

The Plant Press



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Botany Profile

Conveying Specimen Value through Digitization

By Elizabeth Jacobsen and Gary A. Krupnick

The United States National Herbarium (Herbarium Code: US) has always been about sharing. Initially, the “diffusion of knowledge” was achieved primarily by publishing articles, hosting visitors, and sending out specimen loans. Now, the Department of Botany is taking sharing to a new level by digitizing a significant portion of the collection’s 5 million specimens using conveyor belt technology contracted from Picturae, a European company that specializes in digitization. Using this new technology, the herbarium has begun the task of imaging specimens at an average rate of about 4,000 specimens per day. The plan is to create an image for half a million plant specimens in 6 to 8 months. This rapid digitization project, which began in October 2015 with the evening primrose family (Onagraceae), is now well into the ferns, and will eventually continue with the sunflower family (Asteraceae).

The timing of the project is no coincidence, according to Sylvia Orli, IT Manager and Webmaster for the Department of Botany. The digitization project “follows rapid and amazing advances in computer technology,” she explains, with the U.S. National Herbarium joining a worldwide digitization effort that is particularly well-liked among herbaria. The once insurmountable task of making millions of specimens accessible is suddenly feasible. The herbarium digitization project, using conveyor-based technology to image natural history collections, is the first of its kind for a herbarium in the United States, and the second

conveyor-based project at the Smithsonian (following the digitization of the National Museum of American History’s National Numismatics Collection).

The U.S. National Herbarium has been working towards the goal of complete collection digitization for a long time. “We have always looked out for opportunities to digitize,” reports Orli, even if those opportunities involved the laborious process of punching holes into a paper card and keying them into a computer, as was done in the 1970s.

An inventory of the Type Collection was initiated in the 1970s to make this portion of the collection easier to use. Over the course of almost 50 years, the herbarium has built a digital inventory of around 1.5 million specimens, representing more than a third of the pressed specimens in the herbarium. Using rapid digitization approaches, the entire collection could be completed in under 10 years.

The herbarium of the Muséum National d’Histoire Naturelle in Paris has already imaged about 7 million specimens using the conveyor technique, although their entries, for now, contain only the image and the name on the specimen’s folder. The U.S. National Herbarium has its eyes on a bigger, more scientifically valuable prize: a complete database of label information and images with verified species names.

The Smithsonian began exploring the idea of using a conveyor belt to image specimens about a year and a half ago. The Office of the Chief Information Officer (OCIO) and the Digitization

Program Office (DPO) are in charge of managing money for Smithsonian’s digitization projects across the entire Institution. Per specimen conveyor costs run at less than a dollar, so it was decided to begin with a portion of the collection and move forward from there. “The hope is that we find a donor,” comments Orli, “but we haven’t found that resource yet.”

Though current technology makes digitization more affordable than ever before, money remains one of the primary obstacles to completing the project. Time, of course, is the other. “We can’t keep up with the level of need,” Orli laments, proposing that we may need to rethink the current workflow. Specimen preparation is time- and labor-intensive, requiring experts who can provide the correct name for a specimen, as well as a set of barcodes linking names to EMu (Electronic Museum management database) for each specimen within each folder. The ideal situation would be to complete this preparation before scanning the images, but with the speed of the conveyor, it will be more efficient to scan first, then retroactively provide the correct labels and barcodes. This arrangement is more cost-effective, if slightly slower. After the scanning is finished, another company (contracted through Picturae) will transcribe the label data and return it for inclusion in the EMu catalogue.

The improved accessibility will make the herbarium a more influential force in conservation and scientific research. In the past, the herbarium relied on speci-

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Pedro Acevedo traveled to Nassau, Bahamas (12/11 – 12/14) to be a guest speaker at a retreat of the Bahamas National Trust.

John Boggan traveled to Philadelphia, Pennsylvania (10/7 – 10/9) to attend the 9th North American Natural History Special Interest Group (NHSIG) and Axiell User Conference at the Penn Museum.

Barrett Brooks traveled to Orlando, Florida (11/3 – 11/8) as a representative of the Smithsonian Scientific Diving Program to attend the Diving Equipment & Marketing Association (DEMA) 2015 Trade Show which featured diving safety seminars and diving equipment repair training.

Laurence Dorr traveled to London, England (11/28 – 12/12) with **Rose Gullledge** to study herbarium specimens in the herbarium of the Royal Botanic Gardens, Kew, for a treatment of the genus *Pterygota* (Malvaceae).

Ashley Egan traveled to Huntington, West Virginia (10/10 – 10/12) to

seek out new populations of *Phaseolus polystachios* to aid in improvement of germplasm collections at the USDA-ARS Germplasm Resources Information Network (GRIN) seedbank; and to Botucatu, Brazil (10/31 – 11/8) to give a talk and co-lead a workshop at the symposium of the Legume Morphology Working Group.

Robert Faden traveled to London, England (8/1 – 9/25) to visit the Royal Botanic Gardens, Kew, and to continue his studies of Commelinaceae for Flora Zambesiaca, which covers the African countries Mozambique, Malawi, Zambia, Zimbabwe and Botswana, and the Caprivi Strip of Namibia.

Vicki Funk traveled to Canberra, Australia (11/25 – 12/5) to present the opening plenary address at the annual conference of the Australasian Systematic Botany Society.

Caroline Puente visited Wilkes-Barre, Pennsylvania (10/15 – 10/16) as an advisor in the creation of a DNA Barcoding program at Wilkes University.

Alice Tangerini traveled to Miami, Florida (10/14 – 10/19) to lead a workshop, present a portfolio showing, and attend presentations and workshops at ASBA 2015, the annual conference of the American Society of Botanical Artists.

Alain Touwaide and **Emanuela Appetiti** traveled to Baltimore (10/30) to examine a 15th century medieval manu-

script of the *Tacuinum sanitatis*, in view of an exhibition at the Walters Art Gallery.

Mohammad Vatanparast traveled to Botucatu, Brazil (10/31 – 11/8) to give a talk at the symposium of the Legume Morphology Working Group.

Warren Wagner traveled to Miami, Florida (11/16 – 11/18) to attend the board meeting of the National Tropical Botanical Garden and the board meeting of the International Center for Tropical Botany.

Jun Wen traveled to Shenzhen and Beijing, China (11/19 – 11/28) to attend planning meetings for the XIX International Botanical Congress and the Journal of Systematics and Evolution, as Vice President of both groups.

Kenneth Wurdack traveled to St. Louis, Missouri (10/1 – 10/5) to conduct research at the Missouri Botanical Garden.

Elizabeth Zimmer traveled to Baton Rouge, Louisiana (10/14 – 10/16) to attend the dedication of the new endowed Shirley C. Tucker Herbarium and to attend a mini-symposium at Louisiana State University.



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Chair of Botany

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Visitors

Craig Costion, University of Adelaide, Australia; DNA barcoding (11/3/14 -10/31/15).

Liang Zhao, Northwest Agriculture and Forestry University, China; *Dichocarpum*, *Pulsatilla*, *Trollius* (Ranunculaceae) and its close relatives (2/5/15-2/26/16).

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

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

Warren Cardinal-McTeague, Canadian Museum of Nature; Plukenetiae (Euphorbiaceae) (9/8-12/11).

Kyra Stillman, University of Chicago; DNA barcode project (10/5 - 12/14).

Patrica Barbera Sanchez, Real Jardín Botánico de Madrid, Spain; Aveninae (Poaceae) (10/16 - 12/30).

Wichman Chipper, National Tropical Botanical Garden; Collaborative research (10/20).

Lynn Gillespie, Canadian Museum of Nature; Euphorbiaceae and Poaceae (10/20 - 10/28).

Stephen Weller, University of California, Irvine; *Schiedea* (Caryophyllaceae) polination biology (10/29 - 10/30).

Rich Rabeler, University of Michigan; Caryophyllaceae (11/4).

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Seduced by an Herbarium

When I interviewed for my position as Curator of Botany here at the NMNH the director asked me why I became a botanist. Fair enough. This is the standard sort of question one asks potential hires and I have resorted to similar queries when the tables were turned. I vaguely recall answering him in the way one does in these situations. I gave him the safe answer: I described how I roamed the woods outside Boston where I grew up, hunted for different plants and animals, and enjoyed learning their names and behaviors. Eventually and mercifully he cut me off and asked me something else. In retrospect, I now think that I should have given him the honest answer: I was seduced by an herbarium.

How did this happen? Serendipity was involved. I opted to pursue my undergraduate studies at Washington University in St. Louis. I was interested in English and comparative literature and Stanley Elkin, the novelist, was my first advisor. He was gruff, impatient, intimidating, and not all that helpful as a mentor, but I stayed the course. I read English and French literature and for no particular reason I fulfilled my science credits by taking geology classes. On a whim I enrolled in a spring wildflower class and in retrospect realize that it was then that I began to hear the siren song of Botany. Walter Lewis was the instructor and in addition to learning about his passion, spring beauties (*Claytonia virginica*) and their complicated cytology, I was introduced to floras, keys, taxonomy, systematics, and the concept of herbarium specimens and herbaria. There was something very attractive about botany and slowly I became torn between art and science. Presented with such a dilemma what does the typical undergraduate do? He (or she) takes time off to contemplate the conundrum. I was no different.

While I wrestled with what I wanted to do with my life, be a writer or be a botanist, I built myself a plant press and headed off to Alaska and the Yukon Territory to hike, camp, and collect plants. When I decided to re-enroll in school I returned to St. Louis with a modest collection of boreal and alpine plants and innocently brought them to the Missouri Botanical Garden, which I had never visited before, to ask how I might identify them. The herbarium had recently moved into the John S. Lehmann Building and when I first set foot in that space I was awed. One descended a half flight of stairs and came into a brand new pristine facility. The slate floors were spotless. The columns were glistening stainless steel. The millions of specimens were housed in massive red compactors and the compactor aisles opened with the press of a button. I had never seen anything like this. I was smitten and instantly seduced. But it was not just the facility and the collection that succeeded in seducing me. It was the graduate students who took the time to make me feel welcome, find me cabinet space, explain the nuances of collecting and

identifying plants, introduce me to the curators, talk to me about their research, and invite me to the seminars that were frequently held in the Garden's auditorium.

While I prefer to keep my personal life private I freely admit that my first herbarium love was the Missouri Botanical Garden. Other herbaria have turned my head since and I am fond of them all. Whether or not our relationships continued I have always tried to stay on good terms with each one. Each herbarium has allowed me to learn something new and enriched my life. When I began graduate school it was in Chapel Hill and I am embarrassed now to admit that after being shown its herbarium I innocently asked where the rest of the collection was stored. I thought every herbarium was the size of the one in St. Louis. At about the same time I became acquainted with the combined herbaria of Harvard University and every time I visited Boston, which was once or twice a year, I found my way to neighboring Cambridge. I began to learn the nuances of how large herbaria differed and how their taxonomic and geographic strengths reflected a combination of chance and design. As with Missouri, the openness of the staff and researchers talking passionately about their projects made the visits to Divinity Avenue exciting and intellectually stimulating.

Continuing graduate school in Austin I better came to appreciate the role and importance of large university herbaria and fell in love with the Plant Resources Center that holds the combined University of Texas and Lundell herbaria. Here again it was not the physical space or the specimens but the intellectual ferment that made the herbarium attractive. Not only were there professors and researchers, but also scores of fellow graduate students. And, more importantly, collecting and adding to the herbarium was encouraged. The mountains of northern Mexico were closer than those of west Texas and they were still yielding novelties so whenever we could we headed south. These trips allowed me to flirt briefly with the Geo. B. Hinton Herbarium, a private collection kept at the Rancho Aguillilla in the hills of Nuevo León. This herbarium is unlike any other I have ever known. It is small but probably the most beautiful herbarium in the world. The work table is a large cottonwood tree split in half and balanced on brick feet. The specimens are stored around the margins of the room in hand-crafted metal boxes in arched brick alcoves covered in decorative tiles. Here Jaime Hinton, George Hinton's son, married science and art.

After finishing graduate school, work took me back to St. Louis and my first love, but we grew distant and I spent little time in Missouri. I was off to more exotic localities and became acquainted with tropical herbaria

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Chair

With

A

View

L.J.
Dorr



Staff Research & Activities

Robert Faden visited the Royal Botanic Gardens, Kew, August 1 to September 25, to continue his studies of Commelinaceae for Flora Zambesiaca (FZ), which covers the African countries Mozambique, Malawi, Zambia, Zimbabwe and Botswana, and the Caprivi Strip of Namibia. He concentrated mainly on the genus *Aneilema* completing accounts of 23 of the 24 species in the flora. The last species will be completed from specimens previously borrowed from Kew. He also completed accounts of four more species of *Commelina*—the largest genus in the flora—leaving only four of the 41 species he recognizes in the flora still to be treated. Faden also finished his studies of the types of 15 *Commelina* names described from the Democratic Republic of Congo (formerly Belgian Congo and Zaire) mostly by E. De Wildeman, and borrowed by Kew from BR, which will result in a number of newly recognized synonyms to be cited in the FZ account. For the genus *Cyanotis*, Faden completed preliminary accounts for the four remaining described species (of 8 in FZ) but was unable to study the collections that represent at least two undescribed taxa. He hopes to borrow those specimens from Kew. The remaining genera of Commelinaceae in FZ, *Anthericopsis* (1 species), *Coleotrype* (1), *Floscopa* (5), *Murdannia* (3), *Palisota* (1), *Polliia* (1), plus the endemic, monospecific *Triceratella*, were completed previously and submitted to the editor of the flora, Jonathan Timberlake. Faden is planning another study trip to Kew in 2016 to complete his account of Commelinaceae for this flora.

Gary Krupnick attended the 15th Annual International Conference of the North American Pollinator Protection Campaign (NAPPC), held at the U.S. Department of the Interior in Washington, D.C. At the meeting, NAPPC convened 10 task forces who aim to establish goals surrounding a certain pollinator issue, from issues on honey bee health, to the development of a web application to help beekeepers diagnose and treat hive maladies, to help-

ing reverse monarch butterfly population decline. Krupnick served as co-chair of the NAPPC Federal Strategy Implementation Task Force, which is bringing federal and non-federal partners together to help the Federal Strategy on Pollinator Health become a reality through direct action. Krupnick also serves on the NAPPC Steering Committee.

Alain Touwaide is a visiting professor at the University of California Los Angeles, for the fall and winter terms. During the fall (October and November 2015), he taught a class on the legacy of ancient medicine, and delivered a public lecture on the ancient Mediterranean pharmacopeia at UCLA Royce Hall on November 18. In the winter term (January and February 2016) he is teaching two classes: one on venoms, poisons and medicines from Antiquity to the Renaissance, the other on history of the scientific book. During the stay in Los Angeles, Touwaide and **Emanuela Appetiti** have collaborated with the Huntington Library, Art Gallery and Botanical Gardens on redesigning the garden of medicinal plants and crafting a new interpretative discourse that illustrates the historical and ethnobotanical values of medicinal plants.

Departures

The measure of a man is sometimes described as the quality of his relationships. By this ruler, **Greg McKee** is a

giant among men. It makes it that much harder, therefore, to say good bye as he retires from 30 years of service to the U.S. National Herbarium and moves on to the second half of his life. But, fear not. Like many of his predecessors, Greg's devotion to, and love of, the collection (especially the ferns) has inspired his plans to volunteer on a consistent basis for at least the near future.

By today's standards, the story of Greg's arrival is atypical. Following a stint in the U.S. Navy, and a civilian role at the Navy Yard, he found himself, by an unknown (to me) twist of fate, in our plant mounting room. Here he could be seen carefully securing specimens to herbarium paper ... a meticulous but important step in processing specimens that he never failed to appreciate. Even after he moved on to assist David Lellinger in the fern collection, Greg was a frequent visitor to our mounting staff to pass along thanks for a job well done.

Assuming the role of apprentice in the fern collection, Greg studied at Lellinger's side for many years, soaking up the nuances of fern taxonomy, identification, and curation. And when Dave Lellinger retired, Greg became the de facto curator of one of the largest and best pteridophyte collections in the world, a role he embraced for almost 15 years in the absence of a Curator of Ferns. During this time, Greg was the fern collection. He was the contact for students, post-docs, and the



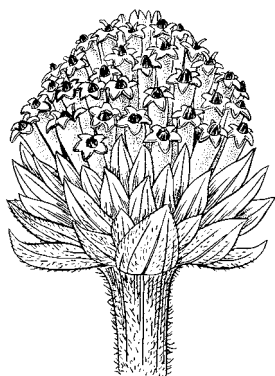
Gregory McKee in Mongolia, 2004. (photo by Adiyabold)

most senior pteridologists from other herbaria. He always demurred, saying that he wasn't a real fern specialist. But his skills and expertise are manifest throughout the fern collection and served him very well on collecting trips to Ethiopia, Mongolia, and Mexico.

The mistake that many people make when asked to describe themselves is to describe their job. Greg never erred in that way. His devotion to family, his wife and his parents, is one that many people should envy. He is a student of global culture and different religious philosophies, drawing on them for strength when facing life's difficulties. His interest in music is extensive and his knowledge of "boomer" pop culture extends to Walt Kelly's Pogo comics (my favorite). He speaks multiple languages, frequently answering my questions in Russian, to which I would just nod. And he's an avid fossil hunter which is likely to outcompete ferns in satisfying his constant need to learn.

Having known and worked with Greg in multiple capacities over many years, there is one word I would use to describe him. Passionate. About everything. Thanks, Greg.

-Rusty Russell



Awards & Grants

Alain Touwaide has been awarded a 6-month "Foreign Fellowship" by the Onassis Foundation (Athens, Greece) for a research program on the history of botany and medicinal plants among the Greek speaking communities in the Ottoman Empire, to be conducted in collaboration with the National Hellenic Research Foundation. Touwaide was also elected as an Associate of the Center for Medieval and Renaissance Studies at the University of California Los Angeles.

Sohmer Receives BRIT International Award of Excellence in Conservation

The Botanical Research Institute of Texas (BRIT) presented its International Award of Excellence in Conservation to Sy H. Sohmer, the Institute's first executive director and its current director emeritus, for his contributions in the field of botany over the whole of his career and in particular his 21 years of service as head of BRIT. The award was given on December 9, 2015. Sohmer is the 21st recipient of the award.

Sohmer joined BRIT in 1993 as its first executive director. Under his leadership the organization grew from a staff of three—housed in a 12,000-square foot warehouse in downtown Fort Worth with about 400,000 dried plant specimens and a botanical and horticultural library of some 50,000 titles—to an organization with a staff of 30, housed in an energy efficient and sustainable building adjacent to the Fort Worth Botanical Garden. BRIT is currently the eleventh largest herbarium in the United States, possessing over 1.1 million specimens and with over 150,000 titles in its library.

Sohmer is currently a Research Associate in the Department of Botany at the National Museum of Natural History. His educational background includes a Bachelor of Science degree from the City College of New York, a Master of Science degree from the University of Tennessee, and a doctorate from the University of Hawaii.

Visitors

Continued from page 2

Manuel Lujan, Rancho Santa Ana Botanic Garden; Clusiaceae (11/16 - 12/1).

Robert Naczi, New York Botanical Garden; New Manual of Vascular Plants of the Northeastern United States and Adjacent Canada (11/17 - 11/19).

Bruce Stein, National Wildlife Federation; Campanulaceae (11/19).

Roger Troutman, U.S. Bureau of Commercial Fisheries, Alaska; Asclepidaceae (11/27 - 11/30).

Barbara Kreutzer and students, Marymount University; Herbarium tour (12/1).

Shelley James, Bishop Museum; New Guinean collections (12/14 - 12/15).

Jennifer Boyd, University of Tennessee at Chattanooga; Appalachian plant species (12/16).

Doug Goldman, U.S. Department of Agriculture; Rutaceae (12/21 - 12/23).

Joan McConville, American Association of Community Colleges; *Historia Plantarum* book collection (12/31).



Chair with a View

Continued from page 3

in Madagascar and Africa. Among the many herbaria I came to know in these years only Tsimbazaza still holds a special place in my heart. Our relationship was relatively brief, but very complicated. In the three years that we were intimate our romance taught me a lot about botany, but looking back I now see that it taught me more about life. Work in Africa led to introductions to large herbaria in Europe and more relationships than I have space to detail. Later still I spent time in Latin America but there is not world enough and time to write about all those romances.

So, what is the moral of my tale? It is not that I have fallen in love with so many different herbaria, big and small, tropical and temperate, nor is it that these facilities are beautiful or plain, rich or poor, but that the true allure of herbaria and collections is the people studying and using them, and the ideas that they generate. Now that for better or worse I am married to the U.S. National Herbarium I want it to be as alluring as my first love. I hope we can continue to make our collection attractive and enticing, and I hope we can seduce new generations to fall passionately in love with systematic Botany.

The 2016 Smithsonian Botanical Symposium, May 20, to Explore Pollination

The Department of Botany and the United States Botanic Garden will convene the 2016 Smithsonian Botanical Symposium, “**Bats, Bees, Birds, Butterflies and Bouquets: New Research in Pollination Biology**,” to be held at the National Museum of Natural History in Washington, D.C., on May 20, 2016.

The act of pollination, transferring pollen from one flower to another, remains one of the most ecologically important interactions between plant and animal. It allows plants to produce seeds and reproduce, and provides pollen, nectar and other rewards to the animals that visit the flowers. Pollination is a keystone function of most terrestrial ecosystems, and an estimated 87 percent of flowering plants depend on animal pollination. Plant-pollinator interactions have led to the evolutionary diversification of major groups of both plants and animals. A diverse plate of foods for humans is a result of pollination as well: one out of every three bites of



food we eat is the result of an animal pollinating a plant. Yet recent evidence shows that pollinator abundance and diversity is on the decline. What does the threat to the health of pollinators hold for the future of native plant populations and agriculture? Will plant and pollinator populations adapt to a changing climate, invasive species, and habitat loss?

The Symposium will highlight current research in pollination biology, from plant physiology and ecology to evolution and animal behavior. New approaches to the study of plant-animal interactions may provide promise to safeguard biodiversity both here in the U.S. and elsewhere. The invited speakers will cover a wide range of such approaches to illustrate the challenges to plant-pollinator relationships in a rapidly changing world.

A full lineup of speakers will present their talks during the day at the National Museum of Natural History’s Baird Auditorium. The event will be followed by a reception and poster session at the U.S. Botanic Garden that evening.

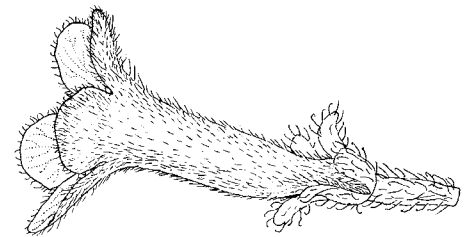
In addition, the 14th José Cuatrecasas Medal in Tropical Botany will be awarded at the Symposium. This prestigious award is presented annually to an international scholar who has contributed significantly to advancing the field of tropical botany. The award is named in honor of Dr. José Cuatrecasas, a pioneering botanist who spent many years working in the Department of Botany at the Smithsonian and devoted his career to plant exploration in tropical South America.

Abstracts for poster presentations may be submitted online at botany.si.edu/sbs/. The deadline for abstract submission is April 13th.

Sponsors of the Symposium are the Department of Botany, the Office of the Associate Director for Research and Collections, the United States Botanic

Garden, and the Cuatrecasas Family Foundation.

There will be no registration fee this year, but attendees must register online at botany.si.edu/sbs/ to attend the event. Visit the website, call 202-633-0920, or email sbs@si.edu for more information.



Recognizing Our Peers

The National Museum of Natural History presented the 2015 Peer Recognition Awards on December 8, 2015. Award recipients are individuals who have given their time and talent to the museum above and beyond what their job calls for and to those who have done something that makes a difference in the outside community, for the museum, or for the larger Smithsonian community. The **Peer Recognition Award Committee** is composed of 11 NMNH staff members representing a cross-section of the entire museum community.

The Department of Botany was recognized at the ceremony when six department members were presented with three different awards.

Melinda Peters and Kenia Velasco Gutierrez from the Department of Botany received the “Conserving Traditional Languages Award,” a team which also included Tom Hollowell from the Information Technology Office and Kate Riesenberger from the Department of Anthropology. They were recognized for being diligent and dedicated members of the



Archilochus colubris (ruby-throated hummingbird) visiting *Campsis radicans* (= *Bignonia radicans*, trumpet vine). From J.J. Audubon, *The Birds of America: from Drawings Made in the United States and Their Territories, 1840-1844*.

large international and inter-disciplinary project, *Documentation and Revitalization of the Language and Traditional Ecological Knowledge of an Isthmus Zapotec Community of La Ventosa* in the southern Mexican State of Oaxaca. This work documents the indigenous plant names of the community for inclusion in a dictionary of the local endangered language. These researchers collected and processed 1,361 herbarium samples, and distributed multiple sets to partner herbaria. This project formed the pilot for the groundbreaking National Ethnobotanical Herbarium Online. To accomplish this, an impressive number of local volunteers and contractors were assembled and trained to assist. The exceptional commitment and remarkable work ethic of these awardees were absolutely necessary to the success of this complex work in a short timeframe.

Jim Harle from the Department of Botany was awarded the “Volunteer Excellence Award.” Harle has worked enthusiastically to create a searchable digital map library. Together with a corps of volunteers and interns that he trained, they have cataloged and imaged over 28,000 maps from four different NMNH Departments as well as the National Museum of African Art. Having the information now available on the Department of Botany website dovetails this remarkable effort with the Museum’s strategy to improve access to its collections through digitization, and its commitment to training the next generation of scientific staff.



Recipients of the 2015 Peer Recognition Awards. (A) Melinda Peters (left) and Tom Hollowell (right) receive the “Conserving Traditional Languages Award” from NMNH Sant Director Kirk Johnson. (B) Jim Harle (right) receives the “Volunteer Excellence Award”. (photo by the Smithsonian Institution)

Vicki Funk, Ida Lopez, and Carolina Puente from the Department of Botany received the “Scientific Team Engaging Young Minds (STEM) Award,” a team which also included members from the Departments of Entomology, Paleobiology and Vertebrate Zoology, Divisions of the National Zoological Park, Smithsonian Gardens, Departments of the National Air and Space Museum, and the Global Genome Initiative. With youth interest in science careers at a low, the vast underrepresentation of minorities and women in Science, Technology, Engineering and

Mathematics (STEM) fields, the Youth Engagement through Science (YES!) mentors generously gave of their time and expertise to ignite the flame of inspiration in young minds. This eclectic team of mentors helped to provide students in the Washington, DC area with an authentic scientific experience, which broadened and deepened their knowledge of science career fields. With the help and accompaniment of their mentors, YES! interns refined their research, analysis and communication skills as they each created an eight minute talk about the scientific work they were performing behind the scenes. These talks were given to audiences during an “Intern Is In” session in Q?rius, The Coralyn W. Whitney Science Education Center. Several interns credit this experience with giving them confidence for future endeavors. Through their personal investment these staff members helped to inspire and engage a group of young people showing them the way to become our future generation of scientists.



Carolina Puente, Vicki Funk, and Ida Lopez (fourth, seventh, and eighth from left, respectively) receive the “Scientific Team Engaging Young Minds (STEM) Award”. (photo by the Smithsonian Institution)



The Quest for the Wild Kidney Bean

By Ashley N. Egan

♪ Beans, beans, the magical fruit
the more you eat, the more you... ♪
... or was that musical... not magical....

Whichever it is for you, beans can definitely be both musical *and* magical. I had the great opportunity of searching for a bean this autumn that may hold magic in its genes. The North American wild kidney bean, also known as the thicket bean, *Phaseolus polystachios* (L.) Britton, Sterns, & Poggenb., of the legume family (Fabaceae), is the only native bean species with a (once upon a time) widespread distribution across the eastern half of the United States, from Texas to Connecticut. This perennial vine prefers open areas where it can twine on thickets or climb on slopes with southern or southeastern exposures, but can also be found rarely in forests with open or shallow canopies where it often climbs its way to the top. Unfortunately, urbanization, agricultural development, and habitat destruction have caused a decline in populations, leading to widely varying estimates of conservation status across its distribution.

So what makes *Phaseolus polystachios* so special? While I think all plants are special (ok...I'm biased), this bean is special by association. The North American wild kidney bean is a wild relative of the cultivated *Phaseolus lunatus* L., commonly known as the Lima bean, which was domesticated from wild ancestors in Meso- and South America. Crop wild relatives are vital reservoirs of genetic diversity, often holding hidden potential as sources for crop improvement in disease resistance, yield, quality, and adaptation to climate change or other ecological or pathological stresses. One such stressor is white mold (*Sclerotinia sclerotiorum*), a ubiquitous pathogen and a major problem for nearly 400 plant species, especially legumes. White mold co-occurs with *Phaseolus polystachios* throughout its native range in the eastern and southeastern United States. Through coevolution in its natural habitat, *P. polystachios* may have acquired white mold resistance – and therein lays its potential magic.

As important as this little bean is, there are relatively few seed collections of *P. polystachios* held in the U.S. National



A ripe pod of the North American wild kidney bean, *Phaseolus polystachios*. (Photo by Ashley N. Egan).

Plant Germplasm System (<http://www.ars-grin.gov/>). As of August 2015, the Western Regional Plant Introduction Station in Pullman, Washington holds over 17,000 accessions of *Phaseolus* from 47 species groups, but held only 13 accessions of the North American wild kidney bean, six of which were collected recently from Florida. At the behest and invitation of Ted Kisha, *Phaseolus* curator at USDA-ARS GRIN in Pullman, I embarked on a quest to find, document, and collect as many populations of *P. polystachios* as I could across the Midwest.

With funding support from the Smithsonian's Global Genome Initiative (ggi.si.edu), my first trip in September took me to Missouri, Illinois, and Indiana where I visited some 15 historically collected sites, finding plants at only four – a success rate that attests to the decline in wild kidney bean populations. But those four sites yielded vital material for collections. Using a population level sampling approach, leaf material for DNA was collected to silica gel for an average of 10 plants per population and three to six seeds were collected per plant, when avail-

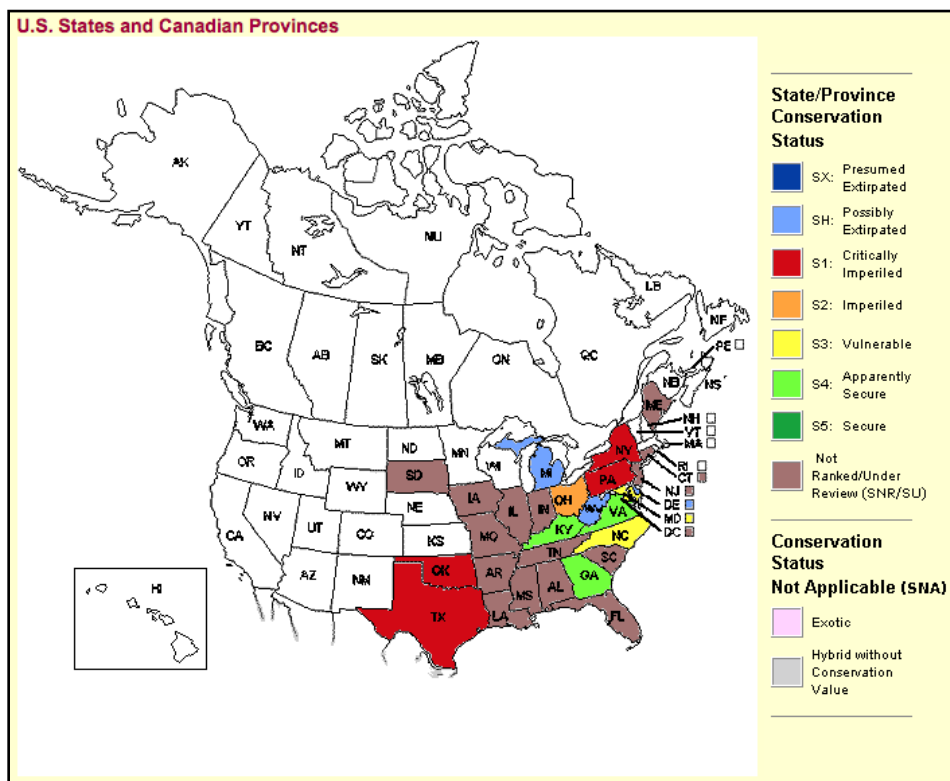
able. A pressed herbarium specimen for each population was taken for voucherizing. These collections have enriched three federal biodiversity repositories: DNA material was placed in the Smithsonian's Global Genome Initiative (GGI) biorepository cryogenic long-term storage units <<http://ggi.si.edu/>>; herbarium specimens have been incorporated into the U.S. National herbarium <<http://botany.si.edu/>>; and seeds have been deposited in the USDA-GRIN seed bank <<http://www.ars-grin.gov/>>.

My second quest took place in October and involved an intense, eight-day excursion devoted solely to population level sampling of *P. polystachios* in Ohio. This time I was joined by Dr. Ted Kisha who is spearheading our research on the genetic diversity of *P. polystachios*. This trip was funded by USDA-ARS Plant Exploration funds. Our plan took us to Wayne National Forest in southern Ohio where we visited 22 different sites where *P. polystachios* was either collected historically or known to be present from current knowledge by regional botanists or foresters. This time we were able to collect seven populations.

Although this wild kidney bean may have had a large distribution, it is becoming increasingly rare across its range. Unfortunately, I encountered another significant threat to its survival – weevils! I first discovered weevils in a population I collected in Indiana in September. I was hoping to not find anymore, but the little pests were present in several of the Ohio populations we collected, to such extent that we struggled to find viable seed within the population – many (and all in one case) of the seeds had been devoured.

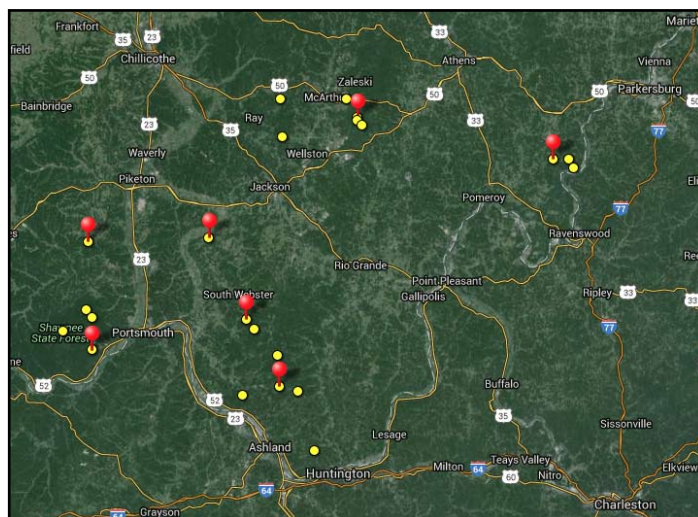
In addition to building collections, Dr. Kisha is pursuing a genetic study to assess the genetic diversity within and among populations of the wild kidney bean, knowledge that will help to document the 'biodiversity' encapsulated in this one species. Many people hear the word biodiversity and think only of the number of species in a given area or ecosystem. But defining biodiversity by species richness alone is a fairly myopic viewpoint. Biodiversity should be defined and explored at the genetic, species, and ecosystem levels. After all, diversity begins at the level of genes: genetic diversity (microevolution) is what ultimately leads to species diversity (macroevolution).

Now, with all the threats stacking



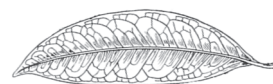
(Top) The native range of *Phaseolus polystachios* across the U.S., showing extensive variation in its conservation status (map from NatureServe.org).

(Right) Collections attempts (yellow dots) and successes (red pins) during Egan's Ohio expedition in October 2015.



up against *P. polystachios*' survival, Dr. Kisha and I are hoping to expand our collections of the wild Kidney Bean across the U.S. to build vital seed collections in the National Plant Germplasm System and in other biorepositories, and to assess genetic diversity. This may be just one plant species, but it is one species potentially vital to agriculture and crop development and represents an important piece of the world's biodiversity in its own right. So I am shouting out a clarion call to all would-be questers: if you are aware of any extant populations of *Phaseolus polystachios* in your area, please share your knowledge with me (egana@si.edu) and Ted (Theodore.kisha@ars.usda.gov).

And please, steward that little population. Watch over it. Don't go out and collect it to oblivion. Nurture it and help it to grow. Unfortunately, we live in a world and in a time where we, *Homo sapiens*, are drastically impacting our world's biological diversity in a very negative way. The IUCN estimates that in the next few decades, the global extinction rate will near 10,000 times the background rate. Let's change that. Let us steward the earth and foster its biodiversity.



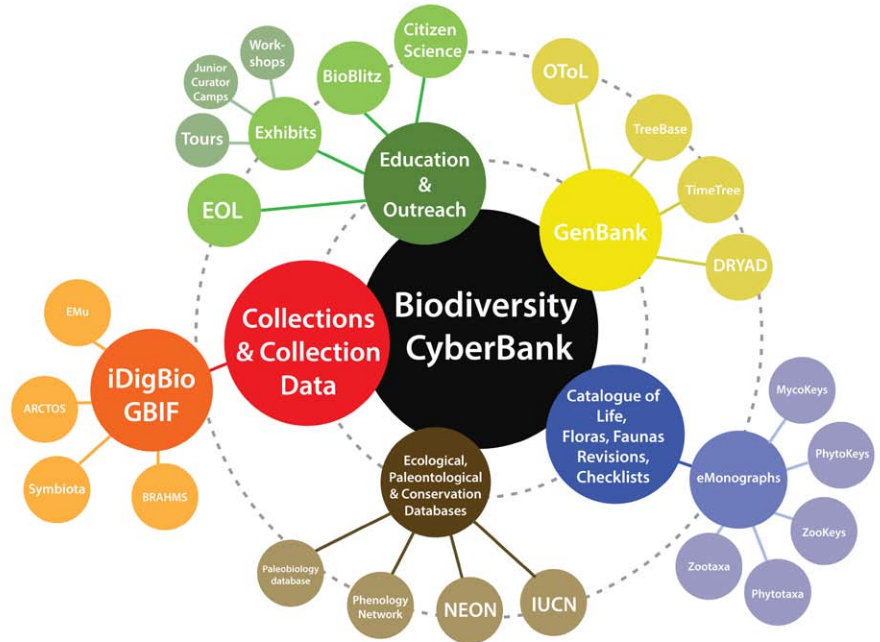
Botanists Call for a New Global Biodiversity CyberBank

By Marc S. Appelhans

In the November 2015 issue of *Journal of Systematics and Evolution*, **Jun Wen**, Stefanie Ickert-Bond, **Marc Appelhans**, **Laurence Dorr** and **Vicki Funk** published the paper “Collections-based systematics: Opportunities and outlook for 2050” (*J. Syst. Evol.* 53: 477-488). Wen et al. evaluated the current state of systematics and natural history collections and provided an outlook for the discipline for the upcoming decades. The paper highlights the important role of natural history collections as the core of biodiversity studies and calls for actions that need to be taken to ensure a robust future for our discipline, as well as the sustainability of herbarium and museum collections.

The paper proposes that the systematics community needs to reorganize to form a World Organization of Systematic Biology in order to formulate and execute a strategic plan for systematics and natural history collections. In a time with major advances in areas of bioinformatics and genomics, the field of systematics also changes rapidly. In order to make use of these advances and to make our studies highly integrative and accessible for the public and other scientific fields, Wen et al. propose a global cyberinfrastructure, the Biodiversity CyberBank, that brings together all data for a specific taxon, i.e. genetic, ecological, paleontological, morphological and conservation data, but with the collections data as the core. Wen et al. argue that collections are no longer the objects of specimens; they represent vitally important big data in the 21st century biodiversity science.

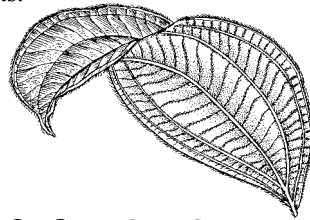
The envisioned CyberBank is comparable to GenBank for genetic data, and is crucial for the future of biodiversity sciences. Similarly, floras, monographs and revisions should make use of all the available data in the bioinformatics and genomic era. Specifically these treatments should not only contain interactive keys, descriptions and notes on ecology and distribution, but also make full use of (1) the increasing amount of digitized collections to model distributions (past, current and future); (2) the vast genetic data to test species delimitations and phylogenetic relationships; and (3) the wide array of digitized literature and herbarium type specimens to link all information related



Vision of the Biodiversity CyberBank, an ambitious global community-wide cyberinfrastructure (from Wen et al. 2015).

to original species descriptions. A new framework of taxonomic monographs is outlined.

As the future of our discipline is largely dependent on a next generation of systematists as well as the general public, the paper also highlights that collections-based systematists must teach systematics as a stimulating and integrative discipline with collections as its core. Systematists must also try to engage and excite the general public whenever possible with cutting-edge technology in biology, and involve them in various citizen-science projects.



Recipient of 2015 Cuatrecasas Fellowship Award Visits NMNH

Manuel A. Luján Anzola, a doctoral student at the Rancho Santa Ana Botanic Garden and Claremont Graduate University, visited the U.S. National Herbarium

for two weeks in November on a 2015 Cuatrecasas Travel Fellowship Award. The award is intended to support work in the spirit of the research of José Cuatrecasas

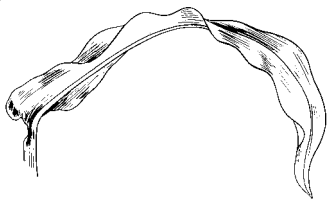


Manuel A. Luján Anzola

and it is open to all who would benefit from studying tropical plants in the collection.

Hosted by **Pedro Acevedo**, Luján studied plant specimens of the genus *Clusia*. He took photographs of 4,282 specimens representing about 250 different taxa of *Clusia*. He carefully examined a number of specimens that might represent the conspecific complement of taxa that have been described only from staminate or pistillate material, and took tissue samples of them for further analysis. He annotated 21 specimens to reflect modern taxonomic changes and identified a number of types in the general collection that will be filed in the Type Collection.

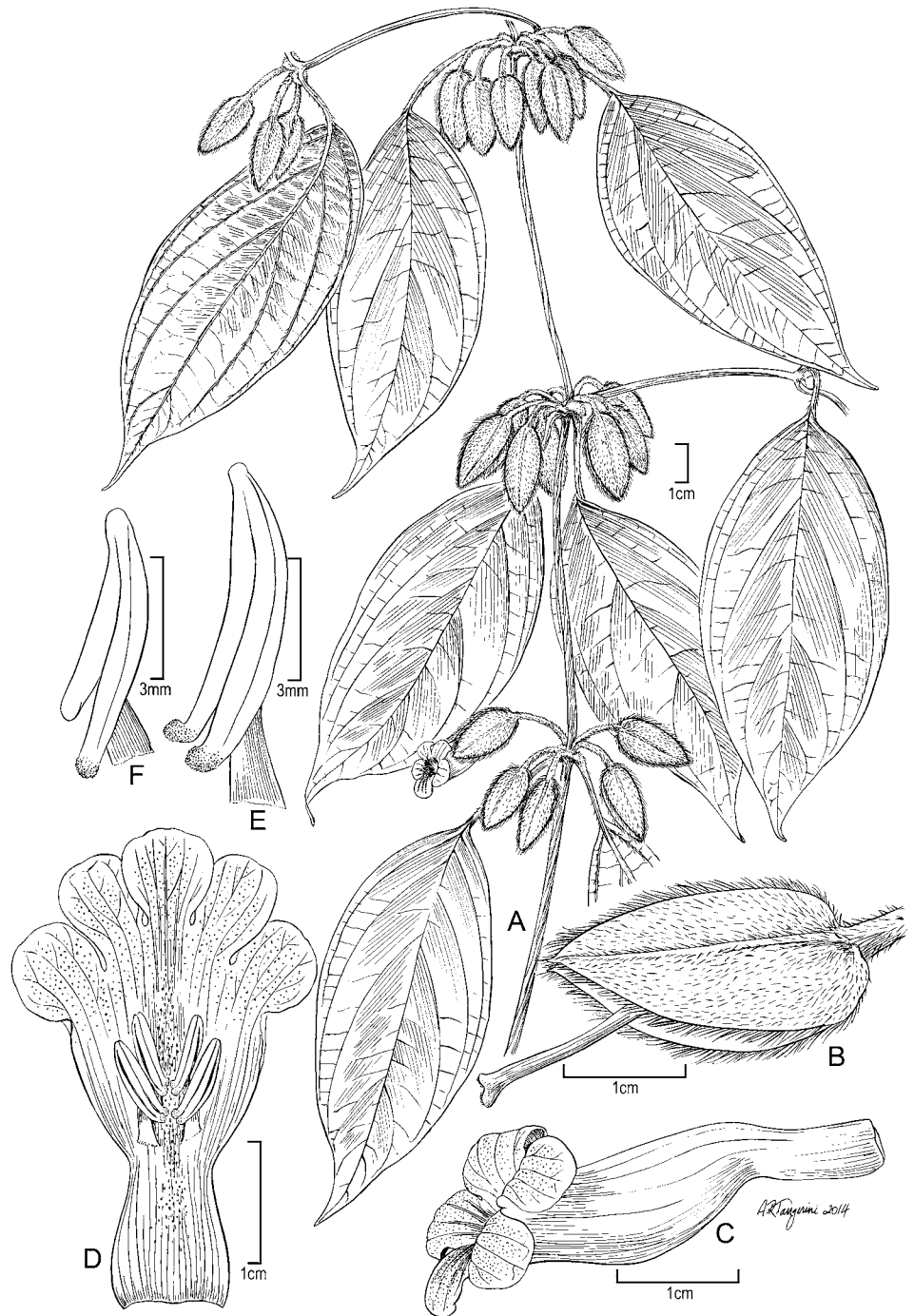
Luján also had the opportunity to work with **Laurence Dorr** on a study of *Clusia* collections from the Flora of Guaramacal National Park project. He worked with **Vicki Funk** and **Carol Kelloff** to establish a future collaboration for the study of *Clusia* specimens from the Biological Diversity of the Guiana Shield Program. Additionally, he studied with **Kenneth Wurdack** to learn about the genetic basis of the resin production system in Malpighiales. Some species of *Clusia* produce resin as a reward for pollinators.



New *Mendoncia* Species Honors Hollenberg

A new species of Acanthaceae, *Mendoncia hollenbergiae* Wassh., has been named in honor of **Linda Hollenberg** whose career was spent in energetic and passionate care of the plant collections in the U.S. National herbarium.

The new species was discovered after the family treatment for the Flora of Ecuador (Wasshausen, D. C. 2013. Acanthaceae. pp. 1-329. In C. Persson and B. Stahl, eds. *Flora of Ecuador*. Department of Biological and Environmental Sciences, University of Gothenburg, Sweden.) had already been published. The new species was collected in the highly diverse, lowland riverside vegetation of the Yasuni



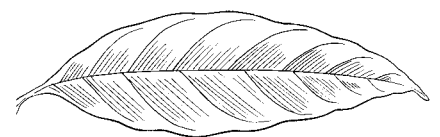
Mendoncia hollenbergiae Wassh.
Napo, Ecuador

National Park in Ecuador.

Presently, the new species is known only from the holotype and one other more recent collection by Nancy C. Garwood. The new species is morphologically similar to *Mendoncia sericea* Leonard ex Wassh., a more widespread species in Amazonian Ecuador and possibly Peru.

The new species was recently described by Emeritus Research Botanist

Dieter Wasshausen in an article published in the *Journal of the Botanical Research Institute of Texas* (9: 81-88; 2015).



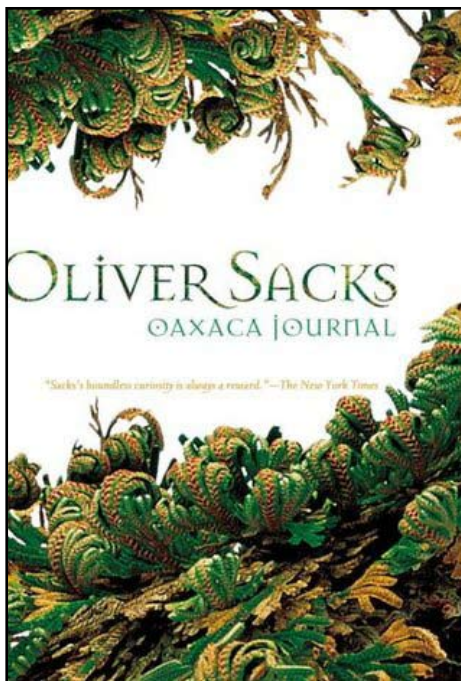
A Year of Ferns

By Spencer Goyette (Adapted from Smithsonian Libraries Unbound)

The Department of Botany's fern collection was highlighted several times last year. It was the main focus of the annual Smithsonian Botanical Symposium and was extended to a full week in June as "Next Generation Pteridology - An International Conference on Lycophyte & Fern Research", and now is a central part of the rapid capture digitization project to digitize and make accessible online the entire fern herbarium.

When I started as an intern and contractor in the Department at the beginning of 2015 I had no idea of the scale of diversity and richness that existed within this distinct plant lineage. My previous knowledge of ferns was elementary at best. In college, most of my professors glossed over the identification and ecology of ferns, opting instead to focus more lesson time on the seed plants.

As a contractor I helped prepare the collection for the digitization that is currently taking place within the herbarium. Most of the work was rote and mundane: replacing species covers, relabeling and making genus folders, moving cabinets of genera to reflect their more accurate phylogeny. Not exciting work but necessary. A definite perk of being around so many different genera and species was witnessing the global diversity of this group that was



NMNH Fern Team (left to right): Gregory McKee, Amanda Grusz, Eric Schuettpelz, Spencer Goyette, and Erin Sigel. (photographer unknown)

represented within our collection: from the diminutive tree fern that inhabits the tops of South American Tepuis, to the devastatingly simple-looking but incredibly speciose Tongueferns (*Elaphoglossum*), to the obscure Grammitids whose names possess a certain mellifluous indelibility (*Melpomene* and *Terpsichore* were among my favorites).

Like many staff and herbarium visitors, I decided to explore the resources available in the Botany and Horticulture Library in order to learn more about the life histories of these plants, and to help ready myself for a two week fern-collecting trip to Puebla, Mexico with a team of pteridologists led by **Eric Schuettpelz**, Curator of Pteridophytes at the National Museum of Natural History. I thought finding a book to read on the subject would be an easy way to build on the little knowledge I had built up over the past few months and prepare me for what turned out to be one of the most interesting adventures of my life.

While any volume focused on the ferns of southern Mexico could be considered

"niche" by even the most eclectic of readers, I was pleased to discover a copy of *Oaxaca Journal* by Dr. Oliver Sacks in our library. Coincidentally, I read *Oaxaca Journal* around the same time as the week-long, fern-focused Botany Symposium. Only on rare occasions are the people who populate the pages of our books presented in three dimensions, yet there they were. At this conference were some of the very same people mentioned in Sacks' book. Although in retrospect it seems inevitable, as the world of serious fern-lovers is not exactly a large one.

Welcoming and familiar, the fern community becomes intertwined with Sacks' narrative in *Oaxaca Journal*, as he describes the landscape of Mexico with a dynamic and colorful eye, connecting humans and flora through time and place. Once we made it into the field I consciously tried to make similar connections of my own between the pressed specimens I had seen in the herbarium with what I had read in Sacks' book to the wonderful array of plants we were seeing daily. In one of my favorite passages from the book

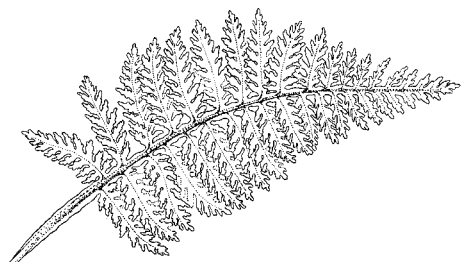
Sacks comments on the enthusiasm with which his fellow travelers identify seemingly dead, desiccated plants:

"It takes a practiced eye to see dried-up, withered and contracted ferns, to pick them out from the brown earth, but most of the group have had experience with this, and now, lenses in hand, careless of their clothes, they are crawling all over the ground, climbing the slopes, picking out new ferns every second. 'Notholaena galeottii!' someone cries. 'Astrolepis sinuata!' cries another, and there are no fewer than five species of Cheilanthes."

As our team began to comb through Puebla's gullies, streams, and mountainsides for ferns, we became a similar symphony of excitement when we happened upon another genus or species. In fact, finding *Scoliosorus*, a Vittarioid fern and one of our main targets, was a major highlight of the trip that we celebrated with hoots and hollers that visibly amused a nearby Cabaña manager.

Working in such species rich habitats was mind-boggling. Every day it seemed like we found new species, uncollected from the days prior. Another book, *The Pteridophytes of Mexico* by John Mickel and Alan R. Smith, provided key insight into potentially new species records and was definitely worth its weight for field identification (more in depth than *Oaxaca Journal*, but equally interesting and more field valuable). Between the spider bites, wasp stings, sunburn, altitude sickness, "ditch bananas," lightning strikes, a deluge or two, and stomach bugs we managed to not only collect more ferns than I would have thought possible, but had a blast at the same time.

It goes without saying that in this Year of Ferns I have been exposed to unique human and scientific experiences that I will remember for the rest of my life and will build upon as I make future career choices.



Specimens from the United States National Herbarium are placed on a conveyer belt for rapid digitization. (photo by Ingrid Lin)

Profile

Continued from page 1

men loans and researcher visits, limited to those individuals who had the necessary resources to travel to study the collections. The costs and difficulties associated with lending specimens, including packaging and shipping costs, are compounded by the risks of mailing fragile specimens. These risks are greatly reduced by redirecting traffic to online images and data.

We have already witnessed some of the benefits of online access. Whenever Museum Specialist Barrett Brooks received a loan request, he would digitize the requested specimens before sending them through the mail. By creating a record of what the specimens looked like before being loaned, Brooks captured an image of the specimen in its original condition in case it got lost or damaged. Often, upon seeing the images, the researcher who made the request decided that he or she can work with the high-resolution images instead, saving the specimens from the dangerous journey.

Digitization will benefit herbarium collections by creating a detailed inventory of plants and records at each herbarium. This database will allow us to track and group individual specimens, as well as keeping record of what is currently on

loan (and to whom). According to Curator Pedro Acevedo, "The first thing we need to know is what we have, then we have a responsibility to put that data out there for others to use."

Because digitization opens up new research possibilities, it will allow the collections to be used more frequently and in new ways. As Laurence Dorr (Curator and Chair of the Botany Department) muses, "When you collect specimens, you don't necessarily know what will happen in the future."

Herbaria develop different strengths based on their location or particular collectors' interests. "Herbaria tend to grow in ways that form unique collections," explains Dorr. "Information is scattered across continents and countries." The U.S. National Herbarium is particularly strong in ferns, specimens from early exploring expeditions, types, Mexico/South America, and the Philippines. Digitization will allow researchers to integrate information from a variety of herbaria, and to keep better track of which herbaria have which specimens.

Similarly, researchers can access specimens from all over the world right from their desks. Acevedo describes how he can access both literature and specimens online. For example, he can pull

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Profile

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up protologues (initial descriptions of a species) for species of *Paullinia* (Sapindaceae), and then compare them alongside

type specimens on his computer. Digitization can lead to reduced travel costs by prioritizing visits only to those herbaria that have exactly what researchers are looking for. The database will also serve

as an inventory that allows researchers to identify under-collected and under-researched areas.

Using specimen images, morphological traits can be used in phylogenetic and evolutionary studies. Perhaps some researchers will perform image analyses and morphometrics. With label data describing the time and location a specimen was collected, researchers will be able to easily track distributions over time to monitor invasive and endangered species. These distribution data may also be used to chart the effects of climate change or human interactions on natural populations and ecosystems. For example, because the information will be globally accessible, those working in tropical areas, such as Guaramacal National Park in Venezuela where Dorr has done some of his research, will be able to access the U.S. National Herbarium and other herbarium specimens to aid in describing new species and mapping biodiversity across difficult-to-access areas.

Herbarium specimens are especially useful in tracing botanical history. A searchable, usable catalogue of specimen collection dates can allow researchers to piece together itineraries of early exploratory expeditions. Additionally, when combined with early descriptions, a digitized database will make it easier to identify types for species described before the late 19th century, when the use of types became standard practice.

Perhaps the most exciting possibility is the promise that the database will grow as new discoveries are made. Curator Eric Schuettpelz states that “by letting people see the specimens, we can increase their value.” As time goes on, researchers might incorporate photos from the field, additional literature, or research findings into the database, adding information to and improving each herbarium specimen.

Even though you cannot take a DNA sample from a digital specimen, digitization helps streamline molecular analysis as well. Curator Ashley Egan, a molecular systematist and population geneticist, describes that she “would benefit from the metadata that will come from the digitization of our specimens,” as they would allow her to integrate metadata from the U.S. National Herbarium with data from other digitized collections all over the world. Further, since the database also functions as an inventory, it will be easier



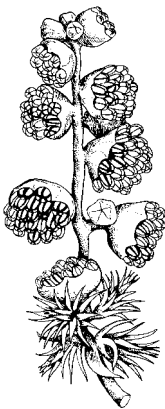
The Venezuelan fern specimen, *Huperzia myrsinites*, collected by Julian Steyermark in 1944, has the distinction of being the 500,000th image captured by the Smithsonian Digitization project, which has digitized objects from across the Smithsonian Institution. The Smithsonian Digitization Program Office team has worked alongside staff to digitize items from nine museums: National Museum of Natural History, Smithsonian Gardens, Smithsonian National Museum of African American History and Culture, National Museum of American History, Smithsonian's Freer and Sackler Galleries, Cooper Hewitt, Smithsonian Center for Folklife and Cultural Heritage, National Air and Space Museum, and Smithsonian National Postal Museum.

to manage requests for DNA samples when they are needed.

While digitization is widely accepted as positive and necessary for moving forward, some have expressed concerns that will need to be considered. First the creation of a database could place rare and endangered plants at risk by revealing their georeferenced locations, making them susceptible to illegal poaching. It is possible, however, to mask critical location information to protect vulnerable species, limiting this knowledge to experts with approved access. Another concern involves the management of the collections themselves. Curators might be reluctant to lend type specimens if they are available online, though some research requires direct interaction with the physical specimen. Some might argue that once specimens are digitized there is little reason to maintain the actual herbarium collections, which may impact funding or other management decisions. Yet, with new technology in molecular biology and DNA barcoding, the actual specimens have proven useful in ways that a digitized image cannot.

It is important to realize that digitized databases are not a replacement for existing herbaria, but simply another tool to expand the possibilities of research. “You can ask questions you couldn’t possibly ask before,” Dorr says. “Specimens are here so you can form ideas about the world and how things are related.”

Elizabeth Jacobsen was a 2015 undergraduate student intern in the Plant Conservation Unit, Department of Botany



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Art by Alice Tangerini

***Oenothera riskindii* W.L. Wagner**

The U.S. National Herbarium has begun a rapid digitization project, starting with the digitization of plants specimens in the family Onagraceae (evening primrose). Onagraceae has developed over the past half century as a model system for the study of plant evolution. At present, systematic revisions are available for virtually the entire family of 660 species in 22 genera. Molecular phylogenetic analyses have resulted in a major new classification of the family with a comprehensive monograph completed in 2007 by Warren Wagner and collaborators. Once imaged and databased, the herbarium's collection will provide more than 25,000 specimen records across the family to be utilized in tandem with ongoing research projects world-wide. Over 130 species are rare or endangered, including the narrowly endemic *Oenothera riskindii*, known only from montane open oak woodland in Rincón de María and adjacent Serranías del Burro in northern Coahuila, Mexico (*Syst. Bot.* 30: 332-355; 2005).



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