Department of Botany & the U.S. National Herbarium

The Plant Press

Smithsonian
National Museum of Natural History

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Botany Profile

Biogeography: There's No Place Like Home

By Gary A. Krupnick

Baird Auditorium at the National Museum of Natural History provided the location for a full day of biogeography talks at the 12th Smithsonian Botanical Symposium, "Location, Location, Location...New Advances in the Science of Biogeography." The speakers celebrated the past contributions of biogeography and provided a look toward future ones that bring a deeper understanding of the relationship between our planet and its biota. The invited speakers addressed why "location" matters with a wide range of modern studies and applications on the geography of life.

Held over two days, the Symposium kicked off on April 24, 2014, with a poster session at the Conservatory of the United States Botanic Garden. An international group of 24 presenters displayed their posters and spoke about their research ranging in topics from lichen biodiversity and algae phylogeny, to the evolution of sea slugs and the effects of climate change on plants.

The next day, the Symposium began with opening remarks by Warren L. Wagner, Chair of the Department of Botany. John Kress, the Interim Under Secretary for Science, also welcomed the participants and speakers to the Smithsonian Institution.

The presentation of the 2014 José Cuatrecasas Medal for Excellence in Tropical Botany took place as Laurence Dorr announced H. Peter Linder as this year's recipient. Linder was recognized for his many accomplishments as an educator and scientist, including his contributions to the systematics, biogeography, and evolution of Restionaceae and Poaceae. Although Linder was unable to attend the Symposium, he sent a message stating how honored he was to receive such recognition: "Although I have little contact to the Andean Asteraceae, I know of the work of José Cuatrecasas. The list of previous recipients is also very impressive—a long list of people I have seen as role models, and whose work I have much appreciated. It is very nice to know that my work on Restionaceae and the danthonioid grasses is appreciated."

Smithsonian Botanical Symposium

Each invited speaker was then introduced by the Symposium Convener, Vicki Funk. Susanne Renner, from the University of Munich, gave the first scientific presentation, "Historical Biogeography and Ecological Biogeography – Come Together Now." Renner began her talk by noting the first instance of biogeography in the scientific literature. In 1820, Augustin P. de Candolle hinted at biological geography: because species become locally adapted, regional floras and faunas differ. De Candolle recognized that to understand biogeographic patterns, one needs to study both the speed of ecological adaptation and the differentiation of regional floras and faunas by speciation and extinction. The German geographer Friedrich Ratzel coined the word *biogeography* in 1891. Renner's talk covered three areas of interest. She first spoke about regional hummingbird and plant communities to describe the speed of adaptation. To approach this topic, the first step is to develop a well-dated phylogeny of hummingbird and plants. Fossil evidence of wing shape suggests swifts are stem relatives of hummingbirds, and precursors of hummingbirds are found in European fossils that date back to 34-28 million years ago. Molecular evidence places the age of modern hummingbirds at 25-18 million years ago. Looking at bird-adapted plant clades, Renner found similar increases in lineages over time, as demonstrated by data of swordbills and passionflowers in the Andes, and hummingbirds and their plants in North America.

Renner then spoke about the worldwide endoparasites Apodanthaceae to describe the problems of relaxed clock models without "good" calibration fossils. Dating clade divergences help us understand the factors that lead to distribution patterns. For a holoparasitic angiosperm, the host age can be used as a calibration point. Renner explained that fossil calibrations estimate older ages of divergence than random local clocks, leading Renner to place more trust in the local clock estimates.

Renner's third area of interest was applying the fossilized birth-death

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Travel

Pedro Acevedo traveled to New York, New York (4/13 – 4/14) to attend a talk on the orchids of the West Indies and to work in the herbarium at the New York Botanical Garden; to San Juan, Puerto Rico (5/20 – 5/26) to present a talk on the history of Puerto Rican biodiversity studies, to be interviewed on the botanical contribution of Agustin Stahl in Puerto Rico at the Fundacion Luis Munoz Marin (FLMM), and to participate in an advisor board meeting to FLMM; and to Barranquilla, Colombia (6/3 – 6/7) to present a plenary talk on plant diversity in the Caribbean at the IV Caribbean Biodiversity Symposium held at Universidad del Norte.

Andrew Clark traveled to Cardiff, Wales (6/22 – 6/28) to present a poster on material transfer agreements at the Society for Preservation of Natural History Collections meeting.

Ashley Egan traveled to Cambridge, Massachusetts (5/28 – 6/1) to visit the Harvard University Herbaria for research relating to phaseoloid legumes (Fabaceae), and to access rare taxa in preparation for 13 Flora of Thailand treatments; to Raleigh, North Carolina (6/18 – 6/25) to attend the Phylogenomics Symposium and Software School for which she was awarded a travel grant, and to present at the Evolution 2014 annual meeting; and throughout the southern United States (6/26 – 7/10) for field collection for population level sampling of kudzu for genetic diversity and population genomics investigation.

Robin Everly traveled to Richmond and Williamsburg, Virginia (4/29 – 5/3) to attend the 46th Annual Meeting of the Council on Botanical and Horticultural Libraries (CBHL).

Vicki Funk traveled to Memphis, Tennessee (4/15 – 4/18) to present a talk at the University of Memphis; and to Raleigh, North Carolina (6/20 – 6/24) to attend the Evolution 2014 annual meeting.

Carlos García-Robledo traveled to Costa Rica (5/1 – 6/22) to conduct field work on climate change and the extinctions of plants and insects in tropical mountains; and to Sierra de Los Tuxtlas, Mexico (6/2 – 6/8) to teach a course on multi-trophic interactions by the Institute of Ecology (INECOL).

Robert Ireland traveled to St. Louis, Missouri (6/1 – 7/7) to visit the Missouri Botanical Garden where he examined moss specimens that he collected in south-central Chile (funded by two grants from the National Geographic Society).

Carol Kelloff traveled to Cardiff, Wales (6/24 – 6/30) to present a poster "Salvaging an Historical Herbarium" at the Society for Preservation of Natural History Collections meeting.

W. John Kress traveled to Dominica (5/3 – 5/9) to conduct field work on *Heliconia* and hummingbird pollination, with **Ida Lopez** and **Yongli Fan**; to Chicago, Illinois (6/5 – 6/7) to meet with the Chair of the Smithsonian Board of Regents, to attend a university forum, "How Do We Think about Climate Change," and to discuss climate change activities with colleagues.

Melinda Peters traveled to Easton, Pennsylvania (4/18) to present a lecture about herbaria uses at Lafayette College; and to Cardiff, Wales (6/22 – 6/28) to present a talk on mercury mitigation at the Society for Preservation of Natural History Collections meeting.

Rusty Russell traveled to Djibouti City, Djibouti (4/29 – 5/15) to conduct plant survey and genomic tissue collection at Lemmonier Air Base; to Riverside, California (6/17 – 6/19) to present a talk on citizen science at the AAAS-Pacific meeting at the University of California at Riverside; and to Cardiff, Wales (6/22 – 6/28) to present a talk on specimen digitization and a talk on the history of Alaskan plant collecting at the Society for Preservation of Natural History Collections meeting.

Eric Schuettpelz traveled to Wilmington, North Carolina (4/21 – 4/23) to attend a master's student seminar and defense; to Durham, North Carolina (5/9 – 5/10) to meet with collaborators; and to Costa Rica (6/30 – 7/8) as an invited instructor for a Tropical Plant Systematics course offered by the Organization for Tropical Studies.

Laurence E. Skog traveled to Cambridge, Massachusetts (5/2 – 5/3) to visit the collections at Harvard's Arnold Arboretum.

Meghann Toner traveled to Cardiff, Wales (6/22 – 7/3) to present a talk on APG Conversion of the herbarium using GIS at the Society for Preservation of Natural History Collections meeting.

Alain Touwaide and **Emanuela Appetiti** traveled to Philadelphia, Pennsylvania (6/21) to attend the meeting of the American-Hellenic Educational Progressive Association (AHEPA) to present research on the medicinal plants of ancient Greece.

Jun Wen traveled to Beijing, China (4/28 – 5/14) to participate in the Flora of Pan-Himalayas meeting; to Myanmar (5/14 – 5/15) to conduct field work; to Philadelphia, Pennsylvania (6/1) to collect specimens; to Concord, Massachusetts (6/12 – 6/14) to collect *Vitis* (Concord grapes); to Blacksburg and Ashland, Virginia (6/19 – 6/21) to collect specimens; and throughout southeastern United States (6/29 – 7/7) to collect specimens.

Elizabeth Zimmer traveled to Durham and Raleigh, North Carolina (6/18 – 6/25) to meet with collaborators studying *Mimulus* and to give a presentation on *Isoëtes louisiana* at the Evolution 2014 meeting.

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Allies in Plant Conservation Sign Memorandum of Understanding

A memorandum of understanding (MOU) is often signed to define relationships among agencies and institutions. On June 30, the Smithsonian Institution joined 11 federal agencies in signing a MOU that continues the work of the Federal Native Plant Conservation Committee of the Plant Conservation Alliance (PCA) and its cooperators in State government and non-government organizations. The PCA is a public-private partnership of governments and non-government organizations that share the same goal of protecting native plants by ensuring that native plant populations and their communities are maintained, enhanced, and restored.

"Every year America suffers significant losses of its native plants and wildlife due to fire, drought, flood and other natural disaster damage," Bureau of Land Management (BLM) Director Neil Kornze said. "The MOU we are signing today calls attention to our need as Federal agencies to adapt to changing realities and to work together to restore affected landscapes for the people, communities and economies that depend on them."

According to the BLM news release, the MOU commits Federal agencies to bolster the collective capacity of the PCA Committee to leverage funds and tools through efforts with non-federal partners. The MOU calls for Federal agencies to assist non-Federal land managers in plant conservation and protection efforts. It also calls for innovative partnerships among public and private sectors, nationally and internationally, to conserve native plants and their habitats before they become critically endangered.

Attendees who form the Federal Native Plant Conservation Committee of the Plant Conservation Alliance meet at the 2014 Seed Conference to sign a MOU and renew their commitment to native plant conservation. From left: Steve Shafer, Agricultural Research Service; Gary Krupnick, Smithsonian Institution; Brenda Pierce, National Park Service; Healy Hamilton, NatureServe; Dan Ashe, U.S. Fish and Wildlife Service; Suzette Kimball, U.S. Geological Survey; Neil Kornze, Bureau of Land Management; Sonny Ramaswamy, National Institute of Food and Agriculture; Gary Solomon, Federal Highway Administration; Stephen Ayers, Architect of the Capitol; Leslie Weldon, Forest Service; and Jason Weller, Natural Resources Conservation Service. Bureau of Indian Affairs Director Michael Black, not pictured, signed the MOU but was not present at the conference. (photo by Tami Heilemann, DOI)

"This is an extraordinary union of such a diverse group of federal and non-federal partners," said Healy Hamilton, chief scientist of NatureServe, a conservation non-profit that delivers the science behind effective conservation. "This partnership speaks to the importance of what we've presented here today: that so many people's economic and ecological interests align when it comes to creating resilient native plants communities."

The Committee Members include the Bureau of Indian Affairs, Bureau of Land Management, Federal Highway Administration, National Park Service, Smithsonian Institution, United States Botanic Garden, United States Department of Agriculture (USDA) Agricultural Research Service, USDA Forest Service, USDA National Institute of Food and Agriculture, USDA Natural Resources Conservation Service, U.S. Fish and Wildlife Service, and U.S. Geological Survey.

The Smithsonian's Department of Botany at the National Museum of Natural History has a history of signing MOUs to further the mission of the Department. In 2000, a MOU was signed between the National Museum of Natural History and the U.S. Botanic Garden in Washington, D.C. The purpose of the MOU was to greatly increase their interactions and enhance the overall mission of each institution through effective collaborations. The MOU between these "Botanical Partners on the Mall" facilitated jointly sponsored exhibits, educational planning, public display projects, and programs such as the annual Smithsonian Botanical Symposia.

In 2007 the Department of Botany and the New England Tropical Conservatory (NETC) signed a MOU for the Indonesian Botanical Exploration and Taxonomy Project (IBETP) to provide a framework for the exchange of scientific and technical knowledge, to undertake joint field research in Indonesia, and to enhance scientific and technical capabilities with respect to botany.

On the horizon is a possible MOU between the Smithsonian's Department of Botany and Jardín Botánico de Bogotá, Colombia, and another MOU with Museo de Historia Natural at Universidad Nacional Mayor de San Marcos in Lima, Peru.

Chair With A View — Warren L. Wagner

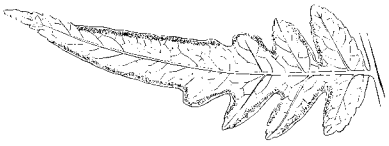
Staff Research & Activities

In April **Ashley Egan** presented a lightning talk on the evolutionary history of kudzu at the National Museum of Natural History. In June **Elizabeth Zimmer** presented a lightning talk on allopolyploids *Isoëtes riparia* entitled "Whose DNA is it?" Sponsored by the Smithsonian's Senate of Scientists, the lightning talk series, "6 Minute Science," features scientists presenting the depth and breadth of their research in six minutes followed by a short Q&A session.

On 16 May **Gary Krupnick** participated in the Endangered Species Day Fair at the U.S. Botanic Garden (USBG). The event, hosted by USBG, the U.S. Fish & Wildlife Service, and the Endangered Species Coalition, included tours of USBG's endangered and native plants, visits with exhibitors from federal agencies and conservation organizations, and demonstrations about what can be done at home to protect native plants. Krupnick hosted a booth displaying specimens from the U.S. National Herbarium of rare and endangered species from the U.S. and abroad.

Alice Tangerini visited Capitol Hill Day School in Washington, DC, to teach a 3rd grade class about botanical illustration. The class was learning about the Lewis and Clark expedition. Tangerini brought samples of her work and some of the Frederick A. Walpole illustrations of the Lewis and Clark collections. She also gave a demonstration of drawing techniques and had the class do a stippling project with *Nautilocalyx chimantensis* as the subject.

In May **Alain Touwaide** and **Emanuela Appetiti** attended the 2014 Dumbarton Oaks Symposium in Garden and Landscape Studies in Washington, DC, devoted to "Sound and Scent in the Garden." At the symposium Touwaide presented a paper entitled **"**Bottled Gardens. Capturing Scents for Health."



Visiting the Past: Bull Run Mountains Conservancy Board of Directors Visits the United States National Herbarium

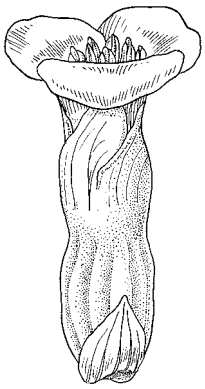
By Meghann Toner and Rusty Russell

In early June, the U.S. National Herbarium hosted the Board of Directors of the Bull Run Mountains Conservancy, Inc. <http://www.brmconservancy.org/> for their annual outing. The goal of this organization is to preserve the Bull Run Mountains through a strong program of education and research. The purpose of their visit was to connect with past research in the Bull Run Mountains by seeing firsthand the vouchers collected through the floristic work of Harry Ardell Allard (1880-1963), former U.S. Department of Agriculture biologist and Smithsonian collaborator. Allard's collections are included with many others that document the diversity of the Washington DC-Baltimore Region. These collections are kept in the appropriately named Washington DC and Vicinity Herbarium segregated within our main collection. On the day of the visit **Mark Strong** and **Meghann Toner** gave a tour of the herbarium and Floyd Shockley provided a behind the scenes tour of the Department of Entomology.

The area of most interest to our first time visitors was the Allard collection. Allard, born in 1880, was a plant pathologist who found special pleasure in the plant diversity he saw on day trips through our region, especially the Bull Run Mountains. In 1943, he and E.C. Leonard coauthored "Vegetation and Floristics of Bull Run Mountains, Virginia" (*Castanea* 8: 1-64; http://www.jstor.org/stable/4031081). More than a dozen of Allard's 240 scientific publications focused on the Bull Run Mountains. The Board of Directors examined 15 Allard collections selected by Toner, as well as 2 of 34 types based on his collecting efforts. Each of these represents a snapshot in time and provides a tangible link to the past.

Allard is also well known for his studies in photoperiodism, not only of plants, but of birds and insects. A fascinating account of his life and work can be read on The Field Book Project blog <http://nmnh.typepad.com/fieldbooks/2011/04/why-the-flowers-bloom.html>.

US 1813929 is the isotype of *Stachys eplingii* J.B. Nelson collected by Harry A. Allard in 1941 on the western slope of Bull Run Mountains, the most easterly chain in the Piedmont in Virginia.



Visitors

Carlos García-Robledo, Smithsonian Fellow; Plant-herbivore interaction (7/20/10-7/17/14).

Ning Zhang, Pennsylvania State University; Vitaceae (1/7/13-6/30/15).

Yongli Fan, Xishuangbana Tropical Botanical Garden, China; Pollination studies (1/13/14-1/12/15).

Nancai Pei, Research Institute of Tropical Forestry, China; Plant reproductive traits (3/1-9/1).

Sarah Anderson, Washington State University; Lichens (4/7-4/15).

Thais Vasconcelos, Royal Botanic Gardens, Kew; Melastomataceae and Myrtaceae (4/9-4/15).

Raquel Monteiro, Jardim Botânico deo Rio de Janeiro, Brazil; South American Bromeliaceae (4/11-4/18).

Young Eun Chang, Queen's University, Canada; Compositae (4/14-4/25).

Chris Frye, Maryland Department of Natural Resources; *Bromus* (Poaceae), *Dryopteris* (Dryopteridaceae), and *Pycnanthemum* (Lamiaceae) (4/14).

Tim Gregory, University of California Botanical Garden at Berkeley; *Dioon* (Cycadaceae) (4/14).

Joelq Cohen, Rockville, Maryland; Cuatrecasas collections (4/14-4/18).

Mohammad Vatanparast, Chiba University, Japan; *Dalbergia* (Fabaceae) (4/14-4/19).

Marcos Carballo, Pennsylvania State University; Viscaceae (4/22-4/26).

Orlando Muñoz, Universidad de los Andes, Colombia; *Begonia* (Begoniaceae) (4/22-5/3).

Caroline Pannell, University of Oxford; Brazilian *Luehea* (Tiliaceae) (4/22-4/29).

Julián Aguirre-Santoro, New York Botanical Garden; *Hohenbergia* and *Ronnbergia* (Bromeliaceae) (4/23-4/26).

Scott Mori, New York Botanical Garden; Lecythidaceae (4/23-4/25).

Nelson Salinas, New York Botanical Garden; *Orthaea* (Ericaceae) (4/23-4/25).

Aliki Heinrich and **Lumi Hilchey**, Arena Destination Marketing, New York; History of medicine (5/5).

Tom Lovejoy and 16 students, George Mason University; Herbarium tour and plant conservation (5/5).

Ramya Prasad, Georgetown University; Medicinal uses of plants in Ayurveda (5/5-7/18).

Sotiris Bafitis, Verity Wine, Washington, DC; Traditional Greek food (5/13).

Kellie Kuhn, University of Connecticut; *Ocotea* (Lauraceace) (5/14-6/13).

Alejandro Zuluaga, University of Wisconsin, Madison; Monsteroideae (Araceae) (5/14-6/4).

Alexander Krings, North Carolina State University; Asclepiadaceae (5/19-5/20).

Alexey Shipunov, Minot State University; North American Plantaginaceae (5/19-5/23).

Caroline Hannaway, American Association for the History of Medicine (AAHM) and **John Parascandola**, University of Maryland, College Park; Medieval medicine (5/22).

Sean Bradley, Bastyr University; Ancient Chinese medicine (5/23-5/27).

Jim Folsom, Huntington Botanical Gardens; Mediterranean medicinal plants (5/23).

Hope Watson, Temple University; Medicinal plants of antiquity internship (5/24-8/8).

Angela Bartolomeo, University of Maryland, Baltimore County; Medicinal plants of antiquity (5/27).

Sterling Herron, Milligan College; *Vitis* internship (5/27-8/2).

Philip Waisen, University of Hawaii at Manoa; Agricultural plants (5/27-6/28).

Dennis Zhu, University of Missouri; Kudzu internship (5/27-8/2).

Elizabeth Mauer, Boston University; Cedar of Lebanon in ancient times (5/28).

Marcia Sprules, Council on Foreign Relations, New York; Medieval and Renaissance herbals (5/29).

Christina Flann, Wageningen University, Netherlands; Asteraceae (5/31-6/5).

Lola Ramirez, Corcoran College of Art+Design; Botany exhibit internship (6/2-8/29).

Ann Alerding, Virginia Military Institute; Plant mounting, herbarium curation (6/3).

Michael Kieffer and five members of the Board of Directors, Bull Run Mountains Conservancy, Inc., Virginia; Herbarium tour (6/4).

Tomas Fer and **Monika Pospíailová**, Charles University, Czech Republic; Zingiberales (6/5-6/13).

Michael Windham, Duke University; Ferns (6/5-6/6).

George Yatskievych, Missouri Botanical Garden; Ferns (6/5).

Karen Yu, Smith College; Plant DNA barcode project internship (6/9-8/15).

Max Aleman, **Billy Cappuccio**, and **Jorge Mena-Ali**, Franklin and Marshall College; *Microbotryum* (Microbotryaceae) infecting Portulacaceae (6/12).

Shelley James, Bishop Museum; New Guinean collections (6/16-6/20).

Tyler Kartzinel, Princeton University; Plant DNA barcode project (6/16-6/17).

Katharine Wilson, Smith College; Plant DNA barcode project internship (6/16-8/22).

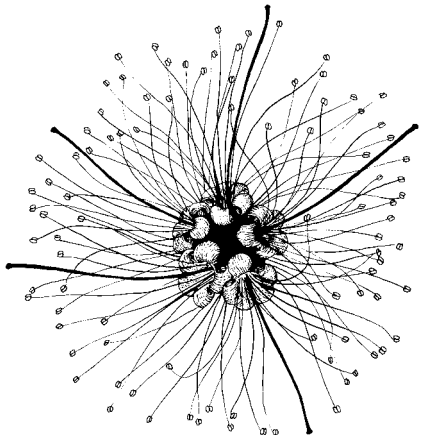
Eric Yarnell, Bastyr University; Medicinal plant uses in antiquity (6/16-6/19).

Julian Campbell, Bluegrass Woodland Restoration Center, Kentucky; Asteraceae and Kentucky flora (6/18-6/19).

Jerry Perry, University of Colorado Denver; Mediterranean history of botany (6/24).

Joe Miller, National Science Foundation, and **Dan Murphy**, Royal Botanic Garden Melbourne, Australia; Fabaceae (6/26-6/27).

Rebecca Jacobs, Indiana University-Purdue University Fort Wayne; Medicinal plants of antiquity internship (6/30-8/15).



Pollinator Week is Abuzz at Museum

The week of June 16-22, 2014, was designated as Pollinator Week to mark a necessary step toward addressing the urgent issue of declining pollinator and plant populations. As a member of the North American Pollinator Protection Campaign (NAPPC), the National Museum of Natural History (NMNH) had a series of events at the Smithsonian to mark Pollinator Week.

This year NAPPC teamed up with Smithsonian's North American Orchid Conservation Center (NAOCC) to promote Pollinator Week with the production of NAPPC's annual Pollinator Poster. The 2014 poster features illustrations of seven orchid-pollinator interactions. Several public programs at NMNH during the week focused on orchids and their pollinators.

Public programs included talks in the Q?rius Theater by Jonathan Mawdsley (Smithsonian Entomologist) speaking on beetle pollinators of South Africa's Kruger National Park, Tom Mirenda (Smithsonian Orchid Specialist) discussing the mysteries of orchid pollination, and Dennis Whigham (Smithsonian Ecologist) talking about conservation of native orchids. **Gary Krupnick** (Smithsonian Conservation Biologist) hosted a "Scientist is In" table in the Butterfly Pavilion, displaying a selection of plant specimens and talking about why endangered plants need their pollinators. A Pollination Party was held at NMNH's Butterfly Habitat Garden where Smithsonian Gardens staff and students from the University of Maryland PollinaTerps had fun family-friendly activities staged throughout the garden.

Gary Krupnick is the "Scientist is In" during Pollinator Week at the National Museum of Natural History, engaging the public with specimens from the U.S. National Herbarium. (photo by Hilary-Morgan Watt, Smithsonian Institution)

NMNH raised awareness of pollination biology through social media and its use of images, blog posts, videos, live-tweeting presentations, and news stories. The most popular NMNH Facebook post during the week was a link to a *Smithsonian Science* story about nectar-feeding bats pollinating *Agave*, an essential ingredient of tequila: http://smithsonianscience.org/2014/06/love-tequila-toast-pollinating-bats/.

NMNH reached out to other Smithsonian social media units and other museums to participate in Pollinator Week. Archives of American Art, Freer and Sackler, the Hirshhorn Museum, the National Portrait Gallery, and the Phillips Collection joined in on the conversation with a unique take on pollinator content. For instance, the National Portrait Gallery tweeted a photograph of Walt Whitman holding a butterfly: https://twitter.com/NPG/status/479653647417352192.

The NMNH #SIpollinator twitter chat, an online conversation about pollination biology and how pollinators affect our daily lives, resulted in 733 tweets. The chat was moderated by Krupnick, and featured a panel consisting of Laurie Adams (Executive Director of Pollinator Partnership), Sam Droege (USGS Native Bee Inventory and Monitoring Program), and Floyd Shockley (Assistant Collections Manager, NMNH Department of Entomology). Droege's image of *Osmia atriventris*, a pollinator of blueberry, was the most retweeted image during the chat: https://twitter.com/NMNH/status/479636784280649728/photo/1.

The NMNH twitter chat premiered just after the White House issued President Obama's memorandum on pollinator protection. The President's memorandum directs federal agencies to focus efforts on research, prevention, and recovery from pollinator losses, including efforts on public education. The Smithsonian Institution will use this opportunity to partner with a number of agencies on pollination research and education.

Stalking the Wild *Hesperomannia*

By Jason Cantley (as told to Vicki Funk)

May 23, 2014, was as typical a Hawaiian morning as any other. The sun was brightly shining and there were a few rain clouds resting against the mountains. The locals were already starting their daily commute to the big city of Honolulu to finish out the workweek. But this day was not an ordinary day for five botanists on the island O'ahu. This morning the botanists were going on a hike to find one of the rarest plants in the world.

Jason Cantley, a newly minted Ph.D. from the Botany Department at the University of Hawai'i at Mānoa, organized this special trip many weeks in advance. The plant they were searching for, *Hesperomannia oahuensis* (Hillebr.) O.Deg. (Compositae: Vernonieae), was at the top of his 'botany bucket list' of plants to see flowering in the wild. In fact, *H. oahuensis* is so exceedingly rare that only two plants (of less than a handful total) developed flowers this year in the wild and unfortunately, one of these wasn't able to fully flower because an invasive rat badly damaged its stem before its flowers were able to fully develop. This meant that there was only one solitary flowering individual of *H. oahuensis* in the wild this year and Jason was determined to see it.

Jason Cantley (second from left) leads a quest for *Hesperomannia oahuensis*, with (left to right) Marian Chau, Sterling Keeley, and Susan Ching.

***Hesperomannia oahuensis* in flower. (photo by Jason Cantley)**

It was a rare confluence of botanists that joined him for the trek: Susan Ching (O‘ahu Coordinator of the Plant Extinction Prevention Program), Marian Chau (Lyon Arboretum Seed Conservation Lab Manager), Maggie Sporck (Hawai‘i State Botanist, Department of Land and Natural Resources), and Sterling Keeley (Professor, University of Hawai‘i at Mānoa). They met at the Kunia Park & Ride and then traveled deep into a valley of the northern Waianae Mountains on the island of O‘ahu. After reaching the trailhead, they trekked uphill on foot quickly through the forest to a dividing valley ridge, which they promptly crossed and then dropped down into a patch of native forest.

The forest was quiet except for the patter of raindrops on leaves from a small cloud above and the occasional wing beats of ‘apapane (*Himatione sanguinea*), Hawai‘i’s most common native bird. The group had grown quiet, perhaps in anticipation that a true Hawaiian gem was very close. And it was. Jason recalls the first moments seeing the beautiful yellow to orange-red and pink flowers through the forest leaves as so powerful it gave him ‘chicken skin,’ or what we mainlanders would call goose bumps. The plant was healthy, nearly seven or eight feet in height with large cordate shaped leaves. It was clear they timed the trip correctly because there were two large flowering heads with colors that recall brilliant Hawaiian sunsets.

The team hadn’t assembled just to see the flowers of *H. oahuensis* in the wild but also to try and help save the species from extinction. Earlier in the week, Susan had collected pollen from a mature greenhouse individual and planned to cross it with the wild plant they had just hiked to. It was a delicate process. She unfolded the wax paper containing the pollen, which was then dusted onto an artist’s paintbrush connected to the end of a hiking pole. Susan proceeded to touch the pollen onto the (hopefully) receptive stigmas of the flowering heads, all in hope of getting successful fertilization and seed set. It would be a waiting game to find out if seeds were indeed produced. If their efforts were successful the seeds would be collected and used to help prevent the elimination this plant from our planet.

After a short solemn lunch break in the rain, the team packed up and started the muddy hike back to the trailhead. On the way out, Jason contemplated how it was such an amazing experience for him to see *H. oahuensis* flowering in the wild for the first time, but sadly also that it was likely his last. For a plant that is so close to the brink of extinction, it is amazing to know that there are people dedicated to providing even a small chance of survival in the wild of such a beautiful and rare plant.

Jason Cantley, from the University of Hawai‘i at Mānoa, was Vicki Funk’s graduate student. His dissertation research includes the development of a robust phylogeny for Coprosma *(Rubiaceae).*

The Third Time's the Charm

By L.J. Dorr

Puya raimondii Harms (Bromeliaceae) is now in flower in the University of California Botanical Garden at Berkeley (http://botanicalgarden.berkeley.edu/whatsnew/Puya2014/index.shtml). This is only the third flowering event for this species in cultivation—all three events occurring in California. It flowered before in Berkeley in 1986 and there was a “smaller” flowering event at the San Francisco Botanical Garden inside Golden Gate Park in 2006. What connects the current flowering event to our department is the fact that I was one of the collectors of the seed that produced the plant that is now in flower. The collection was made almost a quarter of a century ago near Comanche, 80 km southwest of La Paz, Bolivia.

The voucher for the plant flowering in Berkeley is *Luteyn, Dorr, Smith & Buddensick [sic] 11490* (LPB, MO, NY, US) and the specimens were gathered on 29 May 1990. When we collected this plant, Jim Luteyn was a curator at the New York Botanical Garden and I was working for him on a grant to conduct floristic inventories in Andean countries. David Smith was employed by the Missouri Botanical Garden as their resident plant collector in

Continued on page 8

***Puya raimondii* Harms with Marianne Buddensieck (left) & David Smith (right) for scale. (photo by L.J. Dorr)**

Queen of the Andes, *Puya raimondii*, in flower on July 8, 2014, at the University of California Botanical Garden at Berkeley. (photo by Paul Licht)

Puya

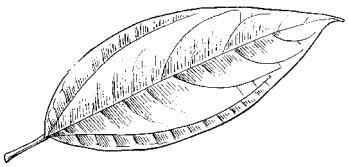
Continued from page 7

Bolivia and Marianne Buddensieck was his wife. Neither Luteyn nor I had seen this spectacular *Puya* that attains 10-15 m in height and we were thrilled to be able to make the short excursion across the Altiplano from La Paz to Comanche to see it in the wild. We were not thinking about collecting and when we did see the plants in flower and fruit we succumbed to the temptation to try to make several herbarium specimens. Lacking ladders or pole pruners we managed to dislodge parts of an infructescence by throwing rocks at the fruiting stalk. We all took part and while I do not remember now who had the best arm it does not matter since somehow we succeeded.

Several sets of herbarium specimens were distributed from the Bronx. The U.S. National Herbarium received one set because Lyman B. Smith was then the world's expert on the taxonomy of Bromeliaceae. He had happily named material Luteyn and I sent him for identification from our many collecting trips throughout the Andes, and he had built the U.S. National Herbarium into one of the world's most important scientific collections for the study of Bromeliaceae.

The word "seed" is featured prominently on the labels of the herbarium specimens that were distributed, which suggests that we were aware from the beginning of the potential to propagate *Puya raimondii*, but I do not remember now whether or not this was discussed nor do I remember reflecting on the age of the plants we saw in the quarries above Comanche. Details as to which gardens received our seed collections are for the most part either long forgotten or lost. We do know, however, that the Berkeley plant was grown from seed that Luteyn gave to Frank Almeda at the California Academy of Sciences in San Francisco, who in turn passed it on to the botanic garden at Berkeley.

After spending a career collecting specimens it is not always easy for me to remember every detail of a particular collecting event. I do remember clearly our brief day-long excursion to Comanche because of these spectacular plants and the unorthodox collecting strategy we were forced to adopt. The photograph that accompanies this note, which has been on a bulletin board above my desk for years, continues to remind me of the day we spent pitching rocks at the "Queen of the Andes."



Aster or Dysaster: Trying to Infer Phylogeny

By V.A. Funk

In April 2014, **Harold Robinson** and **Vicki Funk** published an article in *Phytokeys* (36: 35-40) describing a new genus, *Dysaster*, and a new species, *D. cajamarcensis* H. Rob. & V.A. Funk. Robinson had suggested naming it *Dysaster* because it was so difficult to place. In fact, the article starts off by saying:

"There is something very unsatisfying about a plant, sent for identification, that has no strikingly distinctive feature, but has a combination of characteristics that excludes it from any already known genus. It is particularly unsatisfying when the plant involved is a member of a tribe such as the Astereae in which phyletic studies using DNA… are not yet adequately correlated with morphological and anatomical studies. Nevertheless, such a plant has been collected in northern Peru."

While the authors enjoyed the small joke concerning the name they had no idea that it had deeper meaning. Shortly after it was published, their colleague Jan-Frits Veldkamp (Nationaal Herbarium Nederland) wrote to Funk with some interesting information which is paraphrased below:

Just saw your paper on *Dysaster*. Fortunately, it is not a later homonym of *Disaster* Gilli, *Ann. Naturhist. Mus. Wien* 83: 454 (1979 publ. 1980) from New Guinea (Rhamnaceae) because the orthography, derivation, and distribution are unlikely to be confused (except perhaps in universal databases!). Gilli was a schoolteacher in Vienna and after his retirement went to visit his former students in faraway countries where he made collections. Apparently what he could not identify with the means available in W (Herbarium of the Natural History Museum in Vienna) he described as new. One place he visited was Papua New Guinea where he collected on Mt. Wilhelm, the best known and explored area of the island. Here he, among a number of other novelties, "discovered" a new genus of Rhamnaceae with flowers that resembled two overlapping stars. Hence the name "Disaster". Professor C.G.G. J. van Steenis became very upset with all the new taxa and asked for a loan of the type material. Thus it

became clear that *Disaster* was not a Rhamnaceae, but a Sterculiaceae! Hence Gilli is locally known as Disaster Gilli.

Botanical trivial pursuit at its best!

US 3628267 is a holotype of *Dysaster cajamarcensis* H. Rob. & V.A. Funk, collected from Contumazá, Peru in 1992 by T.F. Stuessy, D.J. Crawford and A. Sagastequi.

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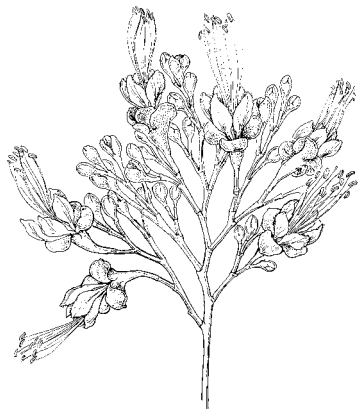

Linder Receives 12th Cuatrecasas Medal

The Department of Botany and the United States National Herbarium present this award to a botanist and scholar of international stature who has contributed significantly to advancing the field of tropical botany. 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 in the Smithsonian Institution's Department of Botany. Dr. Cuatrecasas devoted his career to plant exploration in tropical South America and this award serves to keep vibrant the accomplishments and memory of this outstanding scientist.

The winner of this prestigious award is selected by a committee made up of four botanists on the staff of the Department in consultation with other plant scientists outside of the Smithsonian Institution. Nominations for the Medal are accepted from all scientists in the Botany Department. 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.

H. Peter Linder

Highlights from past presentations to the recipients are available at <http://botany.si.edu/cuatrecasas/cuatrecasasMedal.cfm>.

H. Peter Linder is the 12th recipient of the José Cuatrecasas Medal for Excellence in Tropical Botany. Linder is noted for his contributions to the systematics, biogeography, and evolution of Orchidaceae, Restionaceae, and Poaceae. He is also recognized for his valuable contributions to identifying biogeographical patterns in the Southern Hemisphere and especially in Africa.

Linder, a Professor in the Institute of Systematic Botany of Zurich University in Switzerland, received his B.Sc. from the University of Cape Town in South Africa and his Ph.D. while working at the Bolus Herbarium under the supervision of E.A. Schelpe. His dissertation focused on the orchid genus *Disa* and its allies. This study led to numerous scientific papers and a book written in collaboration with H. Kurzweil entitled *The Orchids of Southern Africa* (1999). The book originally was intended to be a contribution to the *Flora of Southern Africa*, but the flora project was discontinued.

Not content to become an expert on orchids alone, Linder then started working on the African Restionaceae. Originally this work, too, was supposed to be for the *Flora of Southern Africa*. The result has been two major re-orientations of the generic classification (the first based on cladistics of morphology, the second on molecular insights), and a major set of papers using Restionaceae to get at biogeography, key innovations, niche evolution, and palaeoclimates. This work is still ongoing. The revision of the taxonomy was published online in Delta / Intkey format (2001).

In 1988, Linder started working on the grass genus *Pentaschistis*, which expanded into a study of danthonioid grasses. This research led to a generic re-classification, numerous flora accounts, papers on austral biogeography, and papers on radiation patterns. A monograph is in preparation and if he can find six months somewhere he will complete it.

In short, Linder's work by and large has been on the African flora, with a series of papers on the regionalization of this flora, and an interest in Africa as a whole. He also has worked in Australia and New Zealand, but hardly has been to the Americas. This last gap in his travel experience will be closed eventually. Linder was unable to attend this year's Smithsonian Botanical Symposium. He plans, however, to visit in the fall and will present a lecture at NMNH on 2 October 2014. During his visit he will receive the Cuatrecasas Medal in person.

The past recipients of the Cuatrecasas Medal are Rogers McVaugh of the University of North Carolina at Chapel Hill (2001); P. Barry Tomlinson of Harvard University (2002); John Beaman of the Royal Botanic Gardens, Kew (2003); David Mabberley of the University of Leiden, The Netherlands, and the Royal Botanic Gardens, Sydney (2004); Jerzy Rzedowski and Graciela Calderón de Rzedowski of Instituto de Ecología del Bajío, Michoacán, Mexico (2005); Sherwin Carlquist of Rancho Santa Ana Botanic Garden and Pomona College (2006); Mireya D. Correa A. of the University of Panama and Smithsonian Tropical Research Institute (2008); Norris H. Williams of the Florida Museum of Natural History and the University of Florida, Gainesville (2009); Beryl B. Simpson of the University of Texas at Austin (2010); Walter S. Judd of the University of Florida at Gainesville (2012); and Ana Maria Giulietti Harley of the Universidade Estadual de Feira de Santana, Brazil (2013).

Abstracts from the Speakers at the Smithsonian Botanical Symposium

The 12th Smithsonian Botanical Symposium, "Location, Location, Location... New Advances in the Science of Biogeography," was held 24-25 April 2014. The invited speakers covered a wide range of organisms and topics to illuminate modern methods and approaches in the field of biogeography. Below are the speakers' abstracts from the papers that were presented.

Symposium convener Vicki Funk (fourth from left), Botany Chair Warren Wagner (fifth from left), and U.S. Botanic Garden Acting Executive Director Ari Novy (second from right) join speakers Ben Winger, Susanne Renner, Rachel Warnock, Brian Bowen, Mauricio Diazgranados, Jonathan Price, and Erica Goss at the 2014 Smithsonian Botanical Symposium at the National Museum of Natural History. (photo by Ken Wurdack)

Brian W. Bowen
Hawaii Institute of Marine Biology

"Origins of Tropical Marine Biodiversity"

Understanding the process of speciation in the sea is a significant challenge in evolutionary biology. Central to this issue is whether biodiversity hotspots such as the Coral Triangle (between the Philippines, New Guinea, and Indonesia) are producing and exporting new species, or accumulating species that arose elsewhere. Phylogeographic studies yield conflicting results on this issue, but have rejected three paradigms about marine biodiversity: 1) *Speciation is primarily driven by physical isolation*. In contrast, many closely-related species occupy the same or adjacent habitats, reducing the role of physical isolation (allopatry) for speciation in the sea. 2) *Peripheral habitats such as oceanic archipelagos are evolutionary dead-ends that contribute little to overall biodiversity*. In contrast, new studies show that oceanic archipelagos can export biodiversity to other regions. 3) *Speciation in the sea follows the same rules as in terrestrial systems*. Evolutionary pathways above and below the waterline follow markedly different trajectories due to the higher dispersal capability of marine organisms. The realignment of these principles allows for a new understanding of biodiversity production in the sea. Biodiversity hotspots produce and export species, but can also accumulate species produced in peripheral habitat. New species forged by intense competition at biodiversity hotspots can radiate out to depauperate peripheral habitats, where they may evolve novel functions under the "ecological opportunity" proposed by G.G. Simpson. In this reconciliation of "center of speciation" and "center of accumulation", both hotspots and peripheral ecosystems benefit from this exchange in a process named *biodiversity feedback*.

Mauricio Diazgranados
National Museum of Natural History

"Biogeography and Climate Change in the Andes"

The Andes are the most topographically and climatically complex orographic system in the world. With the driest places and some of the wettest localities on Earth, and elevations from sea level to almost 7000 m, the Andes have a striking diversity. The tropical Andes, holding about 45,000 plant species, with 45% of endemism, are considered a global hotspot and epicenter of biodiversity. Unfortunately, massive extinctions are predicted to occur in the Andean high-elevation ecosystems as a result of climate change: studies have predicted that between 10 and 60 percent of the species will be extinct by the end of the century. In fact, climate change can push entire lineages to the verge of extinction, with irreversible gene pool losses, unique to those lineages. However, there is still little research documenting and predicting these changes, and several caveats in the analyses persist. Evolution and biogeography are important aspects when modeling the impacts of climate change on future species distributions. An example will be explored using three clades of Compositae (the subtribe Espeletiinae, the *Werneria* s.l. complex and the *Chiliotrichum* group) that span the high elevation Andean ecosystems from Venezuela to Patagonia. Of particular importance are: 1) number of occurrences per species: how well we know their diversity; 2) resolution: the problem of scale; 3) accuracy of predictors: how well we know the ecosystems; 4) uncertainty in future climate predictions; 5) the dilemma of the narrowly distributed species; 6) computing limitations; and 7) measuring the possible species responses to climate change.

Erica M. Goss
University of Florida

"Untangling the Origin and Global Movement of Notorious *Phytophthora* Plant Pathogens"

The pathogen that caused the Irish potato famine, *Phytophthora infestans*, had an enormous impact on human history and culture. *Phytophthora infestans* is

Abstracts

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just one member of a genus of destructive plant pathogens that cause global economic losses in the billions of dollars annually and have irreversibly changed natural ecosystems. These pathogens are largely known from agriculture or as emerging forest pathogens. Little is known of their native ecology or geographic origins, which puts us in a poor position to manage emerging diseases and prevent future invasions. I will present recent insights into the origin and anthropogenic movement of *Phytophthora* pathogens. We revisited the question of the origin of *P. infestans*, which some have argued is Mexico and others South America. Our results have implications for the emergence and continued evolution of this damaging pathogen. We are also exploring the diversity of *Phytophthora* in minimally disturbed tropical forests, which has provided novel insights into the native biology of these species and will contribute to understanding the evolution of *Phytophthora* pathogens.

Acknowledgements

The success of the Symposium was due to the significant time and efforts of the following people:

Organizers
- Vicki Funk
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- Kenneth Wurdack

And many others who had helped in a myriad number of ways.

Jonathan Price
University of Hawaii at Hilo

"Answering Big Questions with Small Landmasses: Evolutionary Biogeography from Atlantic and Pacific Archipelagos"

Oceanic islands historically have provided a biogeographic lens through which major questions in ecology and evolution have been made clearer. They are optimally simple systems comprising small landmasses with modest diversity and definable spatial and temporal constraints. At the same time, their climatic and ecological complexity mimics that of continental systems. A mounting wealth of phylogenetic studies, particularly for the Hawaiian and Canary Islands, sets the stage for studies of whole floras, supporting a comparatively thorough understanding of the processes by which integrated ecological systems arise. Whereas traditionally species-area relationships have been attributed to ecological processes, phylogenetic diversification can now be explicitly quantified and related to the spatial and historical characteristics of islands. Pacific and Atlantic archipelagoes exhibit features of triphasic species-area relationships, whereby larger archipelagoes contain much larger numbers of species (even for comparably-sized islands), with large, adaptively-radiating lineages responding the most strongly to increases in area. Ecological opportunity is a key driver of diversification, as evidenced by higher rates of speciation within islands and archipelagoes that are more remote and/or physiographically complex. Major adaptive shifts in continental systems happen comparatively rarely, indicating a prevalence of niche conservatism; however the comparative frequency of adaptive shifts on islands offers clues to how major episodes of adaptive evolution have occurred on continents. Tropical islands appear to promote the disproportionate ecological success and adaptive diversification of lineages with a temperate origin, possibly stemming from a greater lability in temperate taxa coupled with the abundance of open niches in island environments.

Susanne Renner
University of Munich

"Historical Biogeography and Ecological Biogeography - Come Together Now"

Molecular phylogenies, haplotype networks, and molecular clocks have revolutionized the science of biogeography. We can now (roughly) date divergence events in groups with or without a good fossil record and infer the history of populations from entire single genomes. In this talk I will discuss ongoing work on the biogeography of hummingbirds, parasitic plants, and the fern *Osmunda*, as well as work by others on *Amborella trichopoda*, the sister species to all other flowering plants. My examples are chosen to represent groups with and without a fossil record to illustrate the power of molecular data, but also the difficulty of inferring the past from the few "tips" of the tree of life that are currently surviving. New methods that I will highlight include Pairwise Sequential Markovian Coalescence (used in *Amborella trichopoda*) and a calibration approach by Tracy Heath, Tanja Stadler, and John Huelsenbeck, which makes use of all of a clade's fossils, not just the oldest ones (used in our *Osmunda* work).

Rachel C. M. Warnock
National Museum of Natural History

Philip C. J. Donoghue
University of Bristol

"Testing the Molecular Clock using Simulated Trees, Fossils and Sequences"

The molecular clock provides a powerful means of establishing an evolutionary timescale. Approaches to calibrating the molecular substitution rate vary in their assumptions and complexity, differ in their use of geological evidence, and invariably yield different divergence estimates. Surprisingly, competing approaches to calibration have never been tested because in reality the true evolutionary timescale is never known. Consequently, it has not been possible to assess the accuracy and precision with which divergence times can ever be known. The solution is to use simulated data, where the relationship between times of divergence and fossil evidence is known. We develop simulations that combine realistic models of speciation, molecular evolution and fossil preservation. We test the accuracy and precision of quantitative and probabilistic methods of deriving temporal constraints from the fossil record. We implement these as bespoke calibration priors in Bayesian molecular clock analyses, and assess

the accuracy and precision of posterior divergence estimates. The results demonstrate that paleontological constraints can be accurate but will typically be imprecise. Accurate molecular divergence estimates require both accurate and precise fossil-based constraints. However, the accuracy of posterior estimates is not determined by the accuracy of the specified calibrations. Instead, accuracy is determined by the way the calibrations are effectively implemented by contemporary Bayesian models of divergence time estimation. This means the majority of studies that have identified a causal link between biotic evolution and climatic change may be invalid, since they lack the accuracy and precision to make the temporal correlations that underpin the causal linkages.

Ben Winger

University of Chicago and the Field Museum

"Resolving the Geographic History of Neotropical Bird Migration: An Extension of the DEC Model"

Migratory species exhibit seasonal variation in their geographic ranges, often inhabiting geographically and ecologically distinct breeding and nonbreeding areas. The complex geography of seasonal migration has long posed a challenge for inferring the biogeographic histories of migratory species as well as the evolution of migration. We developed a phylogenetic model of geographic range evolution to examine the biogeographic origins and histories of migratory species and test hypotheses on the evolution of migration. The model uses a maximum-likelihood framework based on the dispersal-extinction-cladogenesis model to simultaneously examine changes in breeding range and winter range distribution during phylogenetic history. We used this model to investigate the geography history of seasonal migration between North America and the Neotropics in emberizioid passerine birds.

Symposium

Continued from page 1

method to show slow diversification in royal ferns (Osmundaceae), a family of 11-21 extant species and 150 named fossil species. She explained that the traditional method of molecular clock dating includes forcing the oldest fossil record to a specific node in the tree while ignoring the other fossils. In the new fossilized birth-death method, the precise relationship of each fossil is irrelevant and all fossils are used in the tree. The four parameters of the new model are speciation rate, extinction rate, fossil recovery rate, and proportion of sampled extant species. The fossilized birth-death method can thus disentangle speciation and extinction.

Rachel Warnock, a postdoctoral fellow in the Department of Paleobiology at the Smithsonian Institution, presented the talk, "Testing the Molecular Clock using Simulated Trees, Fossils and Sequences." The molecular clock establishes an evolutionary timeline by comparing the genes of living species. Warnock identified two caveats of the molecular clock: (1) the molecular clock does not tick at a constant rate; and (2) calibration of the clock relies on an incomplete fossil record. She pointed out that there is a lag time between the first observed fossil of a species and the true time of origin and divergence.

Warnock explained that the fossil record can be used to obtain accurate constraints on divergence times, but these will invariably be imprecise. She pointed out that the accuracy of molecular clock estimates is determined by the effective, rather than the specified priors. The most reliable and informative results will be obtained with accurate and precise constraints. She said that molecular data cannot be used to mitigate the imprecision associated with fossil calibrations, so priors must be improved. Improving divergence time estimation requires considering preservation and sampling biases. She ended with suggesting that the integration of molecular and paleontological data is essential for telling evolutionary time.

Ben Winger, a doctoral student from the University of Chicago and the Field Museum, presented "Resolving the Geographic History of Neotropical Bird Migration: An Extension of the DEC Model." With collaborator Rick Ree of the Field Museum, Winger has been developing a method to reconstruct the historical biogeography of migrating birds, specifically to understand where a lineage arose and how it came to be found where it is today. Migratory species are a complicated evolutionary problem because they exist in two or more different geographic ranges at different times of the year.

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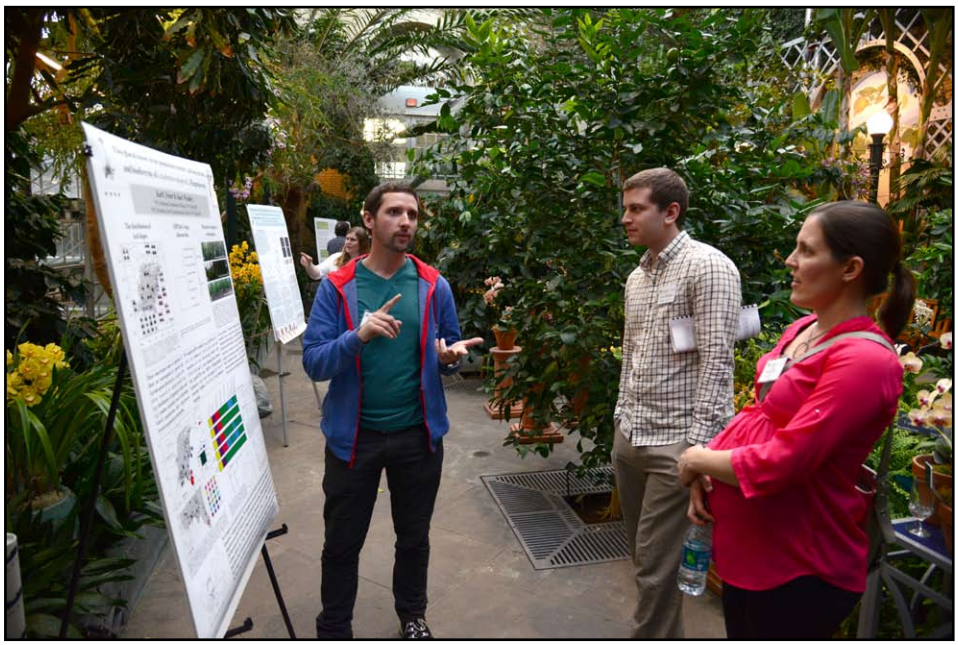

Poster presenters and guests interact at the opening reception of the Smithsonian Botanical Symposium. (photo by Ken Wurdack)

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Symposium

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The dilemma is summarized by two theories. The "Temperate Home" theory suggests that a northern population shifts towards the tropics to avoid a harsh winter. The "Out of the Tropics" theory suggests that a tropical population shifts northward to escape competition for resources in the crowded tropics, and exploit a seasonal flush of resources in the temperate zone. Existing historical biogeographic models are not well suited for understanding the evolution of migration because we cannot consider the breeding range and the wintering range simultaneously.

During his talk Winger introduced an approach to answering this dilemma by using migratory songbirds as a case study. The Emberizoidea or New World nine-primaried oscines is a lineage of about 750 bird species and composed of five major groups – all New World sparrows, warblers, cardinals and buntings, blackbirds and orioles, and tanagers. Ree developed the Dispersal-Extinction-Cladogensis (DEC) model for inferring historical biogeography. Presenting a series of presence absence matrices, transition matrices, and geographic pathways, Winger concluded that the out of the tropics theories that invoke a shift of the breeding range out of the tropics are poorly supported, and that the evolution of Neotropical migration in Emberizoids is consistent with the temperate home theories.

Jonathan Price, the University of Hawaii at Hilo, brought things down to a smaller scale with his talk, "Answering Big Questions with Small Landmasses: Evolutionary Biogeography from Atlantic and Pacific Archipelagos." Price explained that island systems compared to continental systems can be rather simple (definable temporal and spatial constraints, relatively few species derived from original colonists), but can also be quite complex (wide array of climatic habitats, complex ecological interactions), making for an interesting study system in biogeography.

Price found similar species-area relationships and similar distributions of lineages in his comparison of the Marquesas, Societies, and Hawaii archipelagoes. Most lineages have only one species per archipelago, while a few lineages are very diverse. Those lineages that do not speciate in one archipelago do not speciate elsewhere, while those that speciate greatly in one archipelago do so in others. The species radiations are also much larger in larger archipelagoes.

Symposium attendees find an opportunity to chat during the afternoon coffee break. (photo by Ken Wurdack)

Price spoke about the location where island colonists originate. For the Hawaiian archipelago, most colonists came from the Indo-Pacific. Three-quarters of Hawaiian colonists were from tropical regions, while one-third were from temperate. Many lineages also colonized other Pacific Islands after evolving in Hawaii. He also explained that major climatic adaptations are highly conserved, suggesting Hawaiian taxa are in habitats related to their area of origin: low elevation taxa have a tropical origin, while high elevation taxa are from temperate regions. He concluded that diversification is moderated by both physical constraints and ecological opportunity, but mostly in key lineages.

Brian Bowen, the Hawaii Institute of Marine Biology, switched things up with a marine focus during his talk, "Origins of Tropical Marine Biodiversity." Bowen explained that the primary marine biodiversity hotspot is the Coral Triangle located between the Philippines, Indonesia, and New Guinea. Three hypotheses explain the existence of this hotspot: (1) intense competition forges new species with high fitness that radiate out ("center of speciation"); (2) speciation occurs at outer archipelagoes under ecological release and accumulate in the center of the range ("center of accumulation"); and (3) distinct Indian and Pacific faunas overlap at the border between both oceans ("center of overlap").

Bowen continued to explain that populations do not have to be physically isolated to diverge and speciate. For example, sexual selection on the basis of vocal cues has promoted reproductive isolation among sympatric sister species of the Caribbean and East Pacific reef fishes called grunts (genus *Haemulon*).

He then provided examples of phylogeographic support for all three hypotheses that explain biodiversity hotspots. The evolution of West Pacific wrasses (*Halichoeres*) supports the hypothesis of speciation within a center of origin. The center of accumulation hypothesis is supported by the evolution of four derived species within the wrasse genus *Thalassoma*. Center of overlap is supported by the Indian Ocean lineage and the Pacific Ocean lineage of the peacock grouper. Whereas Hawaii was once thought as an evolutionary dead end for marine species, Bowen provided evidence that indicates Hawaii is both a recipient and a source of marine biodiversity.

Continuing on the global perspective theme of biogeography, Erica M. Goss from the University of Florida spoke about the spread of pathogens in the talk, "Untangling the Origin and Global Movement of Notorious *Phytophthora* Plant Pathogens." Using population genetic data, Goss explained, it is possible to

reconstruct global migration patterns of plant pathogens, which are moving at an unprecedented rate due to global trade.

Goss spoke about *Phytophthora ramorum*, a pathogen which was introduced into the western United States three independent times, once from Europe and twice from unknown sources. She provided a lengthy discussion about the migratory patterns of the potato late blight, *P. infestans*, a pathogen of *Solanum* species. In the 1840s, it migrated from South American to Europe. In the early 1900s, there were multiple migrations between the Americas and Europe. The divergence times of the multiple lineages can be traced using mtDNA genomes taken from herbarium samples.

Goss explained that a coalescent genealogy of the RAS locus indicates that the center of origin of *P. infestans* is the Andes Mountains; yet a multi-locus study shows support for a Mexico center of origin. She further explained that hybridization and introgression most likely play a role in the evolution of the pathogen resulting in either global diversification of the genus or the Andes acting as a sink for new species. Emerging pathogens are being discovered in both agricultural crops and in the wild.

Goss concluded with three working hypotheses for *Phytophthora* evolution: (1) allopatric speciation with historically dispersed limited soil and aquatic types; (2) sympatric speciation by aerial host-specific clades; and (3) speciation by micro-environment with clades showing a mixture of morphological characters.

The final talk of the day addressed how global climate change may impact biogeography of the future. Mauricio Diazgranados from the Department of Botany at Smithsonian's National Museum of Natural History spoke on "Biogeography and Climate Change in the Andes." After an introduction about the significance of the biodiversity of the Andes, Diazgranados gave an overview of global climate change. Current projections show that the temperatures in the tropical Andes will increase, while the northern Andes will experience increased precipitation and the southern Andes decreased precipitation. The effect on the paramos will be an upslope migration of the biological communities.

Diazgranados outlined five possible species responses to climate change: range shift, adaptation to altered habitat, expansion of habitat, contraction of habitat, and extinction/extirpation. Using the Espeletiinae (Compositae) as a case study, he spoke about how the distribution of these high-elevation plant species will be impacted by climate change. His species distribution modeling shows that of the 133 species examined, by the year 2080, 17 will experience extinction and 24 will have severe contraction in their range.

Diazgranados discussed limitations that impact these modeling scenarios. The first is the limited knowledge of species diversity: over 48 percent of Espeletiinae species are represented by fewer than 10 collections. He explained the difficulty in modeling with fewer than 10 collections. Secondly, the problem of scale affects how accurate species are modeled to habitat type. Another limitation is the accuracy of predictors: with over 6,000 reliable climate measuring stations worldwide, only 129 are in the Andes, leading to a deficiency of information.

Next he spoke about the uncertainty in future climate predictions where species responses differ between the climate change models. Narrowly distributed species pose another dilemma: 20 percent of Espeletiinae species have total areas of less than 4 km^2. The sixth limitation Diazgranados presented was an issue of computing: the complete run of the 23 global climate change models on the 133 Espeletiinae species over 8 decades takes 1.9 terabytes of data with approximately 2 million files and over 24,000 maps. The final limitation discussed was measuring the various possible species responses to climate change.

Diazgranados concluded his talk with four take home messages: we need (1) much higher resolution of predictors; (2) more accurate information about soils and ecosystems; (3) better computing facilities; and (4) stronger efforts for geographers, geologists, climatologists, and soil scientists to work together.

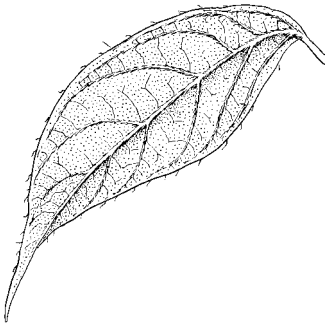
The Symposium concluded with an evening reception in the Museum's Rotunda and a chance for this year's attendees to tour the Fossil Hall before it closed for a 5-year renovation.

Next year's 13th Smithsonian Botanical Symposium will take place on Monday, June 1, 2015. It will be part of a larger five-day conference, "Next Generation Pteridology: An International Conference on Lycophyte and Fern Research." The Smithsonian Botanical Symposium will open the conference as a one-day public event, followed by three days of focused scientific talks and workshops for pteridologists and other researchers. Field trips and garden tours will round out the conference. Be sure to check the symposium website at http://botany.si.edu/sbs for updates.

Supplementary Symposium Links on the Web

The website to the 12th Smithsonian Botanical Symposium <http://botany.si.edu/events/sbsarchives/sbs2014/> has many links and documents related to the conference. Included on the website is the full program, abstracts of the talks, links related to the speaker's presentations, and selected images from the various events. Additional items related to the Symposium can be added to the list of links and documents by sending an e-mail to sbs@si.edu.

The Symposium archive pages <http://botany.si.edu/events/sbsarchives/> also includes programs, abstracts and images from the past 11 symposia: "Linnaean Taxonomy in the 21st Century" (2001); "The Convention on Biological Diversity" (2002); "Botanical Frontiers in Southeast Asia" (2003); "Botanical Progress, Horticultural Innovations, and Cultural Changes" (2004); "The Future of Floras: New Frameworks, New Technologies, New Uses" (2005); "Island Archipelagos: Cauldrons of Evolution" (2006); "Partners in Evolution: Interactions, Adaptations, and Speciation" (2008); "Genes, Genomics and Genome Evolution in Plants" (2009); "Food for Thought: 21st Century Perspectives on Ethnobotany" (2010); "Transforming 21st Century Comparative Biology using Evolutionary Trees" (2012); and "Avoiding Extinction: Contemporary Approaches to Conservation Science" (2013).



Art by Alice Tangerini

Cyrtandra uapouensis W. L. Wagner & Lorence

At the 2014 Smithsonian Botanical Symposium, Jonathan Price (University of Hawaii at Hilo) spoke about the evolutionary biogeography of Pacific archipelagos. Two conclusions in his talk were that lineages that speciate greatly in one archipelago do so in others and species radiations are much larger in larger archipelagoes. The *Cyrtandra* (Gesneriaceae) lineage exemplifies these two conclusions (*Am. J. Bot. 98: 449-459; 2011*). Shown here is *Cyrtandra uapouensis*, a critically endangered species endemic to the high ridges of Ua Pou in the Marquesas Islands (*PhytoKeys* 30: 33-64; 2013).

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