Department of Botany & the U.S. National Herbarium

The Plant Press

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Botany Profile

We Are All Lichens

By Manuela Dal Forno

Do you remember the question in Introductory Biology 101, "What are lichens?" According to traditional concepts, a lichen is the resulting structure (known as a thallus) from the symbiosis between a fungal partner (the mycobiont) and an algal-like partner (the photobiont), either a green alga and/or a cyanobacterium ("blue-green alga"). Lichens play important roles in the environments they live in, participating in nutrient and water cycles and particularly nitrogen fixation, forming biological soil crusts, and serving for animals in many ways, such as camouflage, shelter, nests, and food, among many other ecological functions lichens have. Humans use lichens as traditional sources for medicine and in the pharmaceutical and perfume industry. They also play an outstanding role as biological indicators of environmental health.

You probably learned this as graduate or undergraduate student, or if you were lucky, while taking biology in high school. However, times have changed and the definition of lichens also needs a bit of an update. We now know that lichens harbor a diverse and complex community of bacteria, archaea (single-cell organisms), and fungi, as stable components of the symbiosis. These microorganisms together make up the lichen microbiome. And more recently, Toby Spribille and colleagues (*Science* 353: 488–492. 2016) found that additional fungal partners may also play important roles for the association aside from the mycobiont.

The earliest studies of lichen microbiomes revealed the existence of diverse communities of bacteria in addition to the two dominant partners (Gonzáles et al. 2005 *FEMS Microbiol. Ecol.* 54: 401–415; Cardinale et al. 2006 *FEMS Microbiol. Ecol.* 57: 484–495, Cardinale et al. 2008 *FEMS Microbiol. Ecol.* 66: 63–71). Most of these studies have focused on bacterial diversity and their potential roles in the lichenization process (Grube et al. 2009 *ISME J.* 3: 1105–1115; Hodkinson & Lutzoni 2009 *Symbiosis* 49: 163–180; Bates et al. 2011 *Appl. Environ. Microbiol.* 77: 1309–1314; Hodkinson et al. 2012 *Environ. Microbiol.* 14: 147–161; Cernava et al. 2015 *Front. Microbiol.* 6: 620; Grube et al. 2015 *ISME J.* 9: 412–424; Erlacher et al. 2015 *Front. Microbiol.* 6: 53). Others have also explored some specific questions, such as bacterial community shifts related to lichen parasitism (Grube et al. 2012 *FEMS Microbiol. Ecol.* 82: 472–481; Wedin et al. 2015 *Environ. Microbiol.* 18: 1428–1439). In general, these studies have shown that lichen-associated microorganisms are not randomly distributed in lichens, but instead reflect the systematic affinities of the lichen partners and/or the associated habitat conditions. It is hypothesized that, just as the human microbiome has important functional roles in human health, the lichen microbiome may be involved in processes such as nutrient supply, resistance against biotic and abiotic factors, and production of hormones (Grube et al. 2015 *ISME J.* 9: 412–424).

To lichenologists, these are key discoveries since they wave a flag for lichenology as a whole, and we do need this "advertisement," as lichenology has not always been a highly visible field and people are not generally aware that lichens are a significant part of the ecosystem.

In September, a recent paper about "plant blindness" (Balding & Williams 2016 *Conserv. Biol.*) and follow-up commentary article (Dasgupta 2016 https://news.mongabay.com/2016/09/can-plant-blindness-be-cured/) was circulated among coworkers in the Smithsonian's Department of Botany. Lichens, along with other lesser-known organisms living on our diverse planet, suffer from the same phenomenon of blindness, and I have done what I could to combat "lichen blindness" throughout my career. Lichens are not plants, but historically and currently, they have been studied under the cryptogamic umbrella offered through botany departments around the world. If animals are the most charismatic component of global biodiversity noticed by people, very distantly followed by plants, then lichens are indisputably at the lowest levels of what the public sees.

How can we raise awareness for lichens? Well, there are several ongoing efforts around the world to combat this lichen blindness. The Field Museum in Chicago, for example, is currently hosting an exhibit called "Lichens: The Coolest Things You've Never Heard Of" (https://www.fieldmuseum.org/at-the-field/exhibitions/lichens-coolest-things-youve-never-heard), and has a Ford Bronco door completely covered by lichens collected in Puerto Rico

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Travel

Pedro Acevedo traveled throughout Oaxaca and Chiapas, Mexico (9/10 – 9/24) with **Herison Medeiros** and **Marcelo Pace** to collect all fertile flowering plant specimens.

Gabriel Arellano traveled to Ledong, China (7/8 - 7/20) to give a talk at an analytical workshop organized by the Smithsonian Center for Tropical Forest Science - Forest Global Earth Observatory and the Chinese Forest Biodiversity Network at Jianfengling National Forest Park; and to Barro Colorado Island, Panama (8/13 – 9/2) to conduct fieldwork to test a mortality protocol that will be implemented in some tropical sites as part of the Next Generation Experiments – Tropics project.

Mike Bordelon traveled to Ithaca, New York (7/18 – 7/21) to attend the annual meeting of the Association of Education and Research Greenhouse Curators.

Barrett Brooks traveled to Narragansett, Rhode Island (9/19 – 9/25) to attend the annual meeting of the American Association of Underwater Scientists at the University of Rhode Island Narragansett Bay campus as the representative of Smithsonian's Dive Safety Officers.

Monica Carlsen traveled to Savannah, Georgia (7/31 – 8/4) to present a paper at the Botany 2016 meeting; and to Honolulu and Hilo, Hawaii (8/25 – 9/12) to collect *Heliconia* and Zingiberaceae specimens.

Manuela Dal Forno traveled to Helsinki, Finland (8/1 – 8/9) to present a poster at the 8th International Association for Lichenology (IAL) Symposium at the University of Helsinki and to participate in an excursion to Pallas-Yllästunturi National Park.

Bort Edwards traveled to Savannah, Georgia (7/31 – 8/4) to attend the Botany 2016 meeting; and to Berkeley, California (8/31 – 9/8) to collect material for the Global Genome Initiative and to conduct his own research into radiations of western North American clades.

Ashley Egan traveled to Savannah, Georgia (7/30 – 8/4) with **Gouri Mahadwar** and **Mohammad Vatanparast** to present a paper at the Botany 2016 meeting; and through eastern Pennsylvania (9/1 – 9/6) and throughout Virginia, North Carolina, and South Carolina (9/15 – 9/30) to collect *Phaseolus polystachios* (Fabaceae) in conjunction with collaboration with the Germplasm Resources Information Network (GRIN) of the U.S. Department of Agriculture.

Sally Eichhorn traveled to Paris France (9/17 – 9/24) to attend the International Association for Plant Taxonomy council meeting as the managing secretary.

Vicki Funk and **Morgan Gostel** traveled throughout Madagascar (9/22 – 10/22) to conduct field work for the Global Genome Initiative project.

Amanda Grusz and **Erin Sigel** traveled to Savannah, Georgia (7/31 – 8/4) to present papers in the "Seed Free Plants at the Genomic Scale" colloquium at the Botany 2016 meeting.

Gabe Johnson traveled to Savannah, Georgia (7/30 – 8/4) to attend the Botany 2016 meeting.

Carol L. Kelloff and **Mark T. Strong** traveled to southern Virginia (9/6 – 9/13) as part of their second Global Genome Initiative expedition to collect unique and rare plants in the Longleaf pine / scrub oak sandhill and pocosin communities and to update the collection in the herbarium; 216 vouchers were collected in 63 families and 183 taxa, 15 ranked State rare in Virginia and one taxa, *Polygonella polygama* (Vent.) Engelm. & A. Gray var. *polygama*, known only from one population in Virginia.

W. John Kress traveled to Honolulu, Hawaii (8/31 – 9/11) to attend the International Union for Conservation of Nature (IUCN) World Conservation Congress and to collect *Heliconia* specimens.

Gary Krupnick traveled to Honolulu, Hawaii (8/31 – 9/11) to present a Pavilion Event on orchid conservation at the International Union for Conservation of Nature (IUCN) World Conservation Congress; and to San Francisco, California (9/11 – 9/14) to attend a round-table discussion about conservation and natural history museums at the California Academy of Sciences.

Marcelo Pace traveled to Mexico City, Mexico (9/4 – 9/9) to give an invited talk at the XX National Botanical Congress of Mexico.

Paul Peterson traveled to London, England (7/17 – 7/22) to give a presentation at the meeting, "Growing the Grass Classification: Celebration of Derek Clayton's 90th birthday and discussion about the future of GrassBase."

Eric Schuettplez traveled to Savannah, Georgia (7/30 – 8/3) to present a paper at the Botany 2016 meeting, and to attend the business meeting of the American Fern Society and the NSF GoFlag project collaborators meeting.

Laurence Skog traveled to Savannah, Georgia (7/30 – 8/4) to attend the Botany 2016 meeting.

Sy Sohmer traveled to Edinburgh, Scotland (7/11 – 7/15) to give a paper on *Psychotria* (Rubiaceae) of Papua New Guinea at the 10th International Flora Malesiana Symposium, "Classify, Cultivate, Conserve," at the Royal Botanic Garden Edinburgh.

Robert Soreng traveled to London, England (7/10 – 7/28) to give an invited talk at the meeting, "Growing the Grass Classification: Celebration of Derek Clayton's 90th birthday and discussion about the future of GrassBase," and to conduct herbaria research at the Natural History

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Presidential Politics

Chair With A View — L.J. Dorr

With presidential politics dominating the news I began to wonder whether or not a president had ever visited the U.S. National Herbarium. Sitting presidents have visited the National Museum of Natural History but as best I can tell none has ever toured Botany. I cannot remember any presidential candidate visiting the museum which is a shame because certainly the museum and herbarium would make a great "photo op" if one wanted to address compelling environmental issues such as biodiversity, extinction, climate change, etc. We have had high ranking officials appointed by the president visit Botany. I remember one sitting cabinet member visiting the herbarium and I know that one retired Supreme Court justice has been given a tour. My complaint about lack of attention from the president or presidential candidates is not an argument that the U.S. National Herbarium lacks connections to the presidency. We in fact have several interesting connections.

Onagraceae is one of the plant families recently digitized as part of our "conveyor belt" project (see *The Plant Press* 19(1): 1, 13-15. 2016) and when the label transcriptions were reviewed I was reminded that we have a specimen (US01361622) of fireweed (*Chamaenerion angustifolium* (L.) Scop.) collected by President Chester A. Arthur in Yellowstone National Park in 1883. The label is typewritten and probably not original. The specimen does have a separate printed annotation that certainly is original. It states simply "Executive Mansion, Washington." Arthur was suffering from nephritis and the trip to Yellowstone was intended to improve his health. Firewood in bloom would catch anyone's attention but why President Arthur, who had no particular interest in Botany or natural history, would collect just one herbarium specimen and donate it to the Smithsonian is beyond me. His time away from Washington may have given him a respite but his health did not improve and Arthur died in 1885 after completing his sole term in office. It appears that this Yellowstone fireweed is the only herbarium specimen that we have collected by a sitting American president.

We also have other specimens associated with presidents. Theodore Roosevelt who occupied the Executive Mansion (a.k.a. the White House) twenty years after President Arthur established a reputation for supporting conservation and even earned credentials as a naturalist. Very shortly after serving his sole term as president Roosevelt headed to East and Central Africa on safari. Although he collected numerous zoological specimens for the Smithsonian and the American Museum of Natural History there is nothing to suggest that Roosevelt took the slightest interest in the African flora. The expedition did collect plants, but this was principally the work of Dr. Edgar A. Mearns. Mearns, an Army surgeon and naturalist, was an experienced plant collector and had earlier made important plant collections while serving on the United States-Mexican International Boundary Commission (1892-94). The labels on Mearns' African collections acknowledge the former president; the printed header is "Smithsonian African Expedition, under the direction of Col. Theodore Roosevelt (1909-10)." The choice of title, Colonel versus President, undoubtedly was made by Roosevelt.

Dr. Waldo L. Schmitt, curator of the Division of Marine Invertebrates in the U.S. National Museum, collected algae and vascular plants as a guest of President Franklin D. Roosevelt on a very brief cruise in 1938 aboard the *U.S.S. Houston*. The cruise embarked from San Diego, visited Baja California, Socorro and Clipperton islands, and Cocos Island before transiting the Panama Canal and returning to Pensacola, Florida. Labels on specimens in the U.S. National Herbarium have the header "Presidential Cruise, 1938 Received through the Honorable Franklin D. Roosevelt." The algae and plants collected on the cruise were certainly incidental to Schmitt's primary interest in marine invertebrates and as with Theodore Roosevelt there is no reason to assume that his distant cousin Franklin had any particular interest in Botany.

If we expand our inquiry beyond the United States the U.S. National Herbarium can lay claim to having a handful of specimens collected by a former president of Venezuela. Dr. José María Vargas became a physician in 1808 and then near the end of 1813 traveled from South America to Edinburgh to continue his medical training. His mentor in Scotland had connections with the Royal Botanic Garden Edinburgh and may have introduced Vargas to Botany. In any case, Vargas also visited continental Europe before returning to the Americas in 1817. At first he resided in Puerto Rico where he practiced medicine and where he had direct or indirect contact with the botanists Auguste Plée and Carlos Bertero. He returned to his native Venezuela in 1825. Somewhere between Europe, Puerto Rico, and Venezuela Vargas began corresponding with Augustin Pyramus de Candolle and between 1829 and 1834 sent several hundred specimens collected in Venezuela to this Swiss botanist who cited many of them in his *Prodromus*. Vargas was then pulled from his medical and academic life into politics and from 1835 to 1836 served briefly as president of Venezuela. The botanical activities of Vargas antedate the establishment of the Smithsonian Institution and the handful of collections we have were not acquired until 1913 through the intercession of Henri Pittier who had established strong ties to the Smithsonian and collected botanical specimens for the U.S. National Herbarium first in Costa Rica and then in Venezuela.

Although the Museum is situated between the White House and the

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Staff Research & Activities

In September, **Bort Edwards** traveled to Berkeley, California to collect material for the Global Genome Initiative and to conduct his own research into radiations of western North American clades. **Vicki Funk's** research group has an ongoing arrangement with the San Francisco Botanical Garden, University of California Berkeley Botanical Garden, and Regional Parks Botanic Garden (Tilden) to collect genome-quality DNA (in silica gel) and voucher specimens, with the understanding that sheets are lodged at both the US and Jepson herbaria. This serves a dual purpose of allowing sampling of many otherwise hard to access species for molecular work as well as initiating a relationship whereby it is hoped that all plants in the three living collections will be vouchered locally as a reference and insurance. All three gardens have remarkably diverse and valuable collections but Tilden is of particular note as it is part of the East Bay Regional Park District, a community supported Special District that has operated independently and for the most part outside of the influence of government administration since 1940, and can be easily overlooked. However this autonomy, and it's location in a climatic sweet-spot, has allowed it to focus on assembling an impressive collection of rare and regional varieties of the Californian flora, and is well worth a visit. Edwards also took the liberty of briefly exploring the north coast of California to collect Compositae with fellow ex-pat post-doctoral fellow Andrew Thornhill (UCB) and his wife Naomi, and satisfied a lifelong ambition of running into *Darlingtonia californica* in its natural habitat.

Darlingtonia californica **(photo by Bort Edwards)**

In September, **Marcelo Pace** gave an invited talk at the XX National Botanical Congress of Mexico, in a symposium for early career scientists named "Estudios actuales sobre la magadiversidad vegetal" (= Current studies on plant megadiversity). He presented on how the multiple origins of vines and lianas across the plant tree of life correlate to an increase in anatomical diversity of stems. This diversification is directly influenced by the evolution of novel anatomical architectures called cambial variants, where he showed that in different lineages of rosids and asterids the appearance of cambial variants led to the evolution of astonishing anatomical complexity. Following the congress **Pedro Acevedo**, **Herison Medeiros** and Pace went on a very successful field trip to collect specimens in Oaxaca and Chiapas, with the support of researchers of the Universidad Nacional Autonoma de Mexico (UNAM). The field trip covered 3,000 km and they collected nearly 260 plant specimens from dry forests, mountains and rainforest, which will enrich the U.S. National Herbarium collection.

Robert J. Soreng and **Paul M. Peterson** attended and presented talks at a conference (Growing the Grass Classification, Systematics Ecology and Evolution – Celebration of Derek Clayton's 90th birthday) in London on 18-19 July 2016. Soreng talked about the state of Poaceae classification and databases while Peterson presented a molecular phylogeny and classification of the Cynodonteae (Chloridoideae). It was truly an international event and grass systematists from around the world attended and celebrated Clayton's many achievements including GrassBase (http://www.kew.org/data/grasses-db.html). Thirty years ago *Genera Graminum, Grasses of the World* (Clayton & Renvoize. 1986. Kew Bull. Addit. Ser. 13: 1-389) was published just prior to the molecular revolution. Since *Genera Graminum*, more than 90 percent of the genera have been investigated using molecular methods and our classification of the grasses (subfamilies, tribes, and subtribes) was recently revised: Soreng, R.J., P.M. Peterson, K. Romaschenko, G. Davidse, F.O. Zuloaga, E.J. Judziewicz, T.S. Filgueiras, J.I. Davis and O. Morrone. 2015. A worldwide phylogenetic classification of the Poaceae (Gramineae). *J. Syst. Evol.* 53(2): 117–137. More about the meeting is available at http://www.kew.org/discover/blogs/kew-science/growing-our-knowledge-grasses.

Chair with a View

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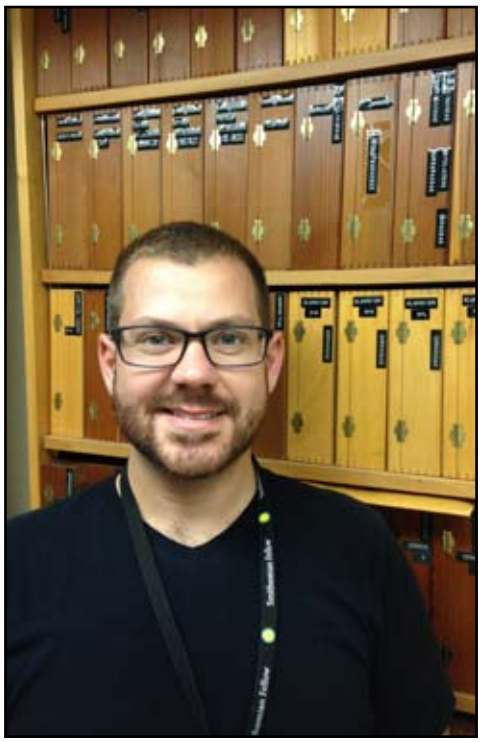
U.S. Capitol most of us interested in science spend little time in either of the latter two buildings. Presidential motorcades regularly travel Constitution Avenue and pass by the Natural History building. We can only hope that a future president will take notice not only of the impressive building but also the work that goes on within its walls. Perhaps he or she will even augment our collection of presidential specimens.

New Faces

Lauren Krizel joined the Center for Tropical Forest Science - Forest Global Earth Observatory (CTFS-ForestGEO) in the July of 2016 as Program Assistant. She earned her B.A. in Environmental Studies from American University and her M.S. in Environmental and Energy Management from George Washington University. Krizel started her career path working with endangered piping plovers on the beaches of New York, and most recently at the Society for Conservation Biology for five years. She is based at the CTFS-ForestGEO headquarters at the Smithsonian National Museum of Natural History in Washington, D.C.

In early July, **Marcelo R. Pace** joined the Smithsonian's Botany Department as a Peter Buck Postdoctoral Fellow. He will be working under the supervision of **Pedro Acevedo** to explore the ontogeny and diversification of wood anatomy in Malpighiaceae and how specific, unusual types of stem secondary growth peculiar



New faces in the Department of Botany: Lauren Krizel (left) and Marcelo Pace (right)

to lianas may be correlated with shifts in diversification rates in the family. Pace obtained his Master's and Doctoral degrees at the University of São Paulo, Brazil, where he explored the anatomical modifications different plant families of tracheophytes have undergone in the shifts from a shrub/tree to vines. His research also included the evolution and development of wood anatomy in Bignoniaceae.

Visitors

Monica Carlsen, Missouri Botanical Garden; Araceae and Zingiberales (2/17/15-2/16/17).

Morgan Gostel, George Mason University; Compositae and GGI-Gardens Program (9/1/15-8/31/17).

Gouri Mahadwar, University of Rochester; Legume phylogenetics internship (9/1/15-8/11/16).

Daniel Vance, The College of William and Mary, and **Katherine Wu**, Mount Saint Mary's College; Natural History Research Experiences summer internship (5/31-8/5).

Declan Cooper, University of Sheffield, United Kingdom; Morphometrics internship (6/1-8/11).

Kelly McLeod, Glasgow School of Art, United Kingdom; Legume systematics internship (6/1-8/11).

Dillon Davis, Wilkes University; Plant DNA barcode project internship (6/6-7/15).

Lyra Morina, University of Maryland, College Park; Plant DNA barcode project internship (6/6-8/19).

Bethany Nowviskie and 14 students, University of Virginia; Herbarium tour (6/8).

Nirasha Abeysekera, Fairfax, Virginia; Herbarium curation internship (6/27-8/12).

Kristen Halper, Fairfax, Virginia; Herbarium curation internship (6/27-8/17).

Eleanor Wagner, Virginia Technical Institute; Citrus family phylogeny (6/27-7/29).

Dylan Cohen, Rancho Santa Ana Botanic Garden; *Loasa* (Loasaceae) (6/29-7/1).

Jessie Tchapda and **Esi Tyree**, Washington, DC; Youth Engagement through Science (YES!) internship (6/29-8/5).

Muriel Poston, National Science Foundation; Loasaceae (7/1).

Selene Li, Livingston, New Jersey; Plant Conservation internship (7/5-8/12).

Anita Montero, Vassar College; Bamboo collection digitization (7/5-8/19).

Karen Stomberg, University of Alaska; Harriman Expedition (7/14-7/19).

Aline Quaresma, Jardim Botânico do Rio de Janeiro, Brazil; Asteraceae (7/18-7/22).

Young Mee Rim, Royal Danish Academy of Fine Arts, School of Conservation, Denmark; Botanical specimen conservation internship (7/18-9/2).

Tanja Schuster, University of Melbourne, Australia; Polygonaceae (7/18-7/19).

Charles Zartman, Coordenação de Pesquisas em Botânica, Instituto Nacional de Pesquisas da Amazônia, Brazil; Bryophytes (7/18-7/19).

Nichole Tiernan, Fairchild Tropical Botanic Garden; *Plumeria* (Apocynaceae) (7/20-7/21).

Patrica Barbera Sanchez, Real Jardín Botánico de Madrid (CSIC), Spain; Aveninae (Poaceae) (7/27-10/23).

Alexander Cotnoir, Dartmouth College; Biological Diversity of the Guiana Shield Program (7/29).

Ryan Ellerby and **Rahim Hirani**, Hampshire College; Plant collection internship (8/1-8/24).

Mark Tebbitt, California University of Pennsylvania; Andean *Begonia* (Begoniaceae) (8/5).

Samantha Peters, California State University at Monterey Bay; Scientific illustration internship (8/8-9/15).

Rubens Coelho, Universidade de São Paulo, Brazil; Neotropical *Allophylus* (Sapindaceae) (8/11-9/10).

Luize Henrique Fonseca, Universidade de São Paulo, Brazil; *Adenocalymma* (Bignoniaceae) (8/11-8/12).

Marianne Schnaubelt, University of California, Irvine; Herbarium curation internship (8/15-8/19).

Bruce Holst, Selby Botanical Garden; Myrtaceae (9/1-9/14).

Vikram Shivakumar, Alexandria, Virginia; Clauseneae (Rutaceae) (9/12/16-3/10/17).

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Travel

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Museum, the Royal Botanic Gardens Kew, and the Linnean Society of London.

Alice Tangerini traveled to Santa Cruz, California (7/3 – 7/10) to participate in the 2016 conference of the Guild of Natural Science Illustrators; and to Savannah, Georgia (7/29 – 8/2) to present a workshop on botanical illustration at the Botany 2016 meeting.

Warren Wagner traveled to Savannah, Georgia (7/29 – 8/4) to present a paper at the Botany 2016 meeting and attend the American Society of Plant Taxonomists council meeting.

Jun Wen traveled throughout China (6/23 – 7/22) to conduct research; to Savannah, Georgia (7/31 – 8/4) to present a paper at the Botany 2016 meeting and to conduct field work; and throughout Connecticut, Massachusetts, and Vermont (8/16 – 8/19), throughout Missouri, Oklahoma, and Arkansas (8/25 – 8/31), and throughout northern California (9/9 – 9/16) to collect Vitaceae and other associated plant specimens.

Elizabeth Zimmer traveled to Austin, Texas (6/17 – 6/22) to present a paper at the Evolution 2016 meeting and to attend the meeting of the editorial board of *Molecular Phylogenetics and Evolution* as Deputy Editor-in-Chief; and to Savannah, Georgia (7/30 – 8/3) to present a paper at the Botany 2016 meeting.

Visitors

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Patrick Herendeen, Chicago Botanic Garden; Herbarium research (9/13).

Lynn Clark, Iowa State University; Bamboos (Poaceae) (9/14-9/15).

Lyra Morina, University of Maryland, College Park; Valuing botanical collections (9/14/16-3/10/17).

Benjamin Cooper, Northwestern University; *Oenothera* sect. *Calylophus* (Onagraceae) (9/19-9/23).

Yash Kalburgi, Northern Virginia Community College; Vitaceae (9/19/16-3/15/17).

Sheena Wang, Johns Hopkins University; Connecting botanical data (9/19-12/6).

Olivia Bascle, George Mason University; Bulky bamboo collection digitization (9/27-12/9).

Jason Cantley, **Nicolas Diaz** and **Nathan Luftman**, Bucknell University; *Coprosma* (Rubiaceae) and *Chenopodium oahuense* (Amaranthaceae) (9/28-9/29).

Javier Francisco-Ortega, Florida International University; Asteraceae and Euphorbiaceae (9/28).

Howard University Herbarium (HUDC) Receives Donation of Ten Herbarium Cabinets from Smithsonian's Department of Botany

Janelle M. Burke, Howard University and Howard University Herbarium

In August 2016, Howard University received a donation of ten herbarium cases from the Smithsonian's Department of Botany. These custom-built cases will replace the previous cases that were no longer functional. The donation will be used to continue to keep the specimens well-preserved and serve as a source for many student projects.

The Howard University Herbarium (HUDC) is a collection of ca. 15,000 plant specimens housed in Just Hall on Howard University's main campus in Washington, D.C.. The HUDC herbarium has strengths in collections from the Caribbean (especially Trinidad), District of Columbia and surrounding environs. Collection strengths include the DC Metropolitan region, the Loasaceae and pteridophyte collections.

Janelle Burke (Smithsonian Research Associate) serves as the Director of the Herbarium. Since her arrival at HU in 2013, Burke has been actively contributing to the collection, through local and international expeditions. The collection is a source for several active student projects, including a comparative study of the Flora of Wheaton Park (Maryland) and a synopsis of the Caribbean flora collection.

Burke recently received an award through the National Science Foundation (NSF) to digitize the mid-Atlantic specimens of this collection as part of the Mid-Atlantic Megalopolis (MAM) Project. This project will digitize, image, and database the ca. 3,000 mid-Atlantic specimens housed at HUDC.

Howard University graduate student Kirstie Grant (left) and undergraduate student Morinne Osborne at work in the Howard University Herbarium. (photo by Janelle Burke)

Alice Tangerini displays samples of her botanical illustrations at the Smithsonian Libraries event, Indoor Recess. (photo by Robin Everly)

Botanical Illustrator, Alice Tangerini, Featured at Smithsonian Libraries Event

By Alice Tangerini & Robin Everly, with contributions by Sara Cardello

This year, Smithsonian Libraries has been expanding its offering of outreach events to the Smithsonian staff and visitors. In August 2016, **Alice Tangerini** was the guest speaker for an outreach program the Libraries is calling "Indoor Recess." Indoor Recess, created and managed by the Libraries' education specialist Sara Cardello, is a monthly program that began in February 2016. It is a way for the Libraries to showcase their spaces, collections, and staff to an audience they are not often reaching, a younger millennial crowd. The rationale for Indoor Recess is to offer a program where learning takes place, but is more casual and playful during the work day. It is also a way to reach out to museum staff and, in this case, feature the world of botanical illustration.

Luckily, Tangerini likes to do outreach to all types of groups, so this gave her a chance to discuss her job and botanical illustration with a new group of people. Cardello worked with Tangerini to come up with the program and illustrations to be traced. Botany Librarian, **Robin Everly**, also worked with Cardello and Tangerini to display contemporary books on botanical illustration from the Botany and Horticulture Library. Amongst the many books on display was the folio sized *Flores do Amazonas* (1980) by Margaret Mee, a botanical illustrator of Amazonian plants.

Nevertheless, Tangerini's presentation and art work, which was also on display, was the main event. Tangerini started by giving a presentation on being a botanical illustrator in the Botany Department. This was followed by participants using tracing paper and colored pencils and choosing one of four copied images from rare books to properly trace and color the image on the tracing paper. The participants displayed enthusiasm for the short 30 minutes they had for drawing. The four samples of art included *Gloxinia* and *Dianthus* from Gartenflora BD.2 (1853), *Alpinia* from Monandrian plants of the order Scitamineae: Liverpool: George Smith (1828) and *Achimenes mexicana* from Houtte, L. van, Flore des serres et des jardin de l'Europe, vol. 9 (1853).

For Everly and other participants, it was fun learning more about Tangerini's job and helping to host an event which allows people to learn more about the Department of Botany and botanical illustration. Tangerini has been asked to do a similar evening program for Smithsonian Associates in early 2017.

Travel Award Recipients to Visit Herbarium

Travel funds from the Department of Botany were recently awarded to four students to visit and use the U.S. National Herbarium in support of their research. The recipients, their affiliations, and approximate dates of visit are as follows:

- **Maria Alves**, Ph.D. student at Universidade Estadual de Feira de Santana (UEFS), Bahia, Brazil, working under the supervision of Nádia Roque: Study of *Aspilia-Wedelia* complex and related genera (Asteraceae). Recipient of a Robinson Award, expected to visit in March 2017.
- **Nicolas F. Brignone**, Ph.D. student Instituto de Botánica Darwinion, Buenos Aires, Argentina, working under the supervision of Raúl Ponzer: Taxonomy and phylogenetics of *Atriplex* lineages (Amaranthaceae). Recipient of a Ruth and Lyman B. Smith Travel Award, expected to visit in November 2016.
- **Ricardo Perdíz**, Ph.D. student at INPA, Amazonas, Brazil, working under the supervision of Paul Fine: Study of *Protium* (Burseraceae) complex *aracouchini*. Recipient of a Cuatrecasas Travel Award, visit between August and September 2016.
- **Wallace Sao Mateus**, Ph.D. student at Universidade Federal do Rio Grande do Norte (UFRN), Brazil, working under the supervision of Jomar G. Jardim: Phylogeny, diversification, and taxonomical revision of *Harpalyce* (Fabaceae). Recipient of a Cuatrecasas Travel Award, visit during August-September 2016.

The review and selection committee consisted of **Pedro Acevedo** (Chair), **Paul Peterson**, and **Eric Schuettpelz**. These trips will help build institutional collaboration and advance botanical systematics.

Poa palustris L. Rediscovered, or Discovered in Maryland?

By Robert J. Soreng & R.H. Simmons

While botanizing in Garrett County, Maryland, early this summer **Rod Simmons**, a Smithsonian Research Collaborator, and **Rob Soreng** spotted and collected fowl bluegrass, *Poa palustris*, a grass thought to be rarely collected in the state. One location was along the river in Casselman River Bridge State Park, and the other location was in Swallow Falls State Park along the Youghiogheny River, where it was associated with *Trautvetteria caroliniensis*, *Avenella flexuosa*, *Rhododendron arborescens*, *R. maximum*, and *Tsuga canadensis*. Voucher specimens from both collections (9322, 9321) are at the U.S. National Herbarium (US) and the Maryland Department of Natural Resources Herbarium (TAWES), a duplicate of specimen 9322 is at University of Maryland, Norton – Brown Herbarium (MARY), and specimen 9321 is at City of Alexandria Herbarium (AVCH).

Poa palustris was previously reported in Maryland from a few old collections, collected in the state some 60 years ago—Prince George's County, Suitland Bog, in 1965 (*F.G. Meyer* 9233, NA), and Baltimore County, Soldiers Delight, in 1972 (F.J. *Monteferrante 076*, BALT). We redetermined these as *Poa pratensis* L. subsp. *pratensis* and *Glyceria canadensis* or *laxa*, respectively from photos kindly provided by Joan Feely (NA) and David Hearn (BALT). The earliest collection from our area may be from D.C., by *E.S. Steele s.n.*, 22 July 1896 (US-DC) (Steele was collecting in the vicinity of Brookland and Terra Cotta [Fort Totten] on that date). Reports from Howard and Washington Counties by M.L. Brown and R.G. Brown (*Herbaceous Plants of Maryland;* 1984) and repeated by E.E. Terrell and P.M. Peterson (*J. Bot. Res. Inst. Texas* 3: 905-919; 2009) are also based on erroneous identifications (at MARY – photos kindly provided by John Hall).

Before these new discoveries in Maryland, *Poa palustris* was ranked SH (State Historical - Possibly Extirpated in Maryland), based on the three old voucher specimens cited above. Now Maryland State Botanist Chris Frye (and Maryland Natural Heritage team) will likely list it as S1 (Critically Imperiled in Maryland). The species mainly occurs in boreal wetlands and is widespread across the United States (https://bison.usgs.gov/), and southern Canada, and across Eurasia. It is considered native in North America, but is also introduced for stabilization of riparian habitats, mainly or only in western North America. There are a few cultivars originating from northwestern Europe.

Soreng has also collected this species in the Dolly Sods (7464) and Canaan Valley of West Virginia (7459) (in 2004), and Bath County, Virginia (3247, in 1987). It is known from at least eight counties in the mountains of Virginia, three in North Carolina, and one in Tennessee. He and Simmons interpret these central and other more southern Appalachian occurrences as relicts from glacial periods.

***Poa palustris*, circled in the center of the photo, against Casselman River. (photo by Rob Soreng)**

Something Stinky This Way Comes

By Morgan Gostel, Vicki A. Funk, Melinda Peters & Susan Pell

Last month, the U.S. National Herbarium received a very special addition to our collections – a specimen from the living collection of the U.S. Botanic Garden's (USBG), our next door neighbor on

The corpse flower during peak bloom at the U.S. Botanic Garden in August 2016. (photo courtesy of the U.S. Botanic Garden)

the National Mall. Between 29 July and 9 August 2016, tens of thousands of visitors passed through the USBG's Conservatory to catch a glimpse of the (in)famous corpse flower, *Amorphophallus titanum*. The flower reached peak bloom between 2–5 August 2016 while much of our Botany Department staff was out of town in Savannah, Georgia, attending the annual meetings of the American Society of Plant Taxonomists and the Botanical Society of America. We still had a chance to revel in the excitement of this rare event, however, thanks to USBG's Science and Public Programs Manager, Susan Pell.

After the flower's peak bloom, Pell contacted the Global Genome Initiative Gardens (GGI Gardens) program to ask if we would like to sample this specimen as a part of our ongoing partnership and to add a herbarium voucher to the herbarium. Of course we said yes!

Preparing a voucher from such a large inflorescence – over 2 meters – is no easy task and required teamwork from several members of the Botany Department over the course of two days (9 and 18 August 2016). On the first day, we prepared a voucher from only the spathe – a large bract that surrounds the spadix, where flowers are born. We captured these moments in a series of photographs and videos. Once USBG determined their pollination attempt had not succeeded, the GGI Gardens team was able to collect and press the rest of the inflorescence.

Informative photos and videos of the corpse flower at the USBG have been posted on Facebook (U.S. Botanic Garden), Instagram (@USBotanicGarden), and YouTube (United States Botanic Garden). USBG also has a corpse flower webpage (www.usbg.gov/corpseflower). Posted videos include interviews, demonstration of the pollination attempt and scent collection, and a time-lapse of the bloom.

Top: Aleks Radosavljevic, Vicki Funk, and Bort Edwards prepare a voucher of the flower's spathe. (photo by Morgan Gostel)

Middle: The spathe in a plant press. (photo courtesy of the U.S. Botanic Garden)

Bottom: GGI-Gardens Interns Kadiera Ingram and Maryam Sedaghatpour with the mounted specimen sheets. (photo by Melinda Peters)

Plant Discovery and Extinction: The Narrow Window

By Craig Costion

Extinction of species is perhaps the one underlying core outcome that all conservation professionals and biologists seek to avoid. Billions of dollars are spent annually throughout the world from donor organizations, governments, and passionate individuals to prevent species from extirpation. This has proven successful for many species, though to date the vast majority of effort has been devoted to charismatic species or those lucky enough to simply be likeable. Plants, though undoubtedly important to people, seem to lack this money attracting charisma.

A recent study indicated that even though 57 percent of the species on the U.S. federal endangered species list were plants, less than 4 percent of the federal budget for all listed species went to plants. The study found a similar pattern in other countries. This cultural bias, which shows a preference to fund the conservation and study of animals over plants, has become known as "plant blindness." Many of us are familiar with the saying that many of the world's plant species are likely to go extinct before they are formally described. Perhaps only a few of us however, can say they have watched this actually happen. What follows is a real life story about the narrow window between plant discovery and extinction.

Timonius salsedoi (Rubiaceae) was described in 1987 by the late Smithsonian botanist, Ray Fosberg and named after a former Peace Corps volunteer that made collections for Fosberg. The species description was based on only one collection from a tiny island less than 1 km^2 in the archipelago of Palau. Since Fosberg had collected *Timonius* extensively throughout Palau, and published a monograph on the genus, the species was presumed to only occur on this small island. I was not entirely convinced, and suspected it was a variant of one of the more widespread species. However, it was equally plausible that this species was a remnant of a once more common species.

Palau is an island complex of ancient volcanic islands (~36 million years ago) and more recent uplifted limestone karst

Specimen of *Timonius salsedoi* collected by Ray Fosberg in 1965 from Malakal Island, Palau.

islands (~1 million years ago). Very different vegetation associations occur on these islands and both have a lot of intact forest. The capital city, Koror, sits in the middle of these two major island groups, spread across three small volcanic islands, including Malakal which is the smallest of the three. These three volcanic islands are entirely urban today. Only two patches of forest remain, one of them on Malakal where Fosberg collected the type of *T. salsedoi*. If Fosberg was correct, then this species may have previously occurred across the islands that are now entirely urban.

In 2011 I was awarded a grant from Conservation International's Critical Ecosystem Partnership Fund (CEPF) to investigate the threatened status of Palau's endemic plants. As part of this project, I outlined a detailed survey for *T. salsedoi* to confirm its taxonomic status and clarify its extent of occurrence. Previous attempts to casually identify *T. salsedoi* in the field proved unsuccessful. All that could be established is that the infertile plants

closely resembled other members of the genus in Palau. I decided to take a comprehensive approach using the latest DNA barcoding technology to compare these plants to others in the same genus. I sampled leaf material from all *Timonius* plants in the two remaining forest patches in the Koror urban area. Then sampled several individuals of all the other well-known *Timonius* species in Palau from different localities to capture some genetic variation. Two fertile specimens that matched the type of *T. salsedoi* were collected during the survey from Malakal, which was exciting, however we had to await results from the DNA lab at the James Cook University in Australia to answer our larger questions. Is this a valid species or a morphological variant of a more common species? If so, the DNA should also tell us how abundant it is since we could not differentiate the infertile trees.

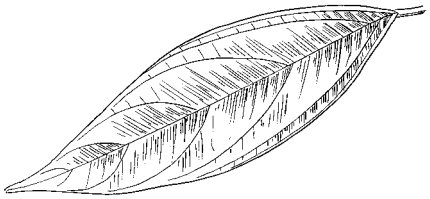
After sequencing seven molecular loci, I had my results. *T. salsedoi* was clearly distinct from the other Palau species, a study that was recently published in *PloS One*. This was exciting, but that was not the most surprising result. None of the additional unidentified infertile collections turned out to be *T. salsedoi.* All came out nested with one of two other common *Timonius* species in Palau. This meant that the entire species was only known from two individual trees.

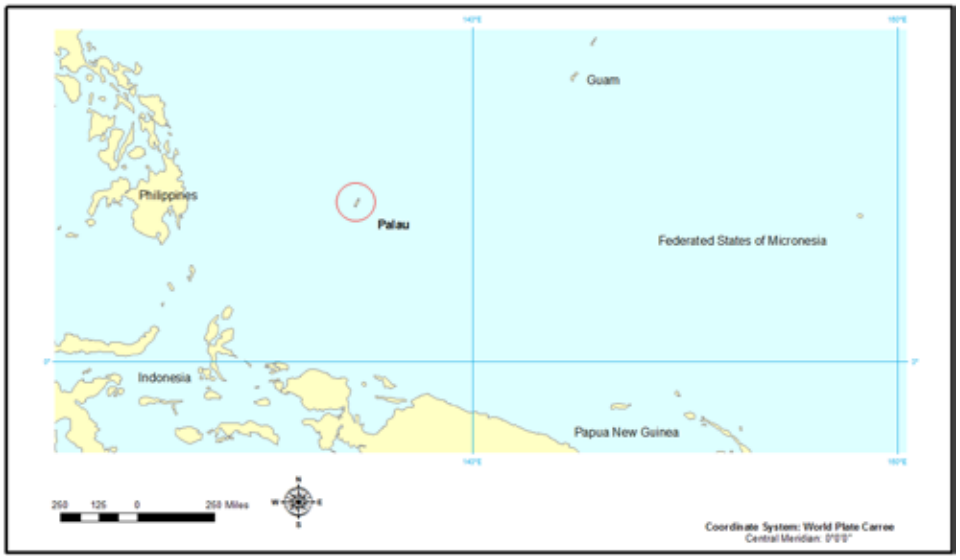
The important point here is that these extant patches of forest are small (traversable on foot through dense forest in 15 to 20 minutes tops) and that the survey was rigorous. Even if we did miss a few, it would only be a few extra individuals. With certainty at that time, I could say the species had fewer than ten individuals remaining but possibly only two.

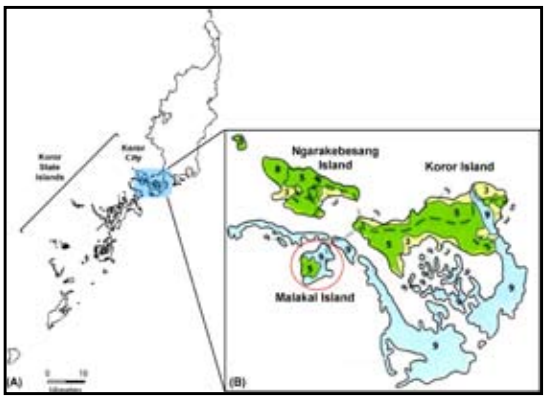
Returning to Palau in 2014, I was hired by the U.S. Forest Service to establish a permanent forest dynamics plot. This plot also happens to be officially the smallest ForestGEO/CTFS plot! Although we did not have a budget for further work on *Timonius*, I returned to the island in hopes of collecting more fertile material. When I arrived to the site that I had been three years earlier, all I could see was an open understory and evidence of a number of large tree falls. Most of the fallen trees were already fully decomposed. I could find no evidence for the existence of any living *T. salsedoi*. Before Typhoon Bopha hit the Philippines in December 2012, it passed over Palau while it was still gaining strength. When it hit Palau it was strong enough to destroy many houses and knock over trees causing an estimated US$10.1 million in damage. Although no human casualties were reported it seems there may have indeed been a greater casualty. Was this single event the tipping point for an entire species?

Although I hope to secure funds to answer this question at some point, I fear the answer is yes. This species was discovered in 1987. By 2012, only 25 years later and by the time science was able to confirm it was in need of a conservation plan it may have gone extinct. In fact, had I not conducted the inventory one year prior to Typhoon Bopha, the species would have simply remained a complete mystery—another dead-end in the herbarium to scratch your head at, and move on.

The molecular era has given us new exciting tools to refine our science but we still face the problem of a disproportionate scale of number of species and funds available for plant science. Unless funding priorities suddenly miraculously change, I suspect this type of story will become more and more common. There was a time when being a taxonomist was quite sexy. The eminent biologists of Darwin's era are said to have been given almost celebrity-like status. As botanists I feel we should seriously consider spending time thinking about how to rekindle some of this public opinion and tackle the epidemic of plant blindness—perhaps even a formal meeting or public forum. If we remain in a "plant blind" era, then we can assume that we will be too blind to even see many plant species go extinct.







Top: The archipelago of Palau, only 465 km², occurs west of the Federated States of Micronesia (FSM), and southwest of the Guam and the Marianna Islands.

Left: The Palau archipelago (A) is shown with the Koror State region in brackets and the Koror urban district shaded. Zoomed in view of the Koror urban district (B) is shown with different soil types shaded. Malakal Island is circled and the other two inhabited islands, Ngarakebesand Island and Koror Island are labeled.

New and Extremely Rare Species of *Melicope* (Rutaceae) Described from Maui

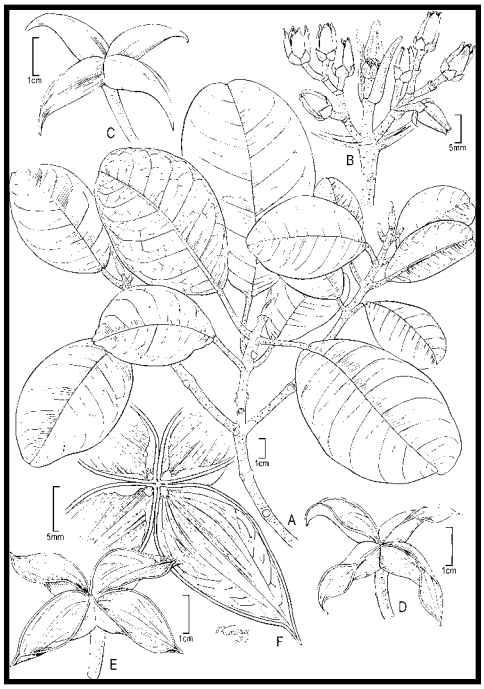
By Marc Appelhans & Warren Wagner

We recently described the species *Melicope oppenheimeri* in the journal *PhytoKeys* together with Ken Wood from the National Tropical Botanical Garden (Kaua`i). New species descriptions are probably published nearly every day, but this new *Melicope* species is special because it ranks among the rarest species on this planet. It is known only from a single valley on West Maui and only seven individual trees have been documented so far. Out of these seven trees, only three are alive today. Considering this minuscule number of individual trees, the species falls under the IUCN Red List category Critically Endangered.

Measures have already begun to prevent the extinction of *Melicope oppenheimeri*. Botanists of the Hawaii Plant Extinction Prevention Program (PEPP) are monitoring the species and two plants that have been produced by air-layering are currently grown at the Olinda Rare Plant Facility on Maui.

The Hawaiian Islands are a prime example for adaptive radiations on an Oceanic Archipelagoes and about ten percent of the successful colonizing lineages have diversified into species-rich lineages within the islands. In the past two centuries, the Hawaiian Islands also are a prime example of the major negative influence of humankind on our environment. Many species have become extinct or are extremely rare today. This trend can be observed in Hawaiian *Melicope*, which consists of 49 currently accepted species and therefore is the most species-rich Hawaiian radiation of woody plants. Five species are regarded as possibly extinct and another 23 species are either federally listed as endangered or are considered to be species of concern.

Flowers of *Melicope oppenheimeri*. (photo by Hank Oppenheimer)



A cultivated individual of *Melicope oppenheimeri* being grown at the Olinda Rare Plant Facility on East Maui (photo by Marc Appelhans). Illustration of *Melicope oppenheimeri* by Alice Tangerini.

Profile

Continued from page 1

as the centerpiece. A full assessment of all species found in this car is available in the *FUNGI* magazine's special issue on lichens (http://www.fungimag.com/archives/v7n2_summer_2014.htm). One of my favorite quotes from the exhibition is by Robert Lücking, who says that a person studying birds, for example, never gets asked, "what is a bird," but when one says, "I study lichens," the follow up question is usually, "What is a lichen?" This is exactly what I aim to change if I can, one person at a time.

Major efforts in the lichenological community are also making knowledge accessible online through portals, such as the Consortium of North American Lichen Herbaria (http://lichenportal.org/), with the United States National Herbarium (US) at the Smithsonian being a participant institution. The US collection is amongst the top ten largest lichen collections in the world, with approximately 250,000 specimens, including an estimated 2,500 types. It is particularly rich in Parmeliaceae, Graphidaceae, and Cladoniaceae specimens, thanks to the work of the late Mason E. Hale and Paula T. DePriest, who both served as curators of the collection.

The title of this article pays homage to a paper my colleague Adriano A. Spielmann (UFMS, Brazil) sent me a few years ago entitled "A symbiotic view of life: We have never been individuals" by S.F. Gilbert, J. Sapp, and A.I. Tauber (*Q. Rev. Biol.* 87(4): 325–341. 2012). In the last sentence of the paper the authors proclaim that "we are all lichens." Recent excitement about the lichen microbiome and additional partners reminds me that this sentence makes a powerful, yet charismatic point about how we all depend on other organisms to become who we are.

Our understanding of microbiome diversity and functionality in organisms and systems has rapidly advanced as new technologies have been developed (and have become more accessible) and greater access to bioinformatics pipelines permits investigators to deal with large amounts of data. Lichens have very rarely been the subject of large-scale microbiome studies, but this is happily beginning to change.

These are exciting times for lichen studies. I thank all my colleagues, through

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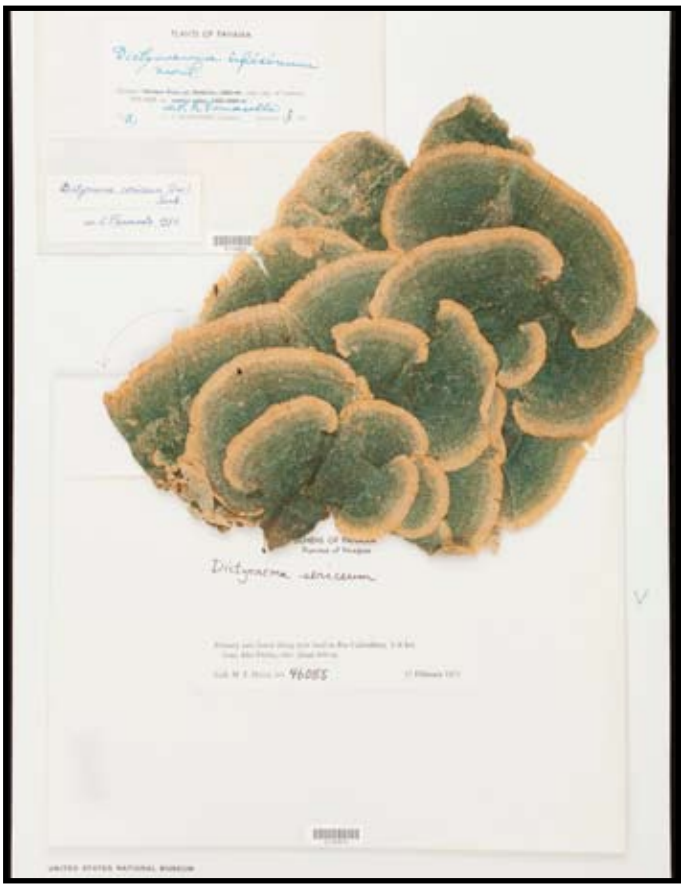
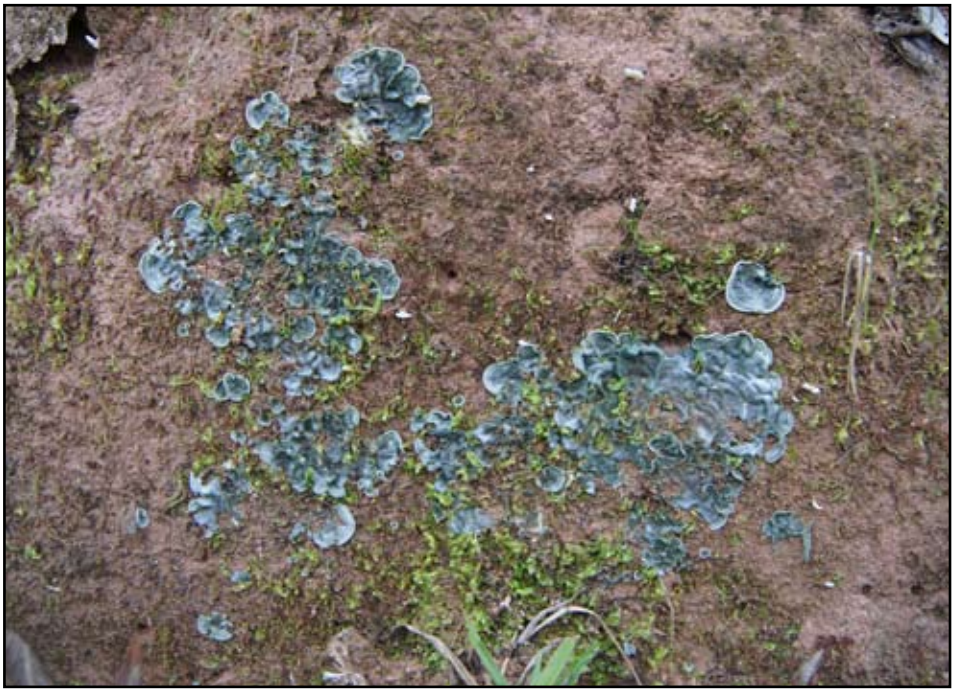
Many epiphytic lichens growing closely together in Las Alturas Biological Station in southern Costa Rica. This image clearly illustrates the different lichen growths: crustose (crust-like), foliose (leaf-like) and fruticose (shrub-like). (photo by Manuela Dal Forno)



Left: The type specimen of *Parmotrema fumarprotocetraricum* Marcelli & Hale (Parmeliaceae, Ascomycota), a species from Brazil described by Mason E. Hale (US) and Marcello P. Marcelli (Instituto de Botânica, SP, Brazil) in 1986. Right: A recently detected new species of *Dictyonema* (Hygrophoraceae, Basidiomycota), based on material collected by Mason E. Hale in Panama in 1975. The particular specimen is so well conserved it looks as if it was just collected.

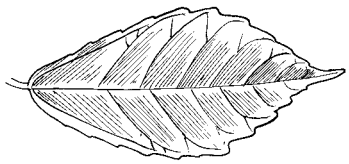


The common *Cora reticulifera* Vain. is one of the few species with wide distribution in the *Dictyonema* clade. It grows across states in Brazil, from Rio Grande do Sul to Minas Gerais, on exposed soil banks by the side of roads ("barracos"). (photo by Manuela Dal Forno)

Profile

Continued from page 13

their publications and social media posts that expose some of the basic questions regarding lichen symbiosis, diversity, and evolution. I hope this moment catches the attention of many students who will contribute to the exciting future ahead in lichenology.



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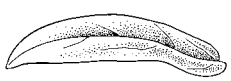
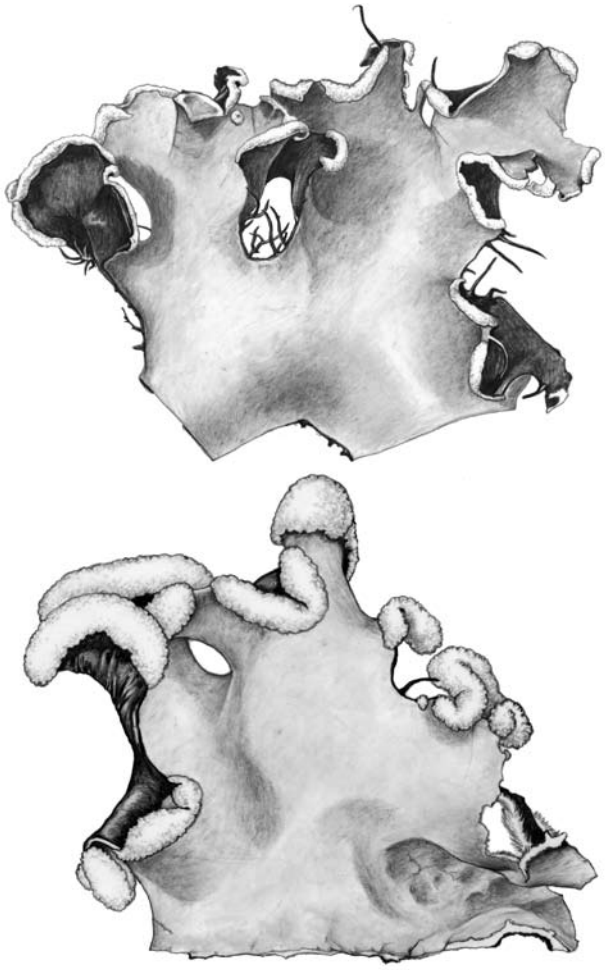


Art by Alice Tangerini

Parmotrema stuppeum (Taylor) Hale and *Parmotrema perlatum species* (Huds.) M. Choisy

The lichens, *Parmotrema stuppeum* (top) and *P. perlatum* (bottom), were figures in Mason E. Hale's *How to Know the Lichens, Second Edition*, published in 1979. The book was part of the Pictured Key Nature Series, a spiral bound field guide which could easily be carried as a travel reference. Alice Tangerini's drawings, illustrated in the polycarbonate pencil technique on drafting film, were combined with graphite drawings by Jack Schroeder and line illustrations by Nancy Halliday, E. Menez, and others. Hale had instructed Tangerini to draw "exactly" what she was given by Hale with no reconstruction or repositioning of the lichen. Tangerini thought that the lichens resembled the eraser shreds from her gray Kneaded erasers so she doctored one with a little acrylic paint in white and black and carefully arranged it in a petri dish like the ones he had given her. He later picked up all of the dishes and told her they were refiled in the herbarium. The mistaken fake lichen was never mentioned so its whereabouts are unknown to this day.



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