Despite 10-fold variation in intergenic space among species, the majority of accessible chromatin regions lie within 3 kilobases upstream of a transcription start site in all species. Additionally, we found a common set of four TFs that appear to regulate conserved gene sets in the root tips of all four species, suggesting that TF-gene networks are generally conserved. These analyses revealed common regulatory principles among plant species as well as fundamental differences between plants and animals.

Theriomorphic (Plant-Human) Beings in Ancient American Art

Rebecca R. Stone, PhD

In the indigenous art of the ancient Americas many blended beings are represented, some part human and part animal, others part plant. One ceramic effigy of a meditating shaman, found in Emory's own Carlos Museum collection, combines human and mushroom characteristics. Furthermore, this shaman has the secondary sexual characteristics of both a woman and a man. In this talk I will explore reasons why such an image of a shaman might be both intersexed and part plant. The many shifting, transformational elements in the imagery of ancient Costa Rica, among other cultures, can be seen as reflecting visionary experience that resulted from the ingestion of sacred plants (known as entheogens).

'Fresh and Fragrant Flowers': Emory's Herbarium and Shakespeare

Sheila T. Cavanagh, PhD

This talk will discuss the use of herbarium materials during Emory's Year of Shakespeare and in subsequent classrooms in order to support interdisciplinary scholarship and understanding for our students.

Pollination and Plant Reproduction in Diverse Plant-Pollinator Communities

Berry Brosi, PhD

This talk will review several of the research topics related to plant science under investigation by the Brosi lab at Emory. Much of the Brosi lab's work uses pollination as a model species interaction and ecosystem function; pollination in turn is crucial for the reproduction of about 90% of the flowering plant species on Earth and for about 30% of food production worldwide. Our research is centered on biological communities containing multiple plant and pollinator species, and we have a particular interest in understanding how both the diversity of species in a biological

community, and the structure of the networked interactions between species, affect pollination and other key ecological functions. Specific research topics include: 1) experimental work on the effects of single pollinator species losses on behavior in remaining pollinators and subsequently on plant reproductive functioning, as well as effects on pollination networks; 2) effects of pollination network structure on stability and functioning, both in the lab and in the field; 3) early-stage experimental work on climate change impacts on pollination networks; and 4) methodological work on DNA metabarcoding of pollen, with implications for better resolution of pollination networks among other applications.

Conservation of Imperiled Plants across the Southeastern United States - How Botanical Gardens Can Guide in Situ and Ex Situ Efforts

Emily E.D. Coffey, PhD

The mission of the Atlanta Botanical Garden (ABG) is to develop and maintain plant collections for display, education, research, conservation and enjoyment. ABG works to advance the science of conservation through research collaborations and native species recovery programs. ABG's plant conservation collections and fieldwork focus on propagation of under-represented endangered plant groups and the restoration and management of their habitats. Key to the success of ABG's conservation program is the high level of botanical and horticultural expertise of its staff. ABG has over 30 years of experience in the conservation and recovery of rare and threatened plant species through research, propagation, collaborative restoration, and habitat management.

Background on the Emory University Herbarium

What is a herbarium?

A herbarium is a museum of preserved plant samples that are used for botanical research and education. Herbarium specimens may include pressed and mounted plants, plant parts (seeds, wood sections, pollen), microscope slides, plant DNA, and objects made from plants. At the Emory Herbarium, we believe in connecting people to plants, and in addition to our pressed herbarium specimens, we also curate ethnobotanical objects (e.g. blow guns, baskets, gourds, herbal medicines, musical instruments, etc.) that can help us to teach students and the public about the importance of plants in our lives.

Digitization Project

Digitization = specimen imaging + databasing

Digitization of herbarium specimens involves capturing both digital images of the specimen itself, and databasing the data affiliated with each specimen. Data found on the specimen tag can include important reference information such as its geographic origin, date of collection, collector name, plant name, and even ethnobotanical use(s) and local name(s). Through the generous donor funding for the Emory Herbarium Revitalization Project, we have successfully completed digitization of more than 20,000 specimens in the collection.

The primary objective of storing and providing access to digital images of our collections is to facilitate global access to the collection. Storing high quality images can also aid long-term preservation of the collection by reducing the need for direct handling and loans of the physical specimens. The GEO team has benefited greatly from working documents provided by the NSF-funded iDigBio (Integrated Digitized Biocollections) project, as well as from interactions with their project team. Moreover, the GEO team has worked closely with staff from the Specify Software Project and SERNEC, who have been very helpful in establishing our local database. The digitized GEO collection will undoubtedly be an important easily accessible resource for botanical research and education at Emory and beyond.

History of the Emory University Herbarium

The Emory University Herbarium (Index Herbariorum acronym: GEO) was founded in 1949 at the urging of the Chair of the Emory Biology Department, Prof. William D. Burbanck, who served as the Herbarium's first director. Prof. W. D. Burbanck was particularly motivated to provide the Biology Department with a herbarium to support rapid expansion in the department's ecology research and teaching programs. The first expansion of the Emory Herbarium's collection came with the deposit of Dr. Don E. Eyles' voucher specimens for his Masters work, completed in 1938 from Emory University. Several of the voucher specimens for his Masters thesis also served to voucher his two primary

publications in the field, two taxonomic keys of aquatic plants of the Southeastern United States (Eyles & Robertson, 1944; Eyles, 1963). Shortly thereafter, Emory University Herbarium absorbed the voucher collection for Robert Thorne's Flora of Southwestern Georgia, completed as a Doctoral thesis at Cornell University (Thorne, 1949).

In 1954, Dr. Madeline Burbanck was hired as the first Emory Herbarium Collections Manager and was responsible for the rapid expansion of the collection, amassing more than 12,000 specimens over the course of the subsequent decade through her active specimen exchange program with the Southern Appalachian Botanical Club at West Virginia University, as well as her own collections supporting her research on Georgia granite outcrop ecosystems (Burbanck & Platt, 1964). Dr. M. Burbanck's research also resulted in two important community outreach successes: the establishment of Burbanck Park in Atlanta and the official designation of Arabia Mountain as a National Heritage Area. Dr. M. Burbanck's efforts to preserve Arabia Mountain were lifelong, culminating in the official designation of "National Heritage Park" October 12, 2006, only months before her death at age 92 on January 1, 2007. Emory University Herbarium is proud to house the voucher specimens that were used by Dr. M. Burbanck in her publications and significant preservation efforts.

Emory University Herbarium continued its mission to support the research community at Emory University under the direction of Prof. William H. Murdy, who dedicated almost 20 years of service to the Emory Herbarium from 1966 – 1982. In 1987, he went on to serve as the Dean of Emory Oxford College. Prof. Murdy's contributions to environmental and botanical efforts continued through the years, and together with Prof. Eloise Carter (Oxford College, Department of Biology) he co-authored "A Report on the Status of Forested Land of Emory University" in 1986 and *Guide to the Plants of Granite Outcrops* in 2000.

Curation of the Emory Herbarium was later directed by Prof. Judith Morgan (Department of Biology), followed by Dr. Brian Smith (Department of Environmental Sciences). This period was dedicated to maintenance of a steady loan program to other institutions in support of research.

Following a roughly two-decade period of decline in use, a new revitalization effort was launched in 2012 under the Curatorial direction of Dr. Cassandra Quave (Department of Dermatology and Center for the Study of Human Health) with the aim of supporting Emory University's active research community, though now with a primary focus on establishing and supporting a Collection in Medical Botany. Collections Manager, Dr. Tharamangala Samarakoon, was given the ambitious task of working with volunteers to create a digital record of the collection, driven by the need to preserve the valuable historical collections of Dr. Eyles, Dr. Thorne, and Dr. M. Burbanck, as well as to provide modern international access to these resources and the Medical Botany Collection. Since 2012, over 20,000 specimens have been carefully repaired, annotated, databased, imaged, and deposited in the publically accessible SERNEC web portal (http://sernecportal.org/portal/index.php). The Emory Herbarium is now home to specimens dating back to the 1800s, and represents diverse flora from the US, Europe, Australia, the Caribbean and the Balkans. The Herbarium has expanded its mission to focus on not only local campus research and teaching support, but also supporting an international scientific community.

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Special Collections Housed in the Emory University Herbarium

The Emory Herbarium is home to a total of 23,150 specimens. It also houses a unique set of special collections that are used in a number of research, conservation, teaching and outreach initiatives at Emory and beyond.

Don E. Eyles Collection

The Eyles Collection consists of 2,905 vouchered specimens collected for his Masters thesis, completed at Emory in 1938. These specimens also serve to voucher his two publications of southeastern aquatic plants, which remain the primary resources for aquatic and maritime plant identification in the southeast. Fourteen specimens from the Eyles Collection were incorporated into the USDA National Arboretum Herbarium as first records of the geographical range of taxa in Georgia. Duplicates of these specimens are on file at GEO. Dr. Eyles extended his taxonomic work throughout his career, which specialized on aquatic host plants of mosquito species. Several taxa denoted as preferred mosquito host plants are vouchered at GEO.

Robert F. Thorne Collection

The Thorne Collection comprises 4,582 vouchered specimens collected for Dr. Thorne's Doctoral dissertation from Cornell University, Flora of Southwestern Georgia. This collection encompasses voucher specimens from four of the five World Wildlife Fund ecoregions currently recognized in Georgia. This collection has strong potential for use in a comparative study of shifting ecoregions in response to climactic changes in the region.

Southern Appalachian Botanical Club (SABC) Collection

The SABC collection was amassed as part of GEO's largest specimen exchange to date. Over the course of twelve years, 806 specimens originating from the Appalachian mountains of Pennsylvania, West Virginia, and southwestern Virginia were received by GEO from WVU. These specimens are an important representation of Appalachian ecosystems and are of great value for teaching regional ecology. Some of these specimens were used during a training session held in 2014 for local elementary STEM educators to help illustrate how Atlanta sits at the junction of Appalachian, Piedmont, and Coastal ecosystems.

Madeline L. Burbanck Collection in Granite Outcrop Collection

The collection of granite outcrop species comprises 383 specimens collected by Dr. Madeline Burbanck, former GEO Collections Manager, during the course of her professional and personal research efforts to document the flora of the rare granite rock outcropping ecosystem. This collection includes species denoted as rare or endangered by the United States National Forest Service. The Burbanck Collection has special research and educational value for projects relating to ecological succession, as granite outcrops are an ideal model for studying plant succession and gradient-based speciation. Additionally, Dr. Burbanck's collection of specimens was critical to her efforts to designate Mount Arabia, Georgia a protected National Heritage Park.

Medical Botany Collection

This collection consists of 822 specimens belonging to two primary categories: those belonging to the "Medicinal Plants of the American Civil War" Collection (191 specimens) and those deposited by several Emory University researchers during the course of their various field expeditions studying the medicinal plants used by traditional cultures (631 specimens). A particular focus is placed on Arberëshë ethnobotany, south Italian collections, Native American Medicinal plants (SE USA) and useful species of the Balkans. Of note, the data on Arberëshë plants is unique in that it represents data from an endangered linguistic group, of which less than 10,000 speakers survive today. This collection is rich in associated data, including scientific taxonomy, folk taxonomy, native ranges of plants, cultivation and management techniques, part of plant used, and often associated laboratory data such as gene sequences and phytochemical data. This collection also includes numerous direct artifacts of plants, such as wood samples, resins, fibers, toxic plants, fungi, spices, carvings, traditional medicinal tinctures and mineral-plant compounds, and processed crop plants. This collection is also of active interest to several international researchers, including researchers from the University of Prishtina (Prishtina, Kosovo) and University of Basilicata (Potenza, Italy).

Poster Abstracts

P001. Novel medicinal plant/fungal extract is potent and selective inhibitor of Zika Virus

Leda Bassit[1], James Lyles[2], Kiran Verma[1], Leah Goldring[1], Olivia Russell[1], Christina Gavegnano[1], James Kohler[1], Cassandra Quave[2,3] , and Raymond F Schinazi[1*]

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A growing number of arbovirus epidemics have occurred over the past two decades, calling special attention to the flaviviruses, especially Zika virus (ZIKV). Beyond mosquito-borne transmission, ZIKV has demonstrated a capacity for vertical transmission from mother to fetus, as well as through sexual transmission. Recent outbreaks have shown links to a rise in birth defects, including microcephaly, and are associated with Guillain-Barré syndrome (GBS) cases in adults. At present, there are no antiviral agents or vaccines approved for the prevention or treatment of ZIKV infection. Novel therapies are needed to combat this global epidemic. To identify novel therapeutics for the prevention and or treatment of ZIKV, we evaluated 90 extracts, representing 10% of a unique natural products library composed of medicinal plant and fungal extracts, constructed based on evidence of traditional medical use for infectious and inflammatory diseases. We identified Extract 640 as a potent and selective inhibitor of ZIKV. The extract is derived from the fruits of a tree used by Cherokee Native Americans as an indigenous medicine. Further refinement of the extract yielded an active partition (640D), which is composed of 42 compounds. This extract exhibited inhibition of ZIKV replication in Vero cells, as well as human neuronal, hepatoma and fibroblast cells with EC50 varying from 2 to 6 µg/ml, and limited cytotoxicity for all four cell types. We are developing novel chemical entities (NCEs) from extract 640D in efforts to test and identify inhibitors of ZIKV replication, and then investigate the mechanistic basis for this activity.

P002. The function of pollination networks

Loy Xingwen, Connor Morozumi, Berry Brosi

Department of Environmental Sciences, Emory University

Pollinators facilitate plant reproduction, maintaining much of our Earth's immense plant diversity. Complex multispecies interactions occur between communities of pollinators and plants and can be summarized in pollination networks. Theoretical studies have focused extensively on how the distribution of interactions in a network ('network structure') affects its integrity and resilience to perturbation, such as species extinctions. Yet surprisingly, it is still unclear if network structure has any direct impact on plant reproduction – a key function of plant-pollinator interactions. We will study pollinator-mediated plant reproduction in spatially-replicated subalpine meadows at the Colorado Rocky Mountains. At each of 9 sites, we will modify natural network structure in a treatment plot paired with a control plot, to examine the link between network structure and plant reproduction. We will accelerate snowmelt in treatment plots to advance spring flowering time, whilst keeping pollinators drawn from the surrounding landscape relatively unchanged, causing a temporal shift in possible plant-pollinator partnerships. We will then survey and build pollination networks for all plots, and measure seed production in locally dominant plant species, isolating pollinator-mediated benefits in each plot with pollen-limitation experiments. Our pilot study suggests that some metrics of networks structure correlate with seed set in pollinator-dependent plant species, but expectedly these patterns are absent in species that are only weakly reliant on pollinators for seed set. These results suggest that the impact of pollination network structure on plant species varies and assessment of network function requires considering the relative fitness of multiple species in a plant community.

P003. *Arabidopsis* MBD9 is required for H2A.Z deposition

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The SWR1 chromatin remodeling complex, which deposits the histone variant H2A.Z into nucleosomes, has been characterized in yeast and animals but had not been purified from plants. We used the conserved SWR1 subunit ACTIN RELATED PROTEIN 6 (ARP6) as bait in tandem affinity purification experiments to isolate associated proteins from *Arabidopsis thaliana*. We identified all 11 conserved subunits found in yeast SWR1 and the homologous mammalian SRCAP complexes. We also identified several additional proteins not previously associated with SWR1, including Methyl-CpG-BINDING DOMAIN 9 (MBD9). We used ChIPseq on *arp6* and *mbd9* mutants to find that MBD9 is required for proper H2A.Z incorporation at thousands of discrete sites, which represent a subset of the regions normally enriched with H2A.Z. Our data establish the SWR1 complex as being conserved across eukaryotes and also provide new insights into the mechanisms that target H2A.Z to chromatin.

P004. Fractionation of enriched *Castanea sativa* leaf extract 224C-F2 yields *S. aureus* quorum quenchers with enhanced bioactivity

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Methicillin-resistant *Staphylococcus aureus* (MRSA) presents one of the most serious infectious disease concerns worldwide, with the WHO having labeled it as a "high priority" pathogen in 2017. The current arsenal of antibiotics works by inhibiting bacterial growth, which exerts great selective pressure for the development of resistance. The development of novel anti-infectives that attenuate quorum sensing (QS) in MRSA has been recurrently proposed as a promising therapeutic approach. QS refers to a system of stimuli and response between cells in a bacterial population that, in MRSA, serves as the key coordinator of virulence. Previously, our lab reported the non-bactericidal quorum quenching (QQ) activity of a fraction of a *Castanea sativa* leaf extract, 224C-F2, demonstrating high bioactivity against MRSA in vitro and in a mouse model of skin infection. A portion of it, 224C-F2c, was identified as the source of bioactivity, and it was further fractionated on reverse-phase high performance liquid chromatography (HPLC). In a reporter strain screen of inhibition of the QS system, six of the preparative HPLC fractions (PFs) exhibited much higher inhibition than 224C-F2c: PF23, 24, 39, 40, 41, 42. Liquid chromatography Fourier-transform mass spectrometry (LC-FTMS) revealed that three m/z values were found to be highly abundant across the six PFs. These six PFs of 224C-F2c represent promising sources for QQ compounds for development against MRSA.

P005. Tibetan Medicine: Evaluation of Plant Extracts for Antiviral Potential

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Tibetan medicine (TM) employs thousands of plants, minerals and processed metals in various combinations to treat different ailments including viral diseases. Their antiviral potential has never been explored by western standards. Samples from selected plants and poly-herbal components were submitted to Herbarium Unit of Central University of Tibetan Studies, India. After aqueous or organic extractions, the potency of each fraction was assessed against Dengue Virus (DENV), West Nile Virus (WNV), hepatitis B and C viruses (HBV and HCV), and HIV-1. Fractions were evaluated at 10 µg/mL for potential toxic effects in multiple cell lines. Initial evaluation of 100 extracts prepared from 26 single plants and 10 traditional medications identified five fractions with significant and selective inhibition of either HIV-1 or HBV replication. Fractions of two plants and two multi-component formulations displayed median effective concentrations (EC50) of 3.4 - 11.7 µg/mL against HIV-1, while a fraction of *Taraxacum tibetanum* (Khurmang) demonstrated an EC50 of 9.5 µg/mL against HBV. We also identified a fraction displaying 54% inhibition against DENV2 at 30 mM and another fraction exhibiting 87% inhibition against WNV at the same concentration. None of these fractions displayed apparent cytotoxicity at concentrations up to 10 µg/mL. This *in vitro* study represents the first report of the anti-HIV, anti-HBV, anti-WNV and anti-DENV potential of Tibetan medicine. Further purification and characterization of these samples is still in progress and could lead to the discovery of new potent direct-acting antiviral agents for the treatment of HIV-1 and HBV.

P006. Quantitative Metabarcoding of Pollen

Anya Cutler, Karen Bell, Timothy Read, Berry Brosi

Department of Environmental Sciences, Emory University

Recent developments in DNA metabarcoding of pollen allow for the high-resolution identification of plant species from samples of mixed pollen grains. This technique has broad applications, ranging from pollinator network studies to forensic palynology. Despite promising utilization, the development of pollen metabarcoding is at an early stage. Our proposed method sequences the *ITS2* and *rbcL* gene regions. Our previous studies have found that these regions can accurately identify the presence or absence of a particular species, but the read counts are not quantitatively reflective of the relative proportions of species in the initial mixed pollen sample. This study will assess the biases potentially affecting the quantitative accuracy of pollen DNA metabarcoding. Because pollen grain morphology and genome size vary by taxa, isolation efficiency, copy number, and amplification efficiency can introduce taxonomic biases in the DNA read counts. Using the pollen of 150 plant species from across the seed plant phylogeny, we will measure: 1) isolation bias by comparing pollen grain number to the read count of a single-copy nuclear gene *LFY*, 2) copy number bias by comparing the *rbcL* and *ITS2* read counts to the *LFY* read counts, and 3) amplification bias by assessing the post-PCR quantitative results using a sample of known marker concentration. We will subsequently develop a bioinformatics pipeline to phylogenetically impute and account for isolation, copy number, and amplification

bias across the entire seed plant phylogeny. Our hope is to create a reproducible and user-friendly pipeline for the accurate quantification of pollen for multi-disciplinary use.

P007. How do plant root exudates regulate architecture of the rhizosphere?

Olga Taran, David G. Lynn

Department of Chemistry, Emory University

The plant rhizosphere is a spatiotemporally organized, readily accessible experimentally, environmentally responsive microbiome. There is a strong evidence for chemical signaling being responsible for the architecture and regulation of the rhizosphere. Small molecules regulate processes ranging from the need for nutrients to quorum sensing, antibiotic production, and host recognition for mutualistic associations. Many of the known chemical signals are unstable in the soil environment, suggesting their propagation is not based on diffusion alone, but rather might exist as reaction-diffusion networks, which are known to create chemical gradients with well-defined spatial resolution. A large proportion of plant and bacteria metabolites are redox active compounds, whose reactions with oxygen often expose complex non-linear kinetics responsible for the abiotic production of H_2O_2 and other reactive oxygen species. Currently such compounds are treated as single molecular entities under initial oxidant/antioxidant paradigms, which ignores the dynamic nature of these reactions. Moreover, these reactions are usually parts of complex biotic and abiotic environments that exist within of 3D matrix of root and soil surfaces. The complex reaction networks created by secondary metabolites in soil, an “external metabolome,” provide a new and exciting context for the emergent field of Systems Chemistry.

We used a bottom-up approach and the ideas from Systems Chemistry, to build a model system that uses a quinone 2,6-dimethoxybenzoquinen produced by plant roots and Methylene blue, a synthetic dye that acts as a proxy for the phenazine cofactors produced by bacteria. We found that depending on the initial conditions, our model can reproduce at least three phenomena observed in the rhizosphere: oxidative burst, found during plant wounding, steady-state reducing gradients, found along the young roots during early development of the plant, and stationary patterns, suggested to regulate the morphology of bacterial biofilms. We provide detailed kinetic models to explain the observed phenomena that can now be used in analysis of similar complex mixtures.

P008. Analysis of the composition of Brazilian peppertree based on anti-virulence activity against *Staphylococcus aureus*

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Methicillin-resistant *Staphylococcus aureus* (MRSA) infections appear primarily as skin or soft tissue infectious (SSTI), but MRSA can cause death and serious morbidity such as pneumonia, cerebral abscess, and septicemia and is transmitted within a variety of settings in hospitals and the community1. The potential hazards of resistant bacteria like MRSA are increasing because resistance is emerging much faster than new antibiotics are being discovered. Fortunately, anti-virulence strategies serve be as a novel mechanism for infection control against Staphylococcus aureus infection, with the potential for a lower risk of rapid resistance acquisition.

Schinus terebinthifolia Raddii, Anacardiaceae (Brazilian peppertree), a traditional Brazilian medicine. Our lab has previously determined that an extract of this plant’s fruits exhibits significant quorum sensing inhibitory activity against MRSA. The extract can decrease the toxin production of *S. aureus*, but does not affect the growth of bacteria. In the present study, we have applied bioassay-guided fractionation techniques to isolate individual bioactive compounds from the complex extract. These compounds are currently undergoing analysis by NMR, MS and X-ray crystallography for the purpose of de novo structural elucidation of active constituents.

P009. Medicinal plants used by Khmer traditional healers for treating liver diseases

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UMR 152 PharmaDev, Université de Toulouse, IRD, UPS, France

Liver cancer represent one of the main public health concern, and it represents the fifth most common cancer worldwide. Although, some medical therapies exist, these treatments are often limited in efficacy and too costly which make them unaffordable for people living in developing countries. In Cambodia, liver cancer is estimated to rank first among all cancer types in men.

In a recent study, it was shown that more than 60% of the patients suffering from liver cancer in Cambodia use traditional medicine for the treatment of their pathology. In order to elucidate the role of traditional medicine in the

survival of liver cancer patients, an ethnopharmacological survey was conducted among traditional healers treating liver diseases in Cambodia.

A total of 42 herbal remedies including 83 medicinal plants belonging to 40 families were mentioned for treating liver disorders. The most predominant families were Leguminosae and Poaceae. Among the plants reported, *Cananga latifolia*, *Andrographis paniculata*, *Smilax* aff. *glabra*, *Gomphrena celosioides*, *Passiflora foetida* and *Physalis minima* were the most cited species. A large part of the herbal remedies used were multi-ingredient recipes and were prepared mainly by a decoction administered orally.

Most of the plants used by healers have already been reported to be used for liver disorders in others ethnobotanical studies and have been studied for their hepatoprotective activity and related activities on the liver. These information support their use in traditional medicine for liver disorders, and should be grasp by authorities for their inclusion in national health care program.

P010. Current Work at the Biology Department Greenhouse

Erik Edwards

Department of Biology, Emory University

At the Biology department greenhouse we assist in research by growing the plants that are needed for the completion of certain experiments as well as providing valuable plant knowledge to researchers. In the greenhouse we are growing five different species of milkweed for research done on monarch butterflies, squash and zucchini plants for research on the gut microbes of squash bugs, fava beans for research on the gut microbes of aphids, and Belgian pea plants for a breeding experiment. In our greenhouse we also breed beneficial insects such as lady beetles for harmful insect control as well as grow starter plants for the Emory educational gardens located around campus and native plant starters that are used by the grounds department and planted in Lullwater and on the main campus grounds. Currently a portion of our greenhouse is being used by the Civitello lab for growing aquatic snails for use in a host/parasite experiment.

P011. Civil War plant medicines inhibit growth and biofilm formation by multidrug-resistant bacteria

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A shortage of conventional medicine during the American Civil War (1861-1865) led Confederate physicians to use native plants as medicines. Francis Porcher, a southern botanist, compiled in 1863 a book of native medicinal plants. In this project, Porcher's book was consulted and samples from three species used as antiseptics during the Civil War were collected in Lullwater Preserve, Atlanta, GA.

Bulk plant specimens were sonicated in methanol, then either partitioned or fractionated by column chromatograph to create 19 samples. Samples were dissolved in DMSO (10 mg/mL) and tested at concentrations ranging from 2-256 µg/mL for growth and biofilm inhibition of methicillin-resistant *Staphylococcus aureus*, carbapenem-resistant *Klebsiella pneumonia*, and multidrug-resistant *Acinetobacter baumannii*.

Samples 617B (hexane partition), 619 (bark extract), and 619F2 (tannin fraction) displayed the most growth inhibition of *S. aureus* with $MIC_{90} \leq 256$ µg/mL, and extracts 619, 619F2, and 620 (gall extract) displayed growth inhibition of *K. pneumonia* and *A. baumannii.* Extracts 616 (leaf extract), 616F1 (non-tannin fraction), 618B (hexane partition), 619F2, 620, and 621 (bark extract) displayed biofilm inhibition of *S. aureus* at sub-MIC_{50} concentrations. Natural products such as those found in these extracts that inhibit biofilm formation in infectious bacteria may have potential utility in treating antibiotic-resistant infections.

P012. Antibacterial Activity of *Prunus serotina* Against ESKAPE Pathogens

Annie Schiffer[1], Sarah Hanson[1], Lisa Giencke[2], Tharangamala Samarakoon[3], Afam Maduka[1], Ella Vardeman[1], James T. Lyles[1], Kat Bagger[1], Monique Salazar[4], Cassandra L. Quave[1,3,4,5]

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Prunus serotina Ehrh., commonly known as black cherry, is a tree species in the Rosaceae family common to the Eastern United States. According to the Native American Ethnobotanical Database, the Chippewa Native American people used a poultice of the inner bark of *P. serotina* as a dermatological aid on old sores and ulcers. As the world faces growing antibiotic resistance, the search for new antibacterial agents, like those used by the Chippewa Native Americans, is critical. *P. serotina* was identified and collected at the J.W. Jones Ecological Research Center in Baker County, Georgia. After separating the specimens into leaves, woody stems, and fruits, each part was ground and

extracted through two consecutive 72-hour macerations using 80% ethanol. The extracts underwent in vacuo concentration, shell freezing, and lyophilization in the phytochemistry lab to isolate active compounds. Extracts were re-dissolved in DMSO, the vehicle in microbiological testing. All extracts of *P. serotina* were screened at a concentration of 256 µg/mL against a panel of ESKAPE pathogens (*Enterococcus faecium*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Acinetobacter baumannii*, *Pseudomonas aeruginosa*, and *Enterobacter* species) for growth inhibitory effects. Although the results suggest growth inhibitory effects of the woody stems towards *K. pneumoniae* and *S. aureus* and inhibition of *E. faecium* by the leaves extract, only the antibiotics inhibited 50% or more of growth. Future directions will involve creating fractions of the extract to further extract the active compounds in the *P. serotina* woody stems.

P013. Impacts of drought on pollinator visitation in scarlet gilia

Kelly Endres, Connor Morozumi, Loy Xingwen, Berry Brosi

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Animal pollination is critical to the reproduction of most terrestrial plant species. Experts predict that human-driven climate change will significantly alter regional weather patterns, with potential impacts on the ecological processes that help to maintain natural ecosystems. In southwestern Colorado, drought frequency is predicted to increase in coming decades and may change patterns of plant-pollinator interactions. Drought can alter the abundance of flowers blooming in a given season, change flowering duration and phenology (timing), decrease nectar volume and increase nectar concentration. This in turn changes the number of flowers available to pollinators, the time and duration at which plant flowering and pollinator activity overlap, and the quality of nectar resources. In this study, we examine how pollinator visitation to a flowering plant, scarlet gilia (*Ipomopsis aggregata*) varies between two extreme drought years (2012 and 2018) to several non-drought years (1996 – 2003). A preliminary analysis comparing one drought year (2018) with a 'normal' year (1997) suggests that mean pollinator visit frequency may be similar between drought and non-drought years. However, we observed a much larger variance in visit frequency during the drought year, with some individual populations receiving extremely numerous to extremely few pollinators during drought. This 'patchiness' of pollinators in drought years could have impacts on certain populations of scarlet gilia, though further analyses are required to determine if drought consistently results in this effect and which pollinator species are most affected.

P014. Analysis of the Antimicrobial Properties of *Pluchea rosea*

Ella T. Vardeman[1], Annie Schiffer[2], Sarah Hanson[2], Lisa Giencke[3], Tharangamala Samarakoon[4], Afam Maduka[2], James T. Lyles[2], Kat Bagger[2], Monique Salazar[5], Cassandra L. Quave[2,4*]

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Pluchea rosea Godfrey (Asteraceae), also known as Rosy Camphorweed, is a flowering plant that is found in marshes, wet prairies, and savannas. *Pluchea rosea* was selected for collection by cross-referencing the Native American Ethnobotanical Database with plants available at the Joseph W. Jones Ecological Research Center in Baker County, Georgia. The Pima Native Americans of Southern and Central Arizona have recorded dermatological applications of related species in the same genus. For example, an infusion of *Pluchea sericea* Nutt. roots is used as a wash for the face and sore eyes. A poultice of the roots is also used to treat snake bites on horses. The aerial parts (leaves, stems, and flowers) and roots were separated after collection to isolate specific chemical compounds found in each part of the plant. The separated ground plant material was extracted by a double maceration with 80% ethanol and processed to isolate soluble phytochemicals through in vacuo concentration and lyophilization. The dried extracts were screened at a concentration of 256 µg/mL for growth inhibitory activity against ESKAPE pathogens *(Enterococcus faecium, Staphylococcus aureus, Klebsiella pneumoniae, Acinetobacter baumannii, Pseudomonas aeruginosa, Enterobacter* sp.) for growth inhibition. ESKAPE pathogens are prevalent infections throughout the world that have developed multidrug resistance. Analyzing potential sources of defense against a panel of ESKAPE pathogens and other arising antibiotic resistant infections is important for combating multidrug resistance as a global public health threat. Beyond this project, *Pluchea rosea* will be fractioned via flash chromatography. The fraction with the most mass will be analyzed by mass spectroscopy to characterize specific active compounds.

P015. *Nymphaea odorata*: Analyzing Growth Inhibition of ESKAPE Pathogens

Afam Maduka[1], Annie Schiffer[1], Sarah Hanson[1], Lisa Giencke[2], Tharangamala Samarakoon[3], Ella Vardeman[4], James T. Lyles[1], Kat Bagger[1], Monique Salazar[5], Cassandra L. Quave[1,3,5,6]

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The Joseph W. Jones Ecological Research Center at Ichauway in southern Georgia has a large diversity of flora that have been used for centuries by Native Americans for both food and medicine. Additionally, the plants found in this region have shown some antibacterial activity against skin infections. *Nymphaea odorata* Aiton (Nymphaceae), also known as the American white water-lily, is a plant that has been shown to have some phenolic compounds, but not many studies have investigated the chemistry or antibacterial activity of the plant. This species is usually found in areas near bodies of water such as ponds or lakes. The plant was selected for analysis by looking at the Native American Ethnobotany research databases, and also cross referencing similar plants with known medicinal affects. After collecting the plant from a small pond area, the roots and stems-leaves were separated and put in a dryer to remove any water. After the plant material was completely dry, it was ground, and then double macerated in 80% ethanol for 72 hours. The macerations were then put on a rotary evaporator to remove the solvent, then shell frozen, and freeze dried on a lyophilizer. The extract was screened for growth inhibitory activity at a concentration of 256 µg/mL against the ESKAPE (*Enterococcus faecium, Staphylococcus aureus, Klebsiella pneumoniae, Acinetobacter baumannii, Pseudomonas aeruginosa*, and *Enterobacter species*) pathogens panel. In the future, chromatography and mass spectroscopic analyses will be applied to further examine the chemical makeup of this species.

P016. Antimicrobial Activity of *Ptelea trifoliata* against ESKAPE Pathogens

Kat Bagger[1], Annie Schiffer[1], Sarah Hanson[1], Lisa Giencke[2], Tharangamala Samarakoon[3], Afam Maduka[1], Ella Vardeman[4], James T. Lyles[1], Kat Bagger[1], Monique Salazar[5], Cassandra L. Quave[1,3,4]

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Ptelea trifoliata (Rutaceae), commonly known as Hop Tree, is a deciduous shrub that grows throughout Northern and Central America. Multiple native peoples from Mexico to Milwaukee have been documented using the plant leaves and roots for varying purposes including gastrointestinal and respiratory medicine, drug potency enhancement, and chemical warfare. Previous scientific studies have discovered active agents within the plant, however, no study has explored its potential dermatological effects. Using this knowledge and additional information from the Native American Ethnobotanical Database, *P. trifoliata* was collected and processed from the Joseph W. Jones Ecological Research Center at Ichauway in Southern Georgia. After processing, extraction by double maceration in 80% Ethanol, and screening *P.trifoliata* against a panel of ESKAPE pathogens (*Enterococcus faecium, Staphylococcus aureus, Klebsiella pneumoniae, Acinetobacter baumannii, Pseudomonas aeruginosa*, and *Enterobacter* sp.) at 256 mg/mL, we noted values that suggest growth inhibition against *S. aureus, E. cloacae*, and *E. faecium*. Due to increasing resistance to various bacteria, reviewing native pharmacological approaches and modernizing their use could revolutionize public health. In future studies, fractionation of each plant part will occur, along with mass spectroscopy on the largest fraction by weight.

P017. Restoration of Species Diversity and Hydrologic Function in Wetlands within the Coastal Dune Lake Watershed

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The Atlanta Botanical Garden in partnership with the Florida Park Service are restoring 220 acres of wetlands at Deer Lake State Park in Walton County, Florida. The project is tasked with improving water quality and restoring wetlands within the watershed of globally rare and imperiled coastal dune lakes in Walton County, Florida. This is made possible by an approximately $6 million grant funded by the Gulf Environmental Benefit Fund (GEBF) through the National Fish and Wildlife Foundation (NFWF). Decades of fire exclusion has led to the degradation of wetlands throughout the southeast. Formerly pruned by frequent naturally occurring fires, areas of wetland hardwood shrubs have expanded their footprint into open herbaceous wetlands. In the continuing absence of fire the shrubs grew to tree form stands, shading out grasses, pitcher plants, and orchids among many other herbaceous species. Reintroduction of fire alone is not enough to restore these wetlands. This project uses both human labor and mechanical means to cut the hardwoods, chip them, and remove the biomass from the site to return the wetlands to an herbaceous dominated, nutrient poor, natural state. Prescribed fire is also reintroduced to mimic the natural process and to reduce the buildup of organic litter. Members of the Atlanta Botanical Garden Conservation and Research Department are responsible for the project coordination, monitoring, and data collection while the Florida Park Service is responsible for the operational components; prescribed fires are conducted jointly. The project as funded will continue through 2021.

P018. Undergraduate Internship Program at the Atlanta Botanical Garden

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Mentoring the next generation of conservation scientists is central to the Conservation & Research department's mission. Our undergraduate intern research programs are facilitated by partnerships with local Atlanta universities including Georgia Tech, Spelman College, and Emory University. Students are able to complete internships for academic credit through their home university. We host students from the greater Atlanta area to gain experience in the field of conservation biology. Undergraduate interns can choose to work on a project of interest. Students in the past have worked on evolutionary biology of orchids, conservation genetics, native pollinator surveys, and rare and endangered species monitoring.

P019. Cross-species genome-wide profiling reveals depletion of characteristic enhancer histone modifications at accessible chromatin sites in plants

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Transcriptional regulation is a fundamental mechanism, and is driven in large part by genetic enhancer elements. While these regulatory elements have been well-studied in animal species, their plant counterparts remain mysterious due to poorly defined secondary characteristics and the absence of high-throughput genome-wide analysis techniques. Here, we compare the enrichment of the four most highly conserved animal enhancer histone PTMs – H3K27ac, H3K27me3, H3K4me1, and H3K4me3 – between Drosophila melanogaster, Homo sapiens, Arabidopsis thaliana, and Oryza sativa genomes. Sites of accessible chromatin were identified through ATAC-seq or DNase-seq, and were analyzed as putative enhancer regions. Additionally, as it has been shown that enhancer activity varies widely between cell types, matched, single cell-type datasets were used for each species. Through the intersection of these data it becomes clear that there are distinct differences between the epigenetic makeup of plant and animal genomes. While these four histone PTMs are present surrounding transcription start sites (TSSs) in all four of the species investigated, A. thaliana and O. sativa showed a marked depletion of these modifications upstream of the TSS, while the animal species showed bimodal enrichment. The plant histone PTM pattern is consistent with the pattern observed at unidirectional promoters, which was further supported by A. thaliana GRO-seq data. When intergenic regions of accessible chromatin were examined – putative enhancer regions – the plant epigenomes showed a distinct depletion of all four of the histone PTMs. However, these sites retain the ability to bind cell type-specific transcription factors and produce RNAs, suggesting that they are functionally active as enhancer elements. Ultimately, this investigation highlights the untapped epigenetic diversity present in higher eukaryotes, and greatly advances the effort to identify genetic enhancers in plants in a high-throughput, genome-wide manner.

P020. Gene regulation during submergence stress response in crop species

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Plants are stationary organisms that must constantly respond to a changing environment in order to survive. Primary detection and response to flood stress occurs in the roots. However, how the specific cell types of the roots respond to these stresses is not completely understood. We have utilized two techniques, INTACT (Isolation of Nuclei TAgged in specific Cell Types) and TRAP (Tagged Ribosome Affinity Purification), to isolate nuclei and translating ribosomes from the root tip of four angiosperms: *Oryza sativa*, *Medicago truncatula*, *Solanum lycopersicum*, and *Solanum pennellii*. We used ATAC-seq (Assay for Transposase-Accessible Chromatin sequencing) to characterize chromatin accessibility changes in root tips in response to 2 hours of submergence. Additionally, we performed RNA sequencing using nuclear RNA, total mRNA, and translating mRNA to characterize the transcriptional and translational response to submergence stress. Threat of flooding stress is perceived differently in each species but our comparison of gene families up-regulated in any RNA population identified a conserved set of Submergence UpRegulated orthologous gene Families (SURFs) present in all four species. Conserved SURFs showed accessible chromatin across their gene bodies during submergence stress. Additionally, promoters of SURFs contained overrepresented motifs that are also found in Transposase Hypersensitive Sites (THSs) more accessible during submergence. Currently, we are elucidating motif occurrence in all four angiosperms across promoters of submergence upregulated genes to identify the transcription factor regulatory module present in all four species. The long-term goal of this research is to identify transcription factors that regulate gene expression during submergence stress in crop species and to use this information to develop hardier crops.

P021. The Role of Fire on Plant Community Composition at Ichauway: A Synthesis

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For nearly a century, the former quail hunting reserve of Robert W. Woodruff, now home to the Joseph W. Jones Ecological Research Center at Ichauway, has been managed with prescribed fire. Ichauway is characterized by a sparse canopy of longleaf pine, virtually no midstory, and extremely high ground cover plant diversity. To better understand the role of fire on plant community dynamics, we have conducted experiments investigating the role of annual prescribed fires conducted in the growing season, the effects of excluding fire from the landscape, and plant community response to fire reintroduction. Our research shows that annual growing season fires largely preclude woody species, including longleaf pine seedlings. Fire exclusion leads to rapid changes in plant community composition, including the development of a dense midstory and a concomitant decline in ground cover species richness. Fire reintroduction shifts the community toward reference conditions, but the rate of recovery depends on many factors. Most of the Ichauway land base is currently managed with a two year fire-return interval, which balances the extremes of these experimental fire regimes: woody species establishment is limited, while still allowing for the recruitment of the next generation of longleaf pine.