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It takes two: A synopsis of a symposium about symbiosis

By Gary A. Krupnick

The 18th Smithsonian Botanical Symposium, co-hosted by the Smithsonian's Department of Botany and the United States Botanic Garden, was held virtually over two days on May 13 and 14, 2021. The Symposium, "Plant symbiosis: The good, the bad, and the complicated," was originally scheduled to take place in May 2020 at the National Museum of Natural History (NMNH) in Washington, DC, but the coronavirus global pandemic pushed the symposium to 2021. The digital event this year successfully brought together six engaging speakers in a Zoom webinar setting to explore current research in the diversity of plant symbioses, examining the relationships plants have with insects, fungi, bacteria, and even other plants. Invited speakers included botanists, ecologists, microbiologists, and geneticists whose research unravels the complicated relationships that plants have with their collaborators and competitors in the natural world.

Eric Schuettpelz, Chair of Botany at NMNH, welcomed the virtual audience to the symposium and Rebecca Johnson, Associate Director for Science and Chief Scientist at NMNH, provided opening remarks. Johnson spoke about our strong relationship with the U.S. Botanic Garden and talked about our shared mission to educate the public about plants and their importance to people and the environment. She celebrated the amazing progress that the Botany Department has made in fully digitizing the specimens in the U.S. National Herbarium and the benefits of those digitized specimens to the scientific community. Even though the museum's doors have been closed, the research still goes on.

Kenneth Wurdack, NMNH Department of Botany, presented the annual José Cuatrecasas Medal for Excellence in Tropical Botany to Sebsebe Demissew from Gullele Botanic Garden and Addis Ababa University, Ethiopia. Demissew accepted the Cuatrecasas Medal from Africa. He expressed his gratitude and encouraged those viewing the symposium to initiate collaboration with Ethiopian botanists (see article on page 6).

Naomi Pierce from Harvard University delivered the first presentation, "Context dependent evolution of the African ant acacia, *Vachellia drepanolobium*, and its multitude of symbionts." She spoke about the classic mutualism of a plant exchanging house and food for patrolling ants. *Vachellia dre-*

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Special Symposium Issue

Symposium

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panolobium with its swollen thorn ant domatia is a dominant tree found on black cotton soils in East Africa. Phytoecious ants (*Crematogaster mimosae*, *C. nigriceps*, and *Tetraponera penzigi*) occupy different trees with one colony per tree.

Pierce's research shows that the classic two-species mutualism is not exactly accurate, and that these mutualisms consist of a multiparty, complex network of interactions. She spoke about her studies with myrmecophiles (insects that live in association with ants), fungi, and bacteria. Her field research shows that 25 species of lycaenid butterflies parasitize acacia-ant mutualisms. She described how trees occupied by the most aggressive ant species, *C. mimosae*, have more myrmecophiles than those inhabited by *C. nigriceps* or *T. penzigi.* Likewise, fungal communities and bacterial communities are distinctive in the trees occupied by different ants. What Pierce found most interesting is that the possible true mutualisms within the system could be between the plant and fungus, and the ants may simply be the vector to carry the fungal cocktail between trees.

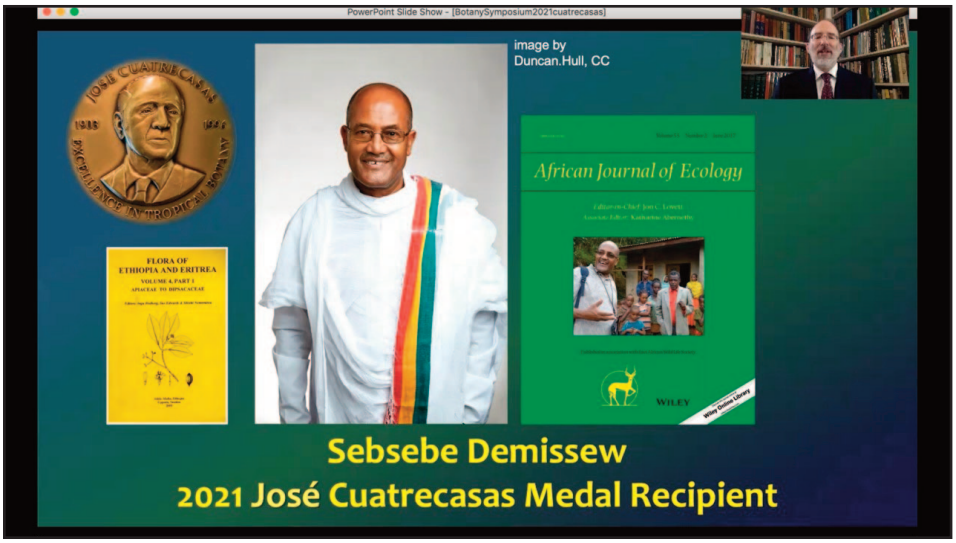
Pierce wrapped up her presentation talking about an unexpected detour that yielded a very interesting result. Can plants respond to the smell of the ants? Different ant inhabitants influence host plant architecture, including domatia size and branching pattern. Pierce's research shows that plants respond differently to the smells of different ant species. Plants exposed to symbiotic ant odor produced more branches, and plants exposed to the odor of *T. penzigi* produced fewer extrafloral nectaries. She summarized that mutualisms are complex networks and because of that one should be careful about assigning causality to observed effects because there may be multiple parties involved.

Susan Pell (top left) moderates a panel discussion with the symposium's first day speakers (clockwise from top right): Jay Bolin, Posy Busby, and Naomi Pierce.

The second presentation of the symposium was delivered by Jay Bolin of Catawba College. His presentation, "*Hydnora* from fungus to foul flower: the natural history of the strangest plants in the world," took us on a journey through the history, ecology, and evolution of a grotesquely beautiful and bizarre plant parasite. Plants in the genus *Hydnora* are entirely subterranean, lack roots, leaves, and chlorophyll, and rely entirely on its host plant for its water and carbon needs. In a brief history lesson, Bolin talked about how Swedish botanist Carl Thunberg in 1775 first described *Hydnora* as a fungus. One year after the original description, Erik Acharius, Linneaus' last student and father of lichenology, redescribed *Hydnora* as a plant in the family Hydnorineae.

Bolin described how the protogynous flowers of *Hyndora* produce heat and emit the odor of rotting meat as a strategy to attract pollinators. Bolin said that pollinating beetles get imprisoned in the chamber flower structure during the female stage of the flower, and then as soon as pollen is shed, the flower walls turn from smooth to textured allowing the pollen-covered beetles to climb out. The fruit of *Hydnora* are large, fleshy, and edible. In germination trials, Bolin discovered that *Hydnora triceps* only germinates in response to the presence of root exudates of its host plant *Euphorbia dregeana* and not related *Euphorbia* species.

Bolin's phylogenetic research of *Hydnora* shows major clades based on host use: a *Euphobia*-parasitizing clade and an early-diverging lineage that parasitizes Fabaceae and *Commiphora*. Over the last 10 years of research, Bolin has simplified the taxonomy, elevated one forgotten species, and described two new species. He spoke about the drivers of speciation including summer versus winter rainfall areas, host specificity and host range, geographic iso-



Ken Wurdack presents the José Cuatrecasas Medal for Excellence in Tropical Botany to Sebsebe Demissew during the virtual 18th Smithsonian Botanical Symposium.

Susan Pell (top left) moderates a panel discussion with the symposium's second day speakers (clockwise from top right): Dong Wang, Manuela Dal Forno, and Leonora Bittleston.

lation, and clear differences in phenology.

The last presentation on the Symposium's first day was presented by Posy Busby from Oregon State University who spoke about the "Assembly and function of the leaf microbiome." Busby began her talk by explaining that all leaves are colonized by microbes, and her focus is on endophytic fungi that live cryptically in leaves. To understand the function of leaf endophytes, Busby described one experiment in which she found that five of seven fungal genera that she tested are capable of modifying disease severity, mostly decreasing, but in one case increasing the severity of the disease. She further examined how fungal communities assemble within leaves and the consequences of the community for ecological function. She described a common garden experiment and a controlled greenhouse experiment using *Populus trichocarpa* (black cotton) and over 30 different commonly occurring endophytes to address these questions.

Busby's common garden study tested host genetic effects and environmental effects on mycobiome composition. The study looked at the natural infection process in contrasting environments: one garden was in the cool, wet environment in Corvallis, Oregon, and the other in a hot, dry environment in Boardman, Oregon. She found over 1,000 fungi across the gardens with differences in communities from early to late season and dissimilar communities in the two locations. Busby found interesting genotype by environment interactions and she found that spatial location within gardens was significant suggesting the importance of stochastic variation.

Busby also talked about her greenhouse experiment in which host genotype and the inoculate process can both be controlled. She found that seven of eight fungi species were sensitive to host genotype, confirming this relationship between genotype and community composition, and the fungi were sensitive to integration order, showing the importance of stochastic variation in organisms. She found that integration history is important for disease outcomes, but that this also varies by genotype. She concluded her talk by explaining that improving our understanding of plant-endophyte symbiosis not only improves our understanding of the ecology and evolution of these fascinating relationships, but it could also potentially improve crop health through microbiome management in agriculture.

The first day of the symposium ended with a panel discussion moderated by Susan Pell (U.S. Botanic Garden) with questions from the audience to the three speakers. Questions included: what was the most surprising thing discovered about plant interactions in the systems that the speakers have studied; how have these interactions indirectly impacted other organisms around the systems that they study; what are the evolutionary advantages of parasitism; and how much genetic material is exchanged between organisms that live in close contact?

The second day of the symposium began with opening remarks and a welcome from Eric Schuettpelz and Saharah Moon Chapotin, Executive Director of the USBG. Schuettpelz emphasized that the symposium is a fundamental collaboration between USBG and the Department of Botany at NMNH, and he thanked everyone on staff at these institutions who helped organize the symposium. Chapotin similarly celebrated the partnership between the two institutions. She highlighted the joint effort to advance native orchid conservation, the collection and preservation of material from endangered plants, and the preservation of wild plant rel-

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On the cover: *Sarracenia purpurea* (photo by R.A. Howard)

Symposium

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atives. She invited those viewing the online symposium to partner with USBG, emphasizing the Garden's living collections of 50,000 plants, including over 500 accessions of plants considered vulnerable and key collections of U.S. native plants, carnivorous plants, economic plants, and aroids.

The first speaker on the second day of the symposium was Leonora Bittleston from Boise State University who spoke about, "Convergent interactions in carnivorous pitcher plant microcosms." Bittleston defined convergent interactions as the independent emergence of multispecies interactions with similar physiological or ecological functions. The focus of Bittleston's research is to understand if convergent interactions occur in pitcher plant communities. Carnivory evolved multiple times across plants and Bittleston described three independent evolutionary events of true pitcher plants across different orders: Nepenthaceae in Southeast Asia, Cephalotaceae in Western Australia, and Sarraceniaceae in the Americas. Do these convergent hosts lead to convergent interactions with their associated communities?

Using metabarcoding of the bacteria and the eukaryotes and shotgun metagenomes, Bittleston found that similar organisms colonized both the *Nepenthes* and *Sarracenia* pitchers, even though they are found on opposite sides of the world. Pitcher plants are rich in degradation enzymes and likely have similar functional roles in the ecosystems in the pitchers. Bittleston conducted a common garden experiment with *Sarracenia* and *Nepenthes* pitchers growing together in the same habitat and found that their pitchers are colonized by very similar communities. For instance, *Nepenthes* hosts were effective alternative hosts for the pitcher plant mosquito, *Wyeomyia smithii*, which is normally only found in *S. purpurea* pitchers.

Bittleston wrapped up her presentation by briefly highlighting some of her continuing work. This research includes the effects of history on bacterial community assembly and function, community dynamics over evolutionary time scales, and how a functional trait-based approach can help us understand microbiomes across space and time.

Dong Wang of the University of Massachusetts Amherst spoke next about, "Indentured servitude: host control of intracellular bacteria in the nitrogen-fixing symbiosis". Plants engage microbes from the soil to help absorb minerals, ions, and water. One of the most important and often limiting elements required by plants is nitrogen, and plants and bacteria have a symbiosis in root nodules where bacteria fix nitrogen for the host plant. Wang described in detail the cell biology of nitrogen-fixation in legume plants.

Wang compared arbuscular mycorrhizal symbiosis (which emerged more than 450 million years ago) to rhizobial symbiosis (which emerged between 50 and 100 million years ago). He asked which functions between the two processes are conserved and which ones are novel. The plant's initial recognition of the microbes is very similar whether it be bacteria or fungus. He explains that the arbuscules and the infection threads are homologous conduits for the microbes. The difference in the nitrogen-fixing process is that a dedicated symbiotic organ called a nodule is produced on the root. Legumes repurposed root developmental genes to construct the nodule.

Wang described why bacterial symbiosis requires a specialized organelle whereas fungal symbiosis does not. Wang explained that legumes developed a mechanism to internalize the bacteria which he described with fine detail. He then explained how legumes reuse directed protein secretion to control the fate of the intracellular bacteria. Wang summarized by saying that the bacteria are domesticated by the host in that the host cell goes to an environment, captures a wild bacterium, put it insides the cytoplasm, then raises it and uses it for its own advantage.

The final presentation of the two-day Symposium was given by Manuela Dal Forno from the Fort Worth Botanic Garden and Botanical Research Institute of Texas. She spoke about, "The lichen dilemma: unveiling diversity in multi-species symbioses." Dal Forno explained that the original concept of lichens has changed from being a dual organism of mycobiont (the fungal partner) and photobiont (the

Naomi Pierce delivers the first presentation examining context dependent evolution of the African ant acacia, *Vachellia drepanolobium*, and its multitude of symbionts.

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photosynthesizing partner) to a diverse community of microorganisms including bacteria. To evaluate who are truly the symbiotic partners in a complex symbiotic system, Dal Forno presented results of a study examining the subtribe Dictyonemateae, a group of basidolichens.

Dal Forno explained that this lichen group was for a long time thought to be composed of a single genus and five species. Many different forms with distinct ecological preferences historically were identified to just one name. To see the true diversity of this group, Dal Forno collected field samples and utilized herbarium specimens to gather ecological, taxonomical, and genetic information. Unsurprising to her, she uncovered an enormous amount of hidden biodiversity. For instance, based on phylogeny, ecology, anatomy, and morphology data, she found that one genus was actually five: Two filamentous genera (*Cyphellostereum*, *Dictyonema*), two foliose genera (*Corella*, *Cora*) and a microsquamulose genus (*Acantholichen*). Further, what was once just five or so species is now over 300 species. A high level of endemism has also been found from previously believed large geographical distributions.

The photobiont in this group is *Rhizonema*, a cyanobacteria. Dal Forno found three putative species: two monophyletic species (*R. neotropicum*, *R. andinum*) and a species complex with many haplotypes (*R. interruptum*). Looking at how these photobiont lineages are distributed across the different lichens in Dictyonemateae, Dal Forno found that many genera of lichens share the same optimal photobiont. Switching to bacterial communities of these same lichens, she discussed that there is a phylogenetic correlation with the diversity and structure of these microbial communities in addition to ecological preferences and growth types. Future research of hers will examine the roles that each symbiont plays in the functionality, stability, and survival of the lichens.

Jay Bolin takes us on a journey through the history, ecology, and evolution of a grotesquely beautiful and bizarre plant parasite, *Hydnora*.

Just as the first day of the symposium, the second day ended with a panel discussion moderated again by Pell with questions from the audience to the three speakers. Some specific questions included: how do pitcher plants change when growing in nutrient-rich soils; how often has nitrogen-fixation evolved; and what adaptations allow lichens to grow in extreme environments? More general questions included: where do you think we are on the discovery curve of these symbiotic dynamics and where do you see your field heading; are there any common characteristics of obligate organisms where perhaps they have lost something in their genomes; and, for the non-obligate participants, what is the impact of being in a mutualistic or symbiotic relationship that changes their function rather than growing on their own?

Posy Busby speaks about the assembly and function of endophytic fungi that live cryptically in leaves.

Over the two-day period, over 220 people attended the symposium. Those who viewed the proceedings watched from 22 countries. All speaker presentations, opening remarks, the presentation of the José Cuatrecasas Medal, and the round-table panel discussions were recorded and are available for viewing at NMNH's Natural History for Scientists YouTube page at <https://www.youtube.com/playlist?list=PLQmxS2U3B6Kbo8GKodMg6FB6K5EHaBaVI>.

The 19th Smithsonian Botanical Symposium is scheduled to take place at the National Museum of Natural History and the U.S. Botanic Garden on Friday, May 13, 2022. The topic is still to be determined. Check the Department of Botany's website for updates.

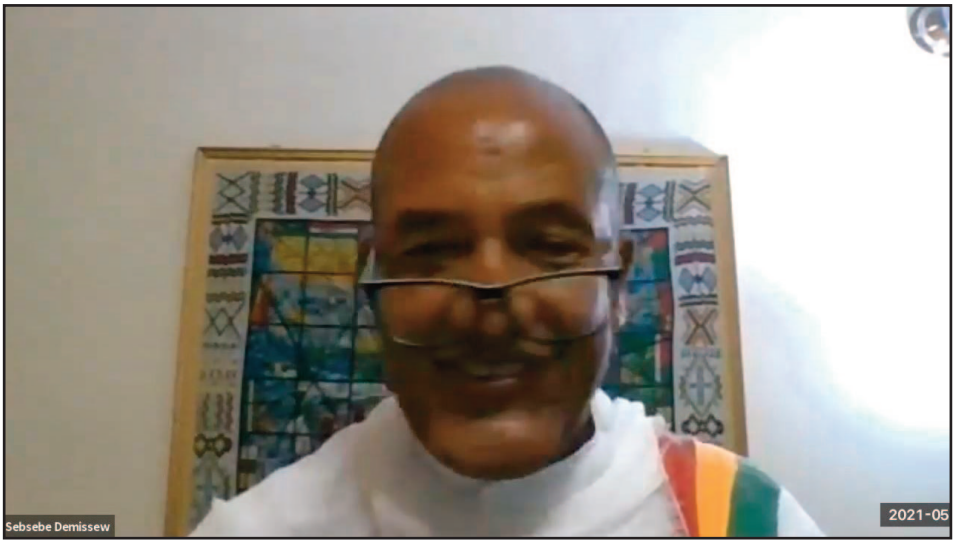
Demissew receives 18th Cuatrecasas Medal

The José Cuatrecasas Medal for Excellence in Tropical Botany is named in honor of Dr. José Cuatrecasas, a pioneering botanist and taxonomist, who spent nearly a half-century working at the National Museum of Natural History. Cuatrecasas had a distinguished career devoted to systematic botany and plant exploration in tropical South America, especially in the Andes, and this award serves to keep vibrant his accomplishments and memory. The Department of Botany and the U.S. National Herbarium present this award at the Smithsonian Botanical Symposium to a botanist and scholar of international stature who has contributed significantly to advancing the field of tropical botany. The award consists of a bronze medal bearing an image of José Cuatrecasas on the front with the recipient's name and date of presentation on the back.

This year the 18th José Cuatrecasas Medal for Excellence in Tropical Botany was presented to Sebsebe Demissew.

Professor Demissew earned a B.Sc. in 1977 and a M.S. in 1980 from Addis Ababa University, and his Ph.D. in 1985 from Uppsala University for research on *Maytenus*, a genus of Celastraceae in tropical Africa and Arabia. His doctoral training was sponsored during the early stages of the Ethiopian Flora Project and he later (from 1996 to its successful completion in 2009) provided leadership of the project involving 91 scientists from 17 countries. This 8-volume work covering 6000 species of ferns and flowering plants with 12 percent endemism, is one of the few finished African floras.

Demissew has authored or coauthored 250 scientific publications and is the authority for 94 new plant names in 13 families. His career at Addis Ababa University has continued as a faculty member and Dean, and he is presently a Professor of Plant Systematics and Biodiversity, and Executive Director of the Gullele Botanic Garden, which is a joint venture of the university and the city of Addis Ababa. The botanic garden is the first of its kind for Ethiopia and was opened to the public in 2019. It has an education and conservation mission. He has had a leadership role in international organizations, and notably as Secretary General from 2000-2003 of AETFAT (Association for the Taxonomic Study of the Flora Tropical Africa). In 2016 he was awarded the Kew International Medal for internationally recognized work aligned with the science and conservation mission of the Royal Botanic Gardens, Kew.



Sebsebe Demissew accepts the 18th José Cuatrecasas Medal for Excellence in Tropical Botany remotely from Ethiopia, Africa.

The Cuatrecasas Medal selection committee took special note of Professor Demissew's many accomplishments as a scientist, tropical botanist, and educator. The committee noted his lifelong work to document and conserve Ethiopian biodiversity with its rich endemism, including leadership of the Ethiopian Flora Project and the National Herbarium. He has been a role model for internationally recognized excellence in the botany of tropical Africa.

Ken Wurdack presented the medal virtually to Demissew via the video conferencing platform Zoom at the 18th Smithsonian Botanical Symposium. Speaking from Ethiopia, Demissew was grateful and humbled to be the recipient of such a prestigious award. Demissew spoke about his research both within Ethiopia and outside of the country, including Somalia, Kenya, Uganda, Tanzania, Cameroon, and South Africa. During his thank you speech, he encouraged the audience to consider initiating collaborations in geography, botany, and geology with Addis Ababa University. He described the vegetative diversity of Ethiopia and explained the wide geographic altitude, with areas as low as 125 meters above sea level to as high as 4530 meters on the mountains.

The past recipients of the Cuatrecasas Medal are Rogers McVaugh from the University of North Carolina at Chapel Hill (2001); P. Barry Tomlinson from Harvard University (2002); John Beaman from the Royal Botanic Gardens, Kew (2003); David Mabberley from the University of Leiden, The Netherlands, and the Royal Botanic Gardens, Sydney (2004); Jerzy Rzedowski and Graciela Calderón de Rzedowski from Instituto de Ecología del Bajío, Michoacán, Mexico (2005); Sherwin Carlquist from Rancho Santa Ana Botanic Garden and Pomona College (2006); Mireya D. Correa A. from the University of Panama and Smithsonian Tropical Research Institute (2008); Norris H. Williams from the Florida Museum of Natural History and the University of Florida, Gainesville (2009); Beryl B. Simpson from the University of Texas at Austin (2010); Walter S. Judd from the University of Florida at Gainesville (2012); Ana Maria Giulietti Harley from the Universidade Estadual de Feira de Santana, Brazil (2013); H. Peter Linder from Zurich University (2014); Paulo Günter Windisch from Universidade Federal do Rio Grande do Sul, Brazil (2015); Kamal Bawa from the University of Massachusetts Boston (2016); Robin B. Foster from the Field Museum (2017); Alan K. Graham from the Missouri Botanical Garden (2018); and Sandra Knapp from the Natural History Museum in London (2019).

Abstracts from the speakers of the 18th Smithsonian Botanical Symposium

The 18th Smithsonian Botanical Symposium, "Plant symbiosis: The good, the bad, and the complicated," was held 13-14 May 2021. The invited speakers explored current research in the diversity of plant symbioses, examining the relationships plants have with insects, fungi, bacteria, and even other plants. Below are the abstracts from the papers that were presented by the invited speakers.

Leonora Bittleston speaks about convergent interactions in carnivorous pitcher plant microcosms.

Naomi Pierce
Harvard University

"Context dependent evolution of the African ant acacia, *Vachellia drepanolobium*, and its multitude of symbionts"

The Whistling Thorn Acacia, *Vachellia drepanolobium*, is a dominant tree on black cotton soils of East African savannas. In exchange for protection against enemies, these ant acacias secrete food rewards from extra-floral nectaries and provide housing in the form of swollen stipular thorns for at least four different species of ant inhabitants. Ant acacias are finely adapted to read the signals of their ant partners, and experiments show they can respond selectively to volatile compounds from different ant species. In addition, abiotic factors such as the stoichiometry of soil nutrients can exert profound effects on these associations. Along with the ants, the trees host a cornucopia of myrmecophiles and microbes, each of which contributes to shape the context-dependent evolution of this complex symbiosis. Fungi in particular may interact symbiotically with host trees to enhance growth, and ants likely play an underappreciated role in vectoring fungi and bacteria between trees.

Jay Bolin
Catawba College

"*Hydnora* from fungus to foul flower: the natural history of the strangest plants in the world"

The parasitic genus *Hydnora* undoubtedly include the strangest plants in the world. Ranging from the Cape of Good Hope to the Horn of Africa and across the Red Sea to the Arabian Desert, the parasitic plant genus *Hydnora* has astounded and amazed naturalists that are fortunate enough to observe it. However, few encounter this bizarre and furtive plant parasite, because it spends most of its life underground stealing water and nutrients from the roots of host plants. When *Hydnora* emerges from the soil, the grotesquely beautiful flowers defy expectation by looking and smelling of rotting meat, indicators of an incredible pollination story. Bolin, an authority on this twisted branch of life, describes the history, ecology, and evolution of this wonderful group of botanical oddities, recounting explorations and new species discoveries from the restricted diamond fields of Namibia to the margins of the Rub' al Kali desert in the Sultanate of Oman.

Posy Busby
Oregon State University

"Assembly and function of the leaf microbiome"

Non-pathogenic microfungi live in and on the leaves of all land plants. Individual fungi within these cryptic communities can alter plant disease severity by antagonizing or facilitating pathogens, or by modulating plant defense. Yet how the leaf mycobiome as a whole alters the landscape of plant disease is poorly understood. In this talk, Busby describes her work in *Populus trichocarpa*, the black cottonwood of the Pacific Northwest USA, which seeks to elucidate leaf mycobiome assembly processes and the consequences of the leaf mycobiome for plant disease.

Leonora Bittleston
Boise State University

"Convergent interactions in carnivorous pitcher plant microcosms"

The 'pitchers' of carnivorous pitcher plants are exquisite examples of convergent evolution. In addition to attracting and digesting prey, they house communities of living organisms. Bittleston asks if these communities also converge in structure or function. Using samples from more than 330 field-collected pitchers of eight species of Southeast Asian *Nepenthes* and six species of North American *Sarracenia*, she demonstrates that the pitcher microcosms are strikingly similar. Compared to communities from surrounding habitats, pitcher communities house fewer species. While communities associated with the two genera contain different microbial organisms and arthropods, the species are predominantly from the same phylogenetic clades. Microbiomes from both genera are enriched in degradation pathways and have high abundances of key degradation enzymes. Moreover, in a manipulative field experiment, *Nepenthes* pitchers placed in a North American bog assembled *Sarracenia*-like communities.

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Abstracts

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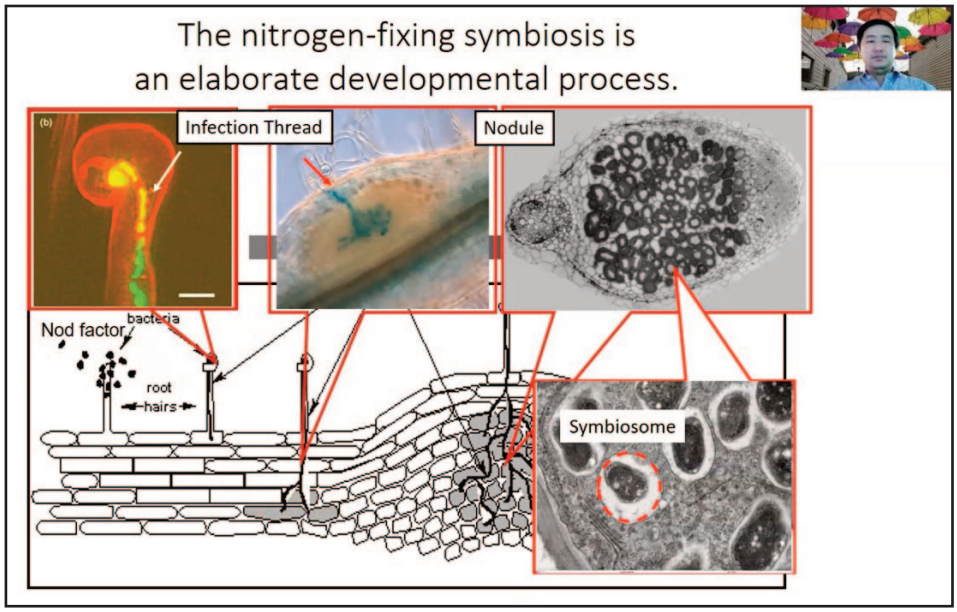
Dong Wang

University of Massachusetts Amherst

"Indentured servitude: host control of intracellular bacteria in the nitrogen-fixing symbiosis"

The nitrogen-fixing symbiosis between legumes and rhizobia carries enormous economic and environmental values. A defining feature of this interaction is the intracellular association of the microsymbiont with its host cell. Wang's research group is searching for the host determinants that allow the bacteria to enter the host cytoplasm, survive in a membrane-bound compartment, and transform into a nitrogen-fixing organelle. One critical insight from their on-going investigation is that the membrane interface between the bacteria and the host cytosol is an important site for signal and nutrient exchange. The host cell redirects its secretory pathway to deliver onto or across this membrane a variety of important molecules, where they interact with the bacteria directly or indirectly to determine the outcome of this interaction.



Dong Wang presents a talk about host control of intracellular bacteria in nitrogen-fixing symbiosis.

Manuela Dal Forno

Fort Worth Botanic Garden | Botanical Research Institute of Texas

"The lichen dilemma: unveiling diversity in multi-species symbioses"

Lichens are complex symbiotic units formed by a main fungal partner, a green algal and/or a cyanobacterial partner, along with a diverse community of microorganisms. They represent an important and diverse biological group present in most terrestrial ecosystems, and a main nutritional strategy in Fungi. Despite being classic examples of symbioses, lichens remain broadly unknown systems given its multifaceted interactions and controversial definitions. In this talk, Dal Forno discusses current concepts in lichenology and utilizes her research in the subtribe Dictyonemateae to present examples of how diversity of symbiotic fungi and bacteria can shape our understanding of lichens.

Smithsonian
Botanical Symposium

Manuela Dal Forno gives a talk in which she reveals the diversity of multi-species symbioses within the basidolichen subtribe Dictyonemateae.

Maria A. Faust (1930-2021)

Dr. Maria Anna Faust, research botanist emerita from the Department of Botany, passed away on April 24, 2021 at the age of 91 from medical complications related to stroke.

Faust specialized in tropical marine dinoflagellate taxonomy and ecology. Born in Hungary, she received a BA (1951) from the Agricultural University of Budapest. Shortly after the Hungarian Revolution of 1956, she fled to Yugoslavia with her husband and infant daughter. There they lived in a refugee camp for 20 months before immigrating to the United States. She then earned her MS (1962) in microbiology at Rutgers University and her PhD (1970) in aquatic microbiology at the University of Maryland at College Park.

Faust began her Smithsonian career at the Radiation Biology Laboratory (SRBL) in Rockville, MD in 1973. After this laboratory was closed and staff reassigned, she worked at the Smithsonian Environmental Research Center (SERC) in Edgewater, MD and ultimately joined in 1987 the Botany Department, National Museum of Natural History-Museum Support Center in Suitland, MD, where she worked until her retirement in 2009. In her 40 year career, she published over 120 research papers. Her most notable publication is "Identifying Harmful Marine Dinoflagellates" (*Contributions from the United States National Herbarium* 42: 1-144; 2002). In 2004, Faust received the Award of Excellence by the *Phycological Society of America*. And in 2010, she was a co-recipient of the Tyge Christensen Award for the best paper published in *Phycologia* in 2009 for a monograph on the toxic dinoflagellate genus *Gambierdiscus*.

Faust was a mentor and a great source of inspiration for many microbiologists and phytoplankton taxonomists, not just those starting their scientific research but also those well established in their careers. Her microscope skills (Scanning Electron Microscope, light and dissecting) were impressive, detailed, and artistic. Her eagerness to share her knowledge and passion for dinoflagellate research has left a lasting impression on many. Her wisdom, kindness, and eagerness to help others will always be remembered.

Faust, predeceased by her husband Dr. Miklos Faust, is survived by her daughter, Judit Quasney and son-in-law Thomas Quasney of Silver Spring, MD, her grandchildren, Evan Quasney of Mercer Island, WA, Daniel Quasney of Washington, DC, and two great grandchildren.

Left: Maria Faust, 2010. Below: Faust in 2009 at the Carrie Bow Cay field station, on the Meso-American Barrier Reef in Belize. (photos by the Smithsonian Institution)

A new species of *Pisonia* birdcatcher tree discovered in the island of Jamaica

By Marcos Caraballo-Ortiz, Keron Campbell, and Sashalee Cross
-Adapted from <https://marcoscaraballo.com/new-pisonia-from-jamaica/>

The diverse Caribbean islands are now home to a new species of tree. In Jamaica, botanists have described a new species of *Pisonia*, a genus better known as "birdcatcher" trees.

This new species, named *Pisonia jamaicensis* and published in the *Journal of Plant Taxonomy and Geography* (*Webbia*), only grows in the central and western mountains of Jamaica. Unlike other members of the genus, the tree is uncommon and even endangered at some localities.

This species adds to the rich biodiversity of the island that records an endemism of over 30 percent with respect to seed plants.

Jamaica is located in a region that is a biodiversity hotspot, and even though the island has been botanized for centuries, this discovery indicates that there is work yet to be done.

Botanists who found this tree in past years confused it with other more common species, including the Water Mampoo (*Pisonia subcordata*) from the coasts of Puerto Rico and Lesser Antilles.

Tree of *Pisonia jamaicensis* growing on the summit of a limestone hill in Jericho, St. James Parish, Jamaica. (photo by K. Campbell)

In early 2000s, the prominent and expert botanist George Proctor recognized the distinctiveness of the new species and proposed naming it "*Pisonia jamaicensis*" in honor of its home island, Jamaica. However, Proctor never formalized the description, and the species remained hidden under incorrect names, and therefore, unknown to science until now.

Female (pistillate) flowers and fruits of *Pisonia jamaicensis*. (photo by K. Campbell)

Now, a team of young botanists from the Caribbean completed the work and described the species, maintaining the name proposed by Proctor to recognize his contribution. The botanists are **Marcos Caraballo-Ortiz** from Puerto Rico (Botany Department, Smithsonian Institution), and Keron Campbell and Sashalee Cross from Jamaica (Natural History Museum of Jamaica, Institute of Jamaica).

Besides describing the new species, the botanists compiled a list of all currently known species of *Pisonia* worldwide, including their major and minor geographic distributions, and also built a taxonomic key to distinguish all kinds of birdcatcher trees reported for the Caribbean.

These resources intend to assist scientists around the globe to better understand the diversity of these interesting trees and to identify them, or at least narrow down possibilities when they encounter them out in the field.

The list of species was necessary because birdcatcher trees have been historically difficult to identify, and their taxonomy was complex because of the many fragmented taxonomic treatments dating back to more than a hundred years.

In fact, this is the first time in more than 50 years that a taxonomic key has been built to separate all the *Pisonia* from the Caribbean, which is especially relevant

because most species are found there. The taxonomic key is important because it aims to provide the first steps to develop further studies on the diversity and ecology of these interesting trees.

Regarding the infamous bird-dispersal mode for the *Pisonia* fruits—which can tangle birds and kill them by starvation—researchers have not found evidence that the sticky fruits of the new species are affecting the populations of native birds.

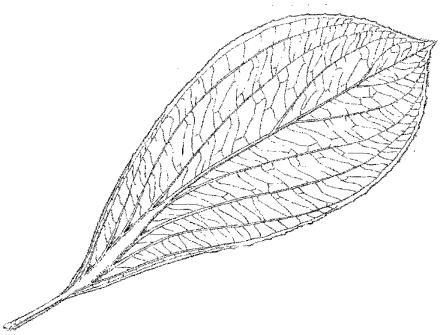
Interestingly, this tree has fewer sticky glands than most other species, which seems to be more "friendly" to the wildlife by having fruits easier to remove.

Jamaica's only other species, *Pisonia aculeata* is a straggling shrub with more sticky glands and is armed with curved spines from which it derived its local names Cockspur and Wait-a-bit, and consequently, can be considered less friendly. It is also more widespread throughout the island than *Pisonia jamaicensis* and found in secondary thickets and woodland margins, mostly on limestone.

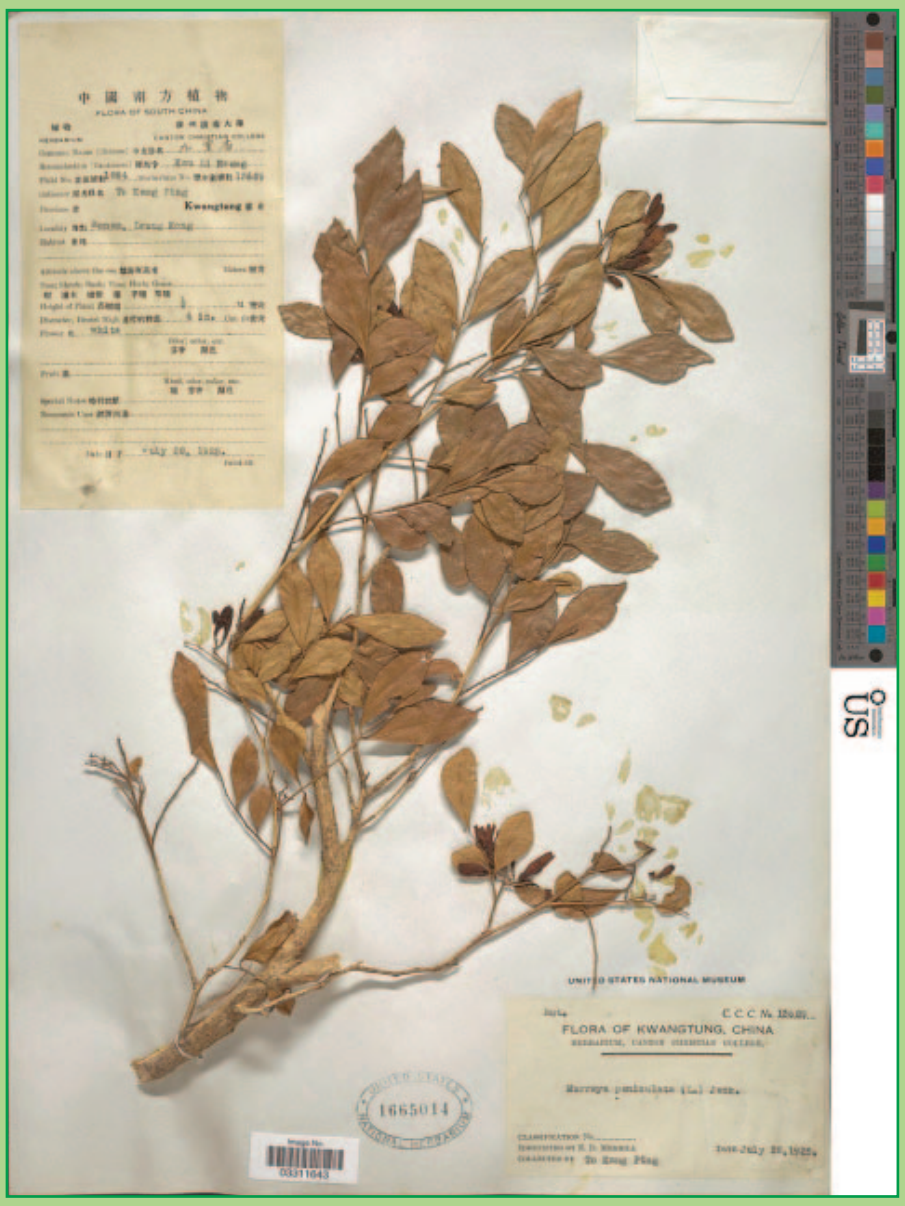
The finding of a new species of tree is evidence that botanical studies in Jamaica are far to be complete and reflect the need to perform floristic studies at regional scales.

Endemic species such as *Pisonia jamaicensis* are a valuable national treasure, and efforts to understand more about their biology and grant them legal protection are critical to preserve their existence for future generations.

The complete scientific article is open access and can be viewed and downloaded from the website of the *Journal of Plant Taxonomy and Geography* (*Webbia*) at <https://oaj.fupress.net/index.php/webbia/article/view/10018/9339>.



SPECIMEN SPOTLIGHT



***Murraya paniculata* collected by T.K. Ping in Guangdong, China on 28 July 1925.**

M-U-R-R-A-Y-A. That's how you spell, *Murraya*, a genus of flowering plants in Rutaceae, the citrus family. It is also the winning word that earned 14-year-old Zaila Avante-garde the Scripps National Spelling Bee championship in July 2021. She is the first Black-American to win the 96-year-old event, and she hails from Harvey, Louisiana.

Murraya plant species are native to Asia, Australia, and the Pacific Islands. Orange jasmine (*Murraya paniculata*) attracts bees with its small, fragrant flowers and attracts small frugivorous birds with its oval, orange-red berries. The U.S. National Herbarium houses 70 pressed specimens of *M. paniculata*, including one collected in southeast China in 1925, coincidentally the same year as the first Scripps National Spelling Bee.

The Department of Botany extends its congratulations to Zaila on her botanically inspired win!

New species of Gesneriaceae named after Funk

- Adapted from Nature India

Researchers from the Indian Institute of Science Education and Research, Bhopal in Madhya Pradesh, India have discovered a new species of plant in Mizoram belonging to Gesneriaceae.

The discovery, they say, is the fruit of extensive fieldwork across northeast India and rigorous sifting through plant specimens in herbariums across the world.

The new plant species sheds some light on the unique evolutionary trajectory of flora in the northeastern parts of India. Such findings, the researchers say, are important in designing conservation approaches to protect the fragile ecosystems of northeast India.

Named after the late botanist **Vicki Ann Funk** from the Smithsonian National Museum of Natural History (NMNH), the plant (*Didymocarpus vickifunkiae*) is an endangered species that currently grows in three districts of Mizoram. It grows on moss-covered trees and blooms light pink flowers during the monsoons.

A newly discovered violet is named *Didymocarpus vickifunkiae* after American botanist Vicki Funk. (photo by N.S. Prasanna)

The author's write, "Vicki was a mentor to many tropical botanists and **Vinita Gowda** is one of them. Vicki was profoundly interested in studying the Indian flora, and specifically Asteraceae. In recognition of her immeasurable contribution to tropical botany, systematics, diversity in science, and women in science we honor her with the species epithet."

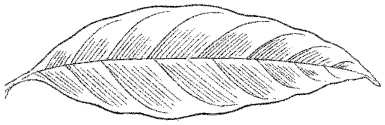
Historical collections and surveys indicate that this species is restricted to high elevation, wet evergreen forests of the Indo-Burma biodiversity hotspot region. The plant and its close relatives span from the western Himalayas to Sumatra. Most of these species are endemic and require specialized habitats to survive, thus acting as an indicator of pristine habitats, the researchers report.

There are 106 currently known species of this genus, of which 26 are present in northeastern states of India.

"This discovery shows that northeast India is home to highly diverse flora because of its unique environment as part of two biodiversity hotspots — the Indo-Burma hotspot and the Eastern Himalayas," says IISER botanist Vinita Gowda, a former post-doctoral fellow at NMNH.

The discovery was published in *Systematic Botany* (46: 229-234; 2021. http://doi.org/10.1600/036364421X16128061189486).

***Didymocarpus vickifunkiae* grows on moss-covered trees and blooms light pink flowers during the monsoons. (photo by N.S. Prasanna)**

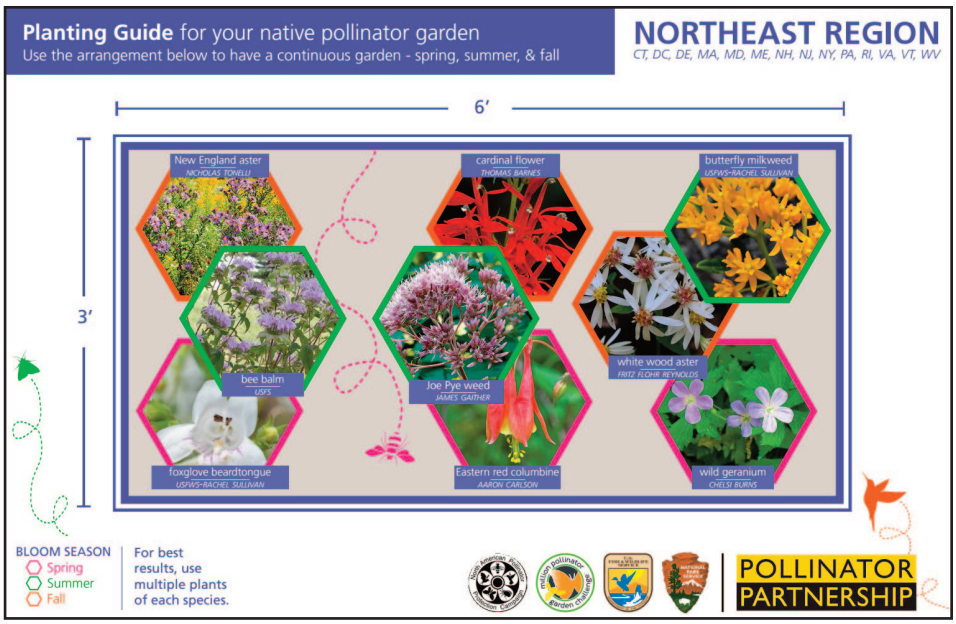


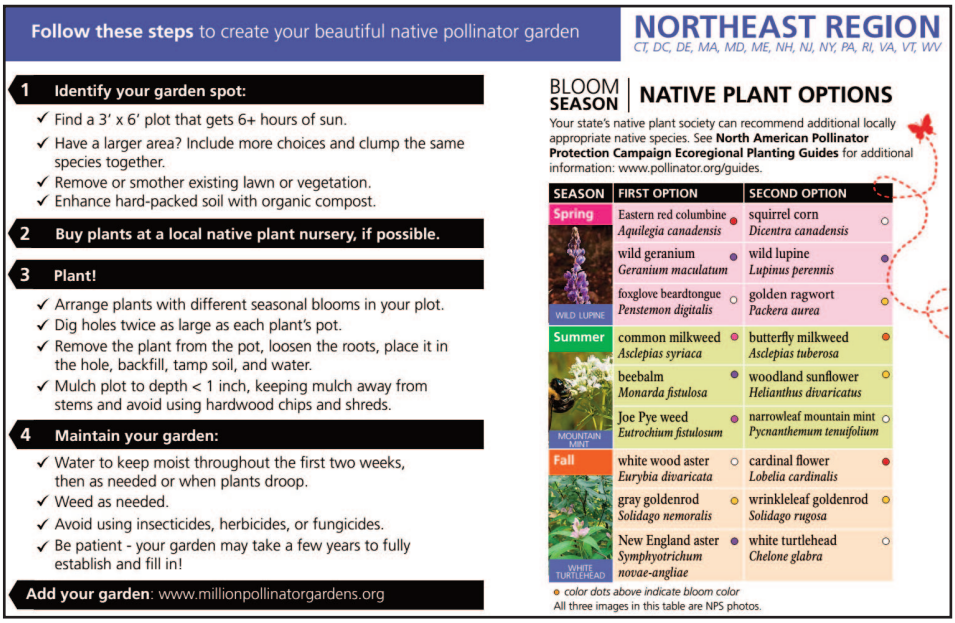
Native Pollinator Garden Recipe Cards are now available

The National Museum of Natural History has teamed with the North American Pollinator Protection Campaign (NAPPC), a collaborative body of more than 170 partners, in making Native Pollinator Garden Recipe Cards. These regionally specific cards, available for download at <https://www.pollinator.org/gardencards>, were designed with easy-to-follow guidelines for creating home pollinator gardens that provide a diverse and colorful floral display throughout all growing seasons. The regional cards provide specific recommendations for native plant species to meet the unique environmental characteristics associated with each region and the pollinators that depend on native habitat. Look for these plants where native plants are sold – native plant nurseries and plant sales sponsored by native plant societies, nature centers, and conservation districts.

Birds, bats, bees, butterflies, beetles, and other animals that pollinate plants are responsible for bringing us one out of every three bites of food. They also sustain our ecosystems and produce natural resources by helping plants reproduce. This service is a precious resource that requires attention and is increasingly in jeopardy. Many populations of pollinating species are in decline and this decline is attributed most severely to a loss in feeding and nesting habitats. Adding natural habitat areas helps. Home gardens can attract and benefit pollinators.

The Native Pollinator Garden Recipe Card series has been designed for the Northeast, Northwest, Intermountain West, Great Plains, Midwest, Southwest, Texas, and Alaska with additional cards coming soon for N. California, S. California, and the Southeast. The recipe cards were a collaborative effort developed by the NAPPC Selecting Plants for Pollinators Task Force of which **Gary Krupnick** (NMNH) is a member. NAPPC's mission is to encourage the health of resident and migratory pollinating animals in North America. NAPPC raises public awareness about pollinators' importance to agriculture, ecosystem health, and food supplies, promotes restoration of pollinator habitat, and supports scientific, economic, and policy research. As a founding participant, NMNH has been a collaborative partner of NAPPC since its inception in 1999.





This Northeast Native Pollinator Garden Recipe Card is one of eight new 2-sided cards designed with easy-to-follow directions for creating home pollinator gardens that provide a diverse and colorful floral display throughout all growing seasons.

How to find black walnuts

By Julia Beros

It's the kind of object you might stumble over while on a walk and kick around with your foot accidentally, a palm sized sphere wrapped in a green and rumpled husk pocked like an eczema flare up, with a density that makes a crisp 'plunk' when it falls from the tree. It's the kind of object you pick up for only a moment, but it leaves a stain of stench and tint on your fingers and a lingering waft of spicy and bright aroma along your trail. This time of year (mid-to-late June) is when these fruits begin to plump up and get picked too young by squirrels with an appetite for impatience. These black walnuts, the young fruits of *Juglans nigra,* begin to litter the forest floor as summer progresses into a dense heat, and for some they are a prized ingredient in a family tradition.

It's this mid-to-late June time of year, according to the notes in my father's book, when it's right to begin collecting young black walnuts. It's this time of year when large glass jars sit on the front porch, filled nearly to the lip with a thick inky liquid packed with vaguely identifiable objects that bob as the pressure shifts inside and stews under the height of summer sun. This is how my father makes orahovica, a walnut liqueur that is brewed on porches and windowsills that look out over the Dalmatian coast. Here in Maryland he continues to brew using the secrets from his family's recipes, and is now developing his own confidential techniques with local ingredients to enjoy a familiar flavor.

Black walnut (*Juglans nigra*) in a forest of the Mississippi Valley, with Robert Ridgway seated at base of tree, 1881. (photo by Smithsonian Institution Archives)

In Croatia homemade liqueurs like orahovica (and its herbal cousin travarica) make use of abundant local plants and the by-products from wine making (brandy) to create richly aromatic and punchy sips of aperitifs, often enjoyed in the company of guests or as a medicinal nightcap. As each home has their own "perfected" recipe whether it be the "perfect" ratio of ingredients, the "perfect" source of walnuts, the "perfect" windowsill with the "perfect" conditions, or the "perfect" home-life dynamic, each home has an inimitable version of the same drink. It's the kind of beverage that you are handed when you are welcomed into a neighbor's home as an introduction to get to know them better, each sip revealing more about the brewer. These traditional brandy drinks were once the libation of choice to share with friends but have become less and less popular with newer generations (perhaps due to the slightly laborious process). Opting for "colas and other soft drinks," my dad condemns, few people keep up the home-brew tradition. While it may be harder these days to find people selling their hooch at the markets, and fewer glass jars guarding windowsills, these traditional recipes are still passed down like family heirlooms.

Here in Maryland the trees of *Juglans nigra* grow stoic and calm throughout the region. A native tree to the Eastern U.S., the black walnut is distinguishable for its dark deeply grooved bark, creating linear patterns, and its often sprawling canopy of large alternate compound leaves. It is described as one of the "most valuable and beautiful native trees" in the *Peterson Eastern Trees Field Guide*, and is prized for its durable and easily workable wood, reiterated in Eliot Wigginton's 1975 book on summer and fall wild plant foods, *Foxfire 3*. Both sources make note that for this reason most large black walnut trees have been felled for furniture and other trades leading to overharvesting. Notable ornithologist, and first appointed curator of birds at the Smithsonian Institution, Robert Ridgway even made great efforts to express concern over the rapid deforestation in his native Mississippi valley region between 1876 and 1881, writing to then Assistant Secretary Spencer Fullerton Baird and including photographs of himself enjoying the pleasant shade afforded by the

black walnuts.

Historically black walnut wood has been used for gunstock and cabinetry, the bark for tanning, the nut husks for dyeing, the bruised nuts for stunning fish for easier capture, and the trees are said to have been frequently planted as ornamentals, marking old home-sites "long after the dwellings are gone." *Juglans nigra* is also known to be an antagonistic companion plant, for its roots secrete a toxic substance, *juglone,* making its root zone nearly uninhabitable by other plants. The fruits are eaten by human, mouse, and squirrel alike, all enjoying the uniquely acerbic and rich taste easily discernible from the familiar and widely available English walnut. It is being studied for viability as a rehabilitation plant for disturbed areas and shows promise for aiding in land reclamation of mined sites. The ground shells of the fruits are used in a variety of applications in the automobile and airline industries. Despite black walnut's purported beauty, value, and incomparable flavor, this is not a nut you will find easily in the grocery store. Nor a nut you will easily crack open.

Growing up in Maryland, our neighbor had a black walnut tree that hung its shade and its fruits over our driveway and house. Although the clutter of walnuts rang loudly on the roof, night and day, and the risk of staining our hands while fumbling with the fruits left spots of sepia in our laundry bin, the tree inspired my father to brew orahovica like his father and mother did (each with their respective secret recipes) only using black walnuts as opposed to the more commonly used English walnut. Sadly, our neighbor had to cut the tree down (along with the nearby mulberry, another tree whose fruits often ended up in our bellies). This did not stop production though. My father set out on bike trails and neighborhoods, looking for the optimal trees, far enough away from roads and car exhaust and bountiful enough with fruit to collect for his yearly batch of brewing.

A specimen of *Juglans nigra* collected by C.L. Pollard in 1895 in Montgomery County, Maryland displaying the plant's compound leaves and fruit.

Young fruit of *Juglans nigra*. (photo by R.A. Howard)

Today we walk through Rock Creek Park and I ask him how he knows when and where to harvest black walnuts. He tells me he just knows. He elaborates that the trees are very distinct, and we will surely pass one soon. He starts by searching for the right bark (although he already knows the location of the larger black walnut trees in the park, having spent time biking and walking through to map out the spots for collecting). "It's a bit serpentine, and thickly crackled. Maybe a bit dark too," he describes. We find a skinny and young tree, the crown so high we can't get close to any of the leaves.

My father takes me out to the clearing where he knows a big tree awaits. The branches outstretched and buoyant like the arms of a marionette held at length by a string and the shade stippling the grass with tiny patches of light. He pulls a leaf closer to examine, describing to me its distinctions. "I see," I answer, "these are alternate compound, and the leaflets look slightly toothed. It seems the terminal leaflet is lacking on most of these leaves," I continue. "Compound?" he asks me, and I describe to him that the "leaf" is the entirety of the multiple leaflets he was seeing individually. We found ourselves looking at the same tree describing the same things with a different vocabulary. This was our coincidence of botanical knowledge: mine relayed through field books and schoolwork and his transferred through generations of keen observation and culinary heritage. We continued to converse over the walnut branches describing it in detail, meanwhile the dense overripe fruits thumped to the ground and began rolling down the hill.

The flora of the D.C. region is plentiful with gastronomic foraging, abundant with plants and foods both rooted in indigenous traditions and able to make connections with those of immigrant cultures. Through local plants like the bright raspberries that speckle hillsides and creep along the rivers, dandelions and plantain leaves, or the elusively in-demand pawpaws, there is a plethora of ways to learn about and explore the botanic and cultural history of food. For my family the black walnut has become something more than a beautiful native tree that provides ecological, agricultural, and industrial value, it ties us back to my father's family traditions and to the glass jar windowsills of the Dalmatian coast.

Memorial held for Harold Robinson

Harold Ernest Robinson, PhD, born in 1932 in Syracuse, NY, and raised in Winchester, VA, passed away on December 17, 2020, at the age of 88. His ashes were interred on Saturday 26 June 2021 at Mount Hebron Cemetery, Winchester, Virginia, in the family plot next to his mother Mabel, along with his father Ernest, and brother William. His brother Charles Robinson's ashes, who passed away earlier, were also interred alongside Harold according to Harold's request.

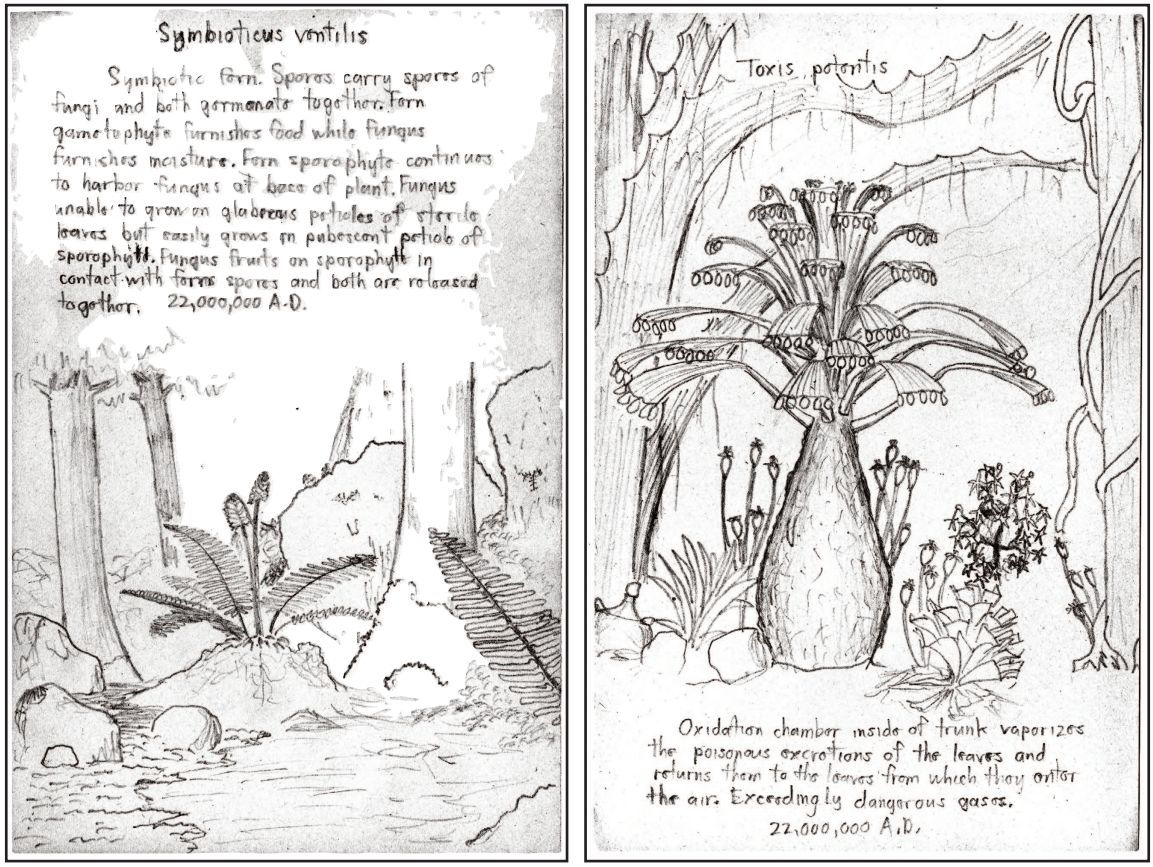
He was the youngest child and last surviving member of his generation of the Robinsons of Winchester, believed to be descended from a British soldier captured in the battle of Saratoga in the Revolutionary War, when the Shenandoah Valley was used as a prisoner of war camp.

Harold's niece, Micki Robinson (St. Petersburg, FL) is a minister and presided over the gathering. Although Harold never married, he had 10 nephews and nieces. All eight of the surviving nieces and nephews attended the memorial along with their spouses and children. Other attendees included staff and affiliates from the National Museum of Natural History (NMNH): Carol Kelloff, Mark Strong, Warren Wagner, Lucy Julian, Larry Dorr, Lisa Dorr, Alice Tangerini, and Ken Wurdack. Phil Recchio (NMNH Development) also attended.

The program was not formal and followed a Quaker style service, requested by Harold, where attendees spoke when they felt moved to speak, sharing remembrances or thoughts about the person, a poem or music. Several of the family spoke about recollections of Harold when they were young, especially that as a babysitter for some of them, he wove fantastic tales which included the most outrageous plants and insects, as well as bizarre human behavior, utilizing Captain Crunch as the leader of these sagas of exploratory expeditions. Harold's niece, Maggie Robinson (Yarmouth, ME), who is an experienced fiddle player played a beautiful solo of "Ashokan Farewell" written by Jay Ungar (inspired by the Catskill Mountains but made famous from use in Ken Burns Civil War PBS series). Several staff from the NMNH Department of Botany (Dorr, Wagner, Tangerini, and Kelloff) all spoke about interactions with Harold over the many years of working together in the department and about his unique approach to research, in which his theories often had been discounted, but ultimately proved amazingly perceptive in the past couple of decades after molecular phylogenetics proved his micromorphological approach to be correct (for a deeper dive into his research, see *Taxon* 70: 690-698; 2021 https://doi.org/10.1002/tax.12524).

Another part of a Quaker memorial is a space where photographs, awards/citations/certificates, and personal mementos can be shown and appreciated, as people are arriving or after the service itself. After Harold's memorial at the cemetery nearly everyone went to a lunch at a nearby hotel restaurant where many of Harold's drawings, collection of toy soldiers and writings, including an unpublished novel were displayed.

- Compiled by Warren Wagner and from memorial program by Frank Vuitch, MD (Dallas, TX)



Harold Robinson's teenage drawings of fictional plants include highly exaggerated dates into the future. Left: "*Symbioticus ventilis*". Symbiotic fern. Spores carry spores of fungi and both germinate together. Fern gametophyte furnishes food while fungus furnishes moisture. Fern sporophyte continues to harbor fungus at base of plant. Fungus unable to grow on glabrous petioles of sterile leaves but easily grows on pubescent petiole of sporophyll. Fungus fruits on sporophyll in contact with fern spores and both are released together. 22,000,000 A.D. Right: "*Toxis potentis*". Oxidation chamber inside of trunk vaporizes the poisonous excretions of the leaves and returns them to the leaves from which they enter the air. Exceedingly dangerous gases. 22,000,000 A.D.

HONORS & AWARDS

Sandra Knapp, president of the Linnean Society, presents the 2020 Jill Smythies Award to Alice Tangerini during the Society's virtual medals ceremony on 24 May 2021.

Alice Tangerini was the recipient of the Linnean Society's 2020 Jill Smythies Award. The award is given annually to a botanical artist for outstanding, diagnostically relevant published illustrations. Due to the ongoing impacts of the COVID-19 pandemic, the 2020 award ceremony was postponed, and a decision was subsequently made to hold the 2021 event via Zoom. Although Tangerini was unable to travel to receive the award in person, she accepted the award during a Linnean Society Medals Ceremony held on 24 May 2021. Sandra Knapp, president of the Society, presented the award to Tangerini during the ceremony.

The following accolade was given to Tangerini by the Linnean Society:

For the excellence of her depictions of plants for scientific use, including the detailed portrayal of their diagnostic characteristics, Alice Tangerini is our 2020 winner of the Jill Smythies Award. In addition to illustrating new species, Alice has illustrated multiple taxa from the same group for the same publication, such that the details of the drawings can be used to distinguish the species.

Since 1972, Alice has made diagnostic illustrations for over 1,000 plant species in pen and ink, graphite, and more recently in digital media, for a variety of publications. Using mainly herbarium specimens as her resource material, she has prepared these illustrations to portray the species in a realistic manner with necessary reconstruction to remove the artefacts of drying and physical damage. Significant taxonomic characters have been enlarged with the aid of a microscope to facilitate their use in species descriptions.

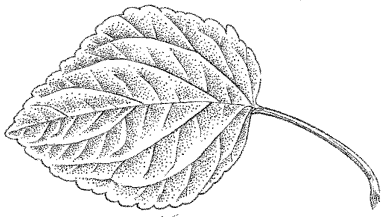
Over the years, the detail and accuracy of her drawings and examinations of the specimens have resulted in authors changing descriptions, based on details observed by Alice that had escaped the botanists' notice. For instance, her detailed examination of a proposed new species of bromeliad resulted in the production of a newly written, enhanced description. As a result, the authors, Lyman B. Smith and Harold Robinson, decided to name the new species *Navia aliciae* in her honour. Such collaboration with scientists in describing a taxon is the hallmark of exemplary botanical illustration.

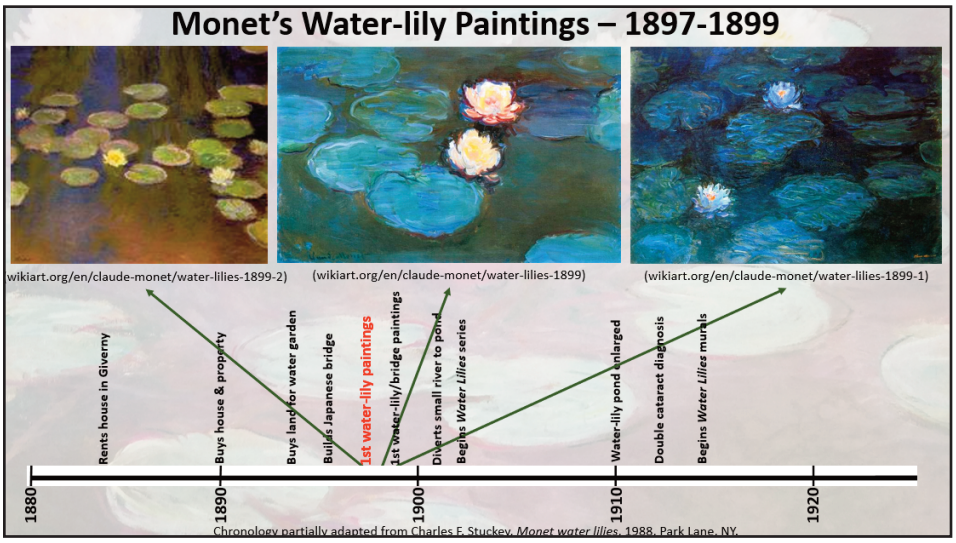
RESEARCH & ACTIVITIES

On May 19, Research Associate **John Wiersema** presented a webinar entitled, "A Taxonomist's View on the Essence of Waterlilies that Inspired Claude Monet," to the membership of Marie Selby Botanical Garden in Sarasota, Florida. In this virtual botanical briefing, Wiersema asked, "What is it about the nature of waterlilies that provided the inspiration for Claude Monet's gardens and so many of his impressionist paintings?" Wiersema's webinar examined the role of waterlilies in the aquatic landscape, explored the relationships among the various forms of waterlilies throughout the world, and probed the aesthetic qualities that have made them the ultimate aquatic ornamental. He also spoke about the early history of waterlily hybridization in Europe in relation to the waterlilies available to Monet when Monet established his water garden in Giverny in the late 19th century, with a closer look at those that successfully established on Monet's estate. Wiersema also finds an appreciation in the sheer beauty and serenity of pristine waterlily settings and a Monet impressionist rendering of it.

Wiersema, a specialist on the taxonomy of the waterlily group, focuses his research on the waterlily genus *Nymphaea*. He has studied and collected these plants in both temperate and tropical countries on six continents, personally cultivating at least 60 such gatherings for direct observation over the last four decades, and examined thousands of global water lily herbarium specimens. He has discovered and described several new species and has participated in over 30 scientific publications on the group. Retired from the U.S. Department of Agriculture's Agricultural Research Service after more than 30 years, he now serves as a Research Associate in the Botany Department of the Smithsonian Institution's National Museum of Natural History. Wiersema gained global standing as a specialist in plant nomenclature, and now has direct editorial involvement with both the botanical and cultivated plant codes of international nomenclature and the international journal *Taxon*. Over his professional career, he has contributed to some 125 scientific publications.

The presentation is available online at <https://www.youtube.com/watch?v=gxlJQwp0N-U>.





In John Wiersema's webinar, "A Taxonomist's View on the Essence of Waterlilies that Inspired Claude Monet," Wiersema provides a chronology of Monet's paintings and looks closely at the botany behind the artist's inspiration.

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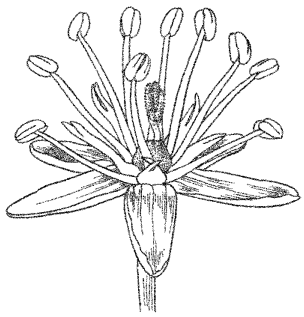
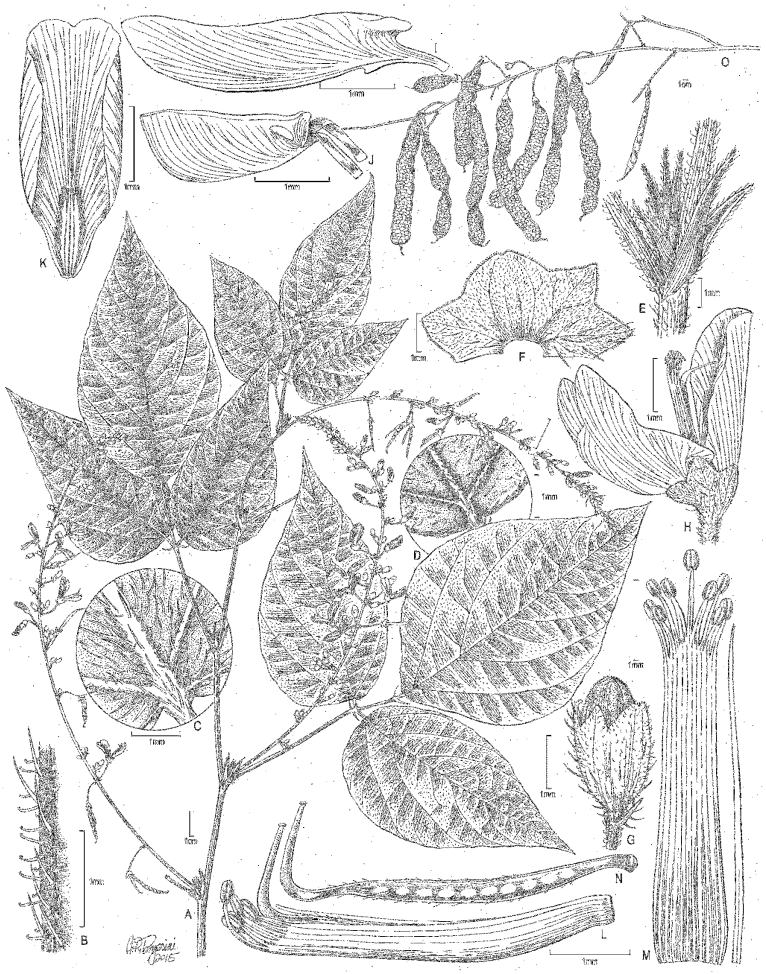


ART BY ALICE TANGERINI

Pseudarthria panii R.Zhang, T.S.Yi & B.Pan

The diversity of plant symbioses and the relationships plants have with insects, fungi, bacteria, and even other plants was the theme of the 18th Smithsonian Botanical Symposium held virtually in May 2021. One presentation focused on nitrogen-fixing symbiosis between legumes and rhizobia. Alice Tangerini has illustrated several nitrogen-fixing legumes. One such plate of hers remains unpublished. When Tangerini received an unidentified plant specimen from Ashley Egan (Assistant Curator 2013-2017), it was possibly a new species of *Desmodium*. Tangerini made the drawing from dried unmounted material and some digital images of the flowers and habit. The drawing was done in two plates and combined. One plate contained all floral dissections and habit and a second plate had the adaxial and abaxial leaf surfaces. The hooked hairs on the pedicel were important to show. In a 2018 paper, a team from Kunming Institute of Botany named this plant as a new species of *Pseudarthria* from Asia.



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