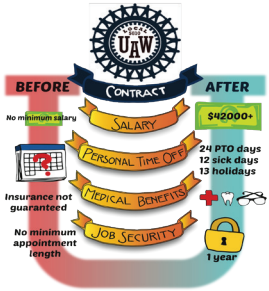
Botanical Society of America

Plant Science Bulletin

Summer 2015 Volume 61 Number 2

1st place triarch
botanical images student travel awards
Jennifer Dixon, Iowa State University
Flowers from *Eragrostis cilianensis* (stinkgrass)

In This Issue.....



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Naomi Volain honored as a top 10 nominee for the Global Teacher Prize.... p. 58

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From the Editor

As the Summer 2015 *Plant Science Bulletin* goes to press, many of us are transitioning from the spring semester into the summer. I find this an especially bittersweet time of year as I wrap up classes and say goodbye to Creighton's graduating seniors. It is a time to reflect on the past academic year, celebrate achievements, and eat University-catered petit fours.

Fortunately, this time of year also means honoring members of the Botanical Society with well-earned awards. In this issue, we are proud to announce the winners of the Kaplan Memorial Lecture and Public Policy Awards. We also present the winners of several student awards, including the Karling and BSA Graduate Student Research, Undergraduate Student Research, Cheadle Travel, and Young Botanist Awards. You can find the winning Triarch images on pages 33-34 and I encourage you to view all the Triarch submissions at http://botany.org/PlantImages/ConantSTA2015.php.

Congratulations to all of these commendable botanists! The Society will be considering many additional awards over the next few months and we will profile more winners in the Fall issue. These will include those named to the Society's highest honor, Distinguished Fellow of the Botanical Society of America (previously the Merit Award).

In addition to these award winners, I am particularly pleased to draw your attention to two articles in this issue that focus on diversity in botany. The article by Michael J. Dockry (page 35) discusses the value of human diversity and inclusion for science and explores strategies for fostering diversity in scientific research. The essay by Jessica M. Budke (page 40) also speaks to strategies for achieving inclusion by enhancing postdoc visibility and facilitating professional success at this critical career stage. Both of these articles should provide ample food for thought.

Also in this issue, you'll find news from the Education, Investment, and Public Policy committees and I encourage you to participate in the survey developed by the Public Policy Committee (link on page 63). This committee needs your responses to help guide their activities and shape the role of our in society in the public policy arena.

As July approaches, I am looking forward to heading North for this year's Botany meeting. I hope that many of you will be able to join me and, as always, the *Plant Science Bulletin* will bring you the highlights.

See you in Edmonton!

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Botanical Society of America Award Winners

The BSA Graduate Student Research Awards

The BSA Graduate Student Research Awards support graduate student research and are awarded on the basis of research proposals and letters of recommendations. Within the award group is the J. S. Karling Graduate Student Research Award. This award was instituted by the Society in 1997 with funds derived through a generous gift from the estate of the eminent mycologist, John Sidney Karling (1897-1994), and it supports and promotes graduate student research in the botanical sciences.

J. S. Karling Graduate Student Research Award

Anne Lucy Stilger Virnig, New York Botanical Garden & The Graduate Center of the City University of New York (Advisor, Dr. Amy Litt), "*From molecular systems to human systems: An interdisciplinary approach to evaluating antioxidant activity and conservation in the neotropical blueberries*"

BSA Graduate Student Research Awards

Daniella Allevato, Cornell University (Advisor, Dr. Kevin C. Nixon), *"Modeling the evolution of phytochemical diversity in* Pilocarpus *via a combined phylogenetic and environmental analysis"*

Jennifer Blake, Rutgers University (Advisor, Dr. Lena Struwe), *"Temporal, spatial, and environmental dimensions of variable sex expression in striped maple,* Acer pensylvanicum *(Sapindaceae)"*

Katharine Cary, University of California, Santa Cruz (Advisor, Dr. Jarmila Pittermann), *"Small trees, big problems: leaf function under extreme edaphic stress in the pygmy forests of northern California"*

Chloe P. Drummond, University of Wisconsin-Madison (Advisor, Dr. Kenneth J. Sytsma), *"Great Lakes-Western North America Disjuncts: a study on the phylogeography, timing, and climate niche space of three representative lineages"*

Katherine Eisen, Cornell University (Advisor, Dr. M. A. Geber, *"Ecological and evolutionary consequences of pollinator sharing in flowering plant communities"*

Claire Ellwanger, Northwestern University & The Chicago Botanic Garden (Advisor, Dr. Jeremie Fant), *"Genetic assessment of management and restoration practices of the federally threatened orchid,* Platanthera leucophaea *(The Eastern Fringed Prairie Orchid)"*

Nicole J. Forrester, University of Pittsburgh (Advisor, Dr. Tia-Lynn Ashman), *"Do doubled genomes double species' ranges? Implications for plant invasions"*

Jacob M. Heiling, Dartmouth College (Advisor, Dr. Rebecca Irwin), *"Ecological significance of pollen secondary chemistry"*

Julie Herman, University of California, Santa Cruz (Advisor, Dr. Kathleen M. Kay), *"A phylogenetic approach to plant chemical defense"*

Israel Jimenez, California State University, Los Angeles (Advisor, Dr. Kirsten Fisher), *"Meiotic sex ratios in the Mojave Desert moss* Syntrichia caninervis*"*

Joshua Scott Lynn, University of New Mexico (Advisor, Dr. Jennifer Rudgers), *"King of the Hill? Potential for novel biotic interactions to limit plant elevational distributions"*

Nora Mitchell, University of Connecticut (Advisor, Dr. Kent Holsinger), *"Using natural hybrids to investigate trait-environment associations and stress response in an evolutionary radiation"*

Nabil Nasseri, University of Vermont (Advisor, Dr. Alison K. Brody), *"Ant-hemipteran mutualisms: host plant antagonist or 'budding' mutualist?"*

Juliet Oshiro, University of California, Santa Cruz (Advisor, Dr. Laurel Fox), *"Predicting flowering phenology responses to climate: integrating long-term data, plant traits and experiments"*

Amber Paasch, Richard Gilder Graduate School, American Museum of Natural History (Advisors, Drs. Eunsoo Kim and Susan Perkins), *"Characterization of a unique method of bacteria ingestion in green algae by fluorescence and electron microscopy"*

Wilnelia Recart, University of California, Irvine (Advisor, Dr. Diane Campbell), *"Beyond the ecological: can presence of an invader affect floral selection in a native species?"*

Anthony Slominski, Montana State University (Advisor, Dr. Laura Burkle), *"The effects of climate-driven phenological shifts on plant-pollinator interactions and plant and pollinator reproductive success"*

Rebecca Stubbs, Florida Museum of Natural History and University of Florida (Advisors, Drs. Nico Cellinese and Doug Soltis), *"Understanding the Arctic flora: Using a model plant group to study evolution at high latitudes"*

Brittany L. Sutherland, University of Virginia (Advisor, Dr. Laura F. Galloway), *"Interploid gene flow at independent contact zones in* Campanula rotundifolia*"*

Christine Urbanowicz, Dartmouth College (Advisor, Dr. Rebecca E. Irwin), *"The influence of neighboring plants on pollination and plant reproduction across a stress gradient"*

Donald R. Kaplan Memorial Lecture

The Kaplan Lecture consists of a synthetic talk in the area of comparative development that reviews a topic for a general botanical audience while providing novel insights based on new or newly analyzed data.

This year's lecture will be given by **Dr. Juerg Schoenenberger**, Department of Botany and Biodiversity Research, University of Vienna, Vienna "*Who dares to call oneself a plant morphologist?*"

BSA Public Policy Award

The Public Policy Award was established in 2012 to support the development of tomorrow's leaders and a better understanding of this critical area. The 2015 recipients are **Andrew Pais**, North Carolina State University, and **Ingrid Jordon-Thaden**, a postdoc at Bucknell University.

Vernon I. Cheadle Student Travel Awards

(BSA in association with the Developmental and Structural Section)

This award was named in honor of the memory and work of Dr. Vernon I. Cheadle. The Cheadle awards are given by the BSA in association with the Developmental and Structural Section

Jessica Chu, Humboldt State University (Advisor, Dr. Alexandru M.F. Tomescu), for the Botany 2015 presentation: "*Reappraising the flora of the Battery Point Formation (Québec) – additional diversity of Early Devonian permineralized plants*" Co-author: Alexandru M.F. Tomescu

Mario Coiro, ETH Zurich (Advisor, Dr. Elisabeth Truernit), for the Botany 2015 presentation: "*Epidermal morphology and the diversification of the cycads*" Co-authors: James E. Mickle and Maria Rosaria Barone Lumaga

Jacob Landis, University of Florida (Advisor, Dr. Pamela Soltis), for the Botany 2015 presentation: "*Investigating the genetic underpinnings of corolla cell size and shape differences in* Saltugilia *(Polemoniaceae)*" Co-authors: Rebecca O'Toole, Kayla Ventura, Douglas Soltis, and Pamela Soltis

Aniket Sengupta, Kansas University (Advisor, Dr. Lena Hileman), for the Botany 2015 presentation: "*Testing the role of bilateral flower symmetry genes in eudicot lineages with radial flowers*" Co-author: Lena Hileman

The BSA Undergraduate Student Research Awards

The BSA Undergraduate Student Research Awards support undergraduate student research and are determined on the basis of research proposals and letters of recommendation. The 2015 award recipients are:

Alexander C. Bippus, Humboldt State University (Advisor, Dr. Alexandru M.F. Tomescu): "*Exploring phylogenetic relationships in the Polytrichaceae (Bryophyta) using fossils and morphology*"

Nicolas Diaz, Bucknell University (Advisor, Dr. Christopher T. Martine), "*Determining the invasive potential of cultivated* Ilex opaca"

Emma Frawley, Bucknell University (Advisors, Drs. Christopher T. Martine and Ingrid Jordon-Thaden), "*Solanum* 'bullita': *the biological and political processes of defining a new species*"

Laryssa Gavala, Bucknell University (Advisor, Dr. Christopher T. Martine), "*Effect of fire on seed germination in* Solanum beaugleholei"

Daniel Hayes, Bucknell University (Advisors, Drs. Christopher T. Martine and Ingrid Jordon-Thaden), "*Flow cytometric seed screen of the apomictic alpine mustard,* Draba oligosperma *Hook, from the North American Cordillera*"

Jens Johnson, University of Washington (Advisor, Dr. Verónica S. Di Stilio), "*Mechanisms of polyploidy and their effect on flower diversification*"

L. Mae Lacey, Bucknell University (Advisors, Drs. Christopher T. Martine and Elizabeth Capaldi), "*Exploring the potential for* Solanum *fruit ingestion and seed dispersal by macropod species in the Northern Territory, Australia*"

Sean Peña, Florida International University (Advisor, Dr. Suzanne Koptur), "*Diurnal and nocturnal pollination of the rough-leaf velvetseed,* Guettarda scabra *(Rubiaceae)*"

Amanda M. Salvi, University of Michigan—Ann Arbor (Advisor, Dr. Selena Y. Smith), "*Effect of canopy shading on morphology, physiology, and self-shading in spiral gingers* (Costus)"

The BSA Young Botanist Awards

The purpose of these awards is to offer individual recognition to outstanding graduating seniors in the plant sciences and to encourage their participation in the Botanical Society of America. The 2015 "Certificate of Special Achievement" award recipients are:

Christa Unger, Humboldt State University (Advisor, Dr. Alexandru M. Tomescu)

Kolby Lundgren, Humboldt State University (Advisor, Dr. Alexandru M. Tomescu)

Steven Unger, Florida International University (Advisor, Dr. Bradley Bennett)

Christine Carson, University of Missouri (Advisor, Dr. Candace Galen)

Jessica Kettenbach, University of Missouri (Advisor, Dr. Candace Galen)

Dan Evanich, Connecticut College (Advisor, Dr. Chad Jones)

Tory Stewart, Connecticut College (Advisor, Dr. Chad Jones)

Morgan Roche, Bucknell University (Advisor, Dr. Chris Martine)

Ally Boni, Bucknell University (Advisor, Dr. Chris Martine)

Ian Gilman, Bucknell University (Advisor, Dr. Chris Martine)

L. Ruth Rivkin, University of Guelph (Advisor, Dr. Christina Caruso)

Ben Kerb, University of Kansas (Advisor, Dr. Daniel J. Crawford)

Kristine Altrichter, Creighton University (Advisor, Dr. Mackenzie Taylor)

Margarita Hernandez, University of Florida (Advisor, Dr. Pamela S. Soltis)

E. Geretz, Rutgers University (Advisor, Dr. Myla Aronson)

Michael Coe, University of Hawaii (Advisor, Dr. Tom A. Ranker)

Monica Dittbern, University of Hawaii (Advisor, Dr. Tom A. Ranker)

Katie Ann Smith, University of Hawaii (Advisor, Dr. Tom A. Ranker)

The BSA PLANTS Grant Recipients

The PLANTS (Preparing Leaders and Nurturing Tomorrow's Scientists: Increasing the diversity of plant scientists) program recognizes outstanding undergraduates from diverse backgrounds and provides travel grants and mentoring for these students.

Alicia Butko, Widener University (Advisor, Dr. Kate Goodrich)

Emma Fryer, Humboldt State University (Advisors, Drs. Michael Mesler and Alexandru Tomescu)

Patrick Gallagher, The College of New Jersey (Advisor, Dr. Wendy Clement)

Jose Miguel Hernandez Ochoa, University of Wisconsin (Advisor, Dr. Juan Zalapa)

Angelina Viviana Martinez, University of Florida (Advisors, Drs. Christine Davis and Pamela Soltis)

Jesus Medina, California State University - Los Angeles (Advisor, Dr. Craig Barrett)

Madeline Metten, University of Northern Colorado (Advisor, Dr. Mitchel McGlaughlin)

Andre Naranjo, University of Miami (Advisor, Dr. Barbara Whitlock)

Chelsea Pretz, Harris-Stowe State University (Advisors, Drs. John MacDougal and Allison Miller)

Mercedes Santiago, Kansas State University (Advisor, Dr. Carolyn Ferguson)

Maryan Sedaghatpour, George Mason University (Advisors, Drs. Jorid van der Ham and Andrea Weeks)

Gary Sur, University of Hawaii - Hilo (Advisor, Dr. Elizabeth Stacy)

Imena Valdes, Florida International University (Advisor, Dr. Suzanne Koptur)

Joshua Wiese, University of Nebraska at Kearney (Advisor, Dr. Bryan Drew)

Economic Botany Section Student Travel Awards

Elliot Gardner, Northwestern University / Chicago Botanic Garden (Advisor, Nyree Zerega) for the Botany 2015 presentation: "*Basic research with practical applications: Phylogenomics and pollination biology in a genus of underutilized tree crops (*Artocarpus*, Moraceae)*" Co-author: Nyree Zerega

Colin Khoury, Wageningen University (Advisor, Paul Struik) for the Botany 2015 presentation "*Increasing homogeneity in global food supplies, agricultural research funding, and recommendations for diversifying food systems*"

Triarch "Botanical Images" Student Travel Awards

Established by Dr. Paul Conant, and supported by TRIARCH Incorporated, this award provides acknowledgement and travel support to BSA meetings for outstanding student work coupling digital images (botanical) with scientific explanations/descriptions designed for the general public.

1st Place: A Flower of a Different Color

Jennifer Dixon
Iowa State University

Grass flowers are rarely seen and often misunderstood. Most people who think of flowers imagine colorful petals and a multitude of arrangements, while in the grasses, flowers are tiny but can be just as diverse and beautiful as other flowering plants. This image is indeed a flower—actually, several tiny flowers called florets. Here we see the delicate "petals" called a palea and lemma, which enclose the reproductive structures within. Grass specialists (agrostologists) can often identify a species of grass just by looking at these tiny inflorescences. Note the purple shades at the tip of each floret, the serrated edges, and the cream-colored veins. This image was taken from dried specimens moistened with Pohl's solution, a mix of water and detergent that is used to soften dried specimens so they are easier to dissect. The darkened shaped within the delicate "petals" are the ovary and stamen of these delicate grass flowers.

Family: Poaceae; Taxon: Eragrostis cilianensis; *Common Name: stinkgrass; candy grass; gray lovegrass*

2nd Place: Bright Colors and Strong Scents

Rebecca Povilus
Harvard University

Flowers of *Illicium floridanum* are showstoppers, both for eyes and noses. The vivid crimson of *I. floridanum* flowers distinguishes it from the other North American *Illicium* species *(I. parviflorum)*, which has more demure, pale-yellow flowers. But that's not the only tip-off: flowers of *I. floridianum* smell like fresh fish. Furthermore, flowers of *I. floridanum* are thermogenic, meaning that they produce heat though internal, metabolic reactions. Warm flowers may help to make their unique scent even stronger and have been hypothesized to provide a cozy retreat for midges, which are a common pollinator for this species. And perhaps the smelly flowers are not so surprising after all—*Illicium* species around the world are known for their fragrances, whether as part of the flowers, leaves, bark, or fruit (you may have seen and tasted the fruits of the south-Asian *I. verum* as the spice star anise).

Family: Schisandraceae; Taxon: Illicium floridanum; *Common Name: Stink-bush*

3rd Place: The Largest Pollination Event on Earth

Alaina Petlewski
Humboldt State University

An almond tree *(Prunus dulcis)* in an orchard outside Visalia, CA being pollinated by a honeybee *(Apis mellifera)*. Roughly half of all flowering plants are self-incompatible, meaning that fertilization by gametes originating from the same plant or a close relative cannot occur. The almond tree *(Prunus dulcis)* is a prime example of a self-incompatible plant. Pollen must somehow make it from the stamen of an almond flower to the stigma of another, unrelated almond flower. Strictly from a statistical point of view, the likelihood of this happening without outside interaction seems slim. So, how does this potentially delicate system involving a self-incompatible plant, not pollinated by wind, make up an $11 billion industry in California? The answer is simple: honeybees, and lots of them. An estimated 1.6 million colonies are required every year to pollinate the 790,000 acres of almond trees in California. This could easily be the largest coordinated pollination event worldwide.

Family: Rosaceae; *Taxon:* Prunus*; Common Name: Almond*

Feature Article

Enhancing institutions and research through human diversity: Reflections on diversity, inclusion, and the future of plant and natural resource sciences[1]

By Michael J. Dockry
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Submitted 27 February 2015.
Accepted 15 April 2015.

Abstract

Many research institutions and professional societies are looking to enhance the diversity of their members, employees, and scientists. To do this, their efforts often focus on recruitment and retention of minority employees and employees from protected classes (e.g., race, religion, sex, age); however, recruitment and retention efforts can prove difficult and do not capture the full potential of increasing institutional diversity. In this essay, I discuss how we can foster human diversity and improve our research simultaneously. Based on the literature and personal experiences, I suggest that increasing diversity is crucial to improving the capacity of our institutions to provide service to others. For this reason institutions should make diversity a core part of their missions.

Key Words: diversity; human diversity; inclusion; institutional missions; science research; service

Human diversity, inclusion, equity, difference, campus climate, cultural transformation, inclusive excellence… these are all words that have been used by individuals and institutions to address disparities in scholastic achievement, health outcomes, social and economic status, and the composition of our institutions. People view these words from many different perspectives. Some of us view them as civil rights issues. Some view them as irrelevant for a modern day merit-based society. Still others view them as important issues for our institutions to tackle. Oftentimes I hear people either reject diversity or promote diversity "for diversity's sake." No matter how we view these words, everyone is affected by them. In this essay I use personal experiences and relevant literature to suggest that promoting and increasing diversity is a crucial ingredient to improving the capacity of our institutions to provide service to others. I then show that for this reason institutions should make diversity a core part of their mission. This essay is based on a panel presentation I gave at the Edward A. Bouchet Graduate Honor Society meeting at Yale University in 2011 and a keynote presentation I gave at the Botany 2014 Enhancing Scientist Diversity in Plant Biology Luncheon in Boise, ID.

Over the course of my career I have cared deeply about collaboration and the inclusion of multiple perspectives in my work. As a US Peace Corps volunteer in Bolivia in the late 1990s, I saw firsthand how multiple perspectives could come together through collaborative planning for a public/private protected area bordering a national park. When working as the assistant forest planner for the Green Mountain and Finger Lakes National Forests in the early 2000s, I worked with a team to revise the national forest plans based on the premise of collaboration, shared learning, and inclusion. In both these planning processes, we believed that the greater the number of perspectives we could get to the table to discuss the issues and possible solutions for forest management, the better forest management plans we could develop. We strove not only to include different voices in the discussion, but we provided different opportunities for involvement. Collaboration and inclusion were core principles of our projects and were deliberately incorporated throughout the entire planning process.

More recently, I have been reflecting upon the value of diversity and inclusion for scientific research. As a member of the Citizen Potawatomi Nation, one of the 566 federally recognized American Indian tribes in the United States, I have been acutely aware of the lack of tribal voices in many research projects, formal education, and our institutions (for the entire list of federally recognized tribes, see Department of Interior [2014]). When I was studying ecology in the early 1990s, it was not uncommon for scientists to view historical tribal influences upon the land and forest resources as minimal. Debates over the amount of influence tribes had on forest and ecosystem structure before the United States was founded would devolve into

discussions about historical human population numbers. More people, according to many researchers at the time, equaled more impact and fewer people meant less impact. Because I studied forestry and ecology, these discussions often revolved around fire. As a student, I remember thinking, "How many people does it take to start a large forest fire?" For me, debates about American Indian historical population sizes did not focus on the right question. The right question was how did and how do tribal people think about their relationship to the land and what do those cultural values mean for land management now and in the past. In the early and mid-1990s it felt like my perspective was in the minority. Today, there are many people asking these broader questions and we are better off as a scientific community because of it. While not new to American Indian communities, Traditional Ecological Knowledge is now an accepted and growing area of innovative and inclusive research (see Pierotti and Wildcat, 2000; Berkes, 2012; Kimmerer, 2013; Emery et al., 2014; Whyte, 2014 for some recent examples). These personal experiences illustrate the power of incorporating a diversity of perspectives into our research. Different perspectives allow us to ask novel questions and gain new insights.

So, why is diversity and inclusion important for our institutions and for science? For one thing, our country is diverse and changing. According to US Census Bureau estimates, the 2015 US population is around 321 million people; 50.7% female; 61.7% white non-Hispanic; 17.7% Hispanic; 13.2% Black; 5.5% Asian; and 1.5% American Indian/Alaskan Native/Native Hawaiian (US Census Bureau, 2014). In other words, the non-white and Hispanic population today is about 38% of the US population and is expected to grow in the next several decades to the point where white non-Hispanics are projected to comprise less than 50% of the population by 2045 (US Census Bureau, 2014). These are important trends for our society, universities, public institutions, scientific research, and for the plant sciences and natural resources. These demographic shifts will change what people expect from our institutions, how people think about natural resources, what their goals are for natural resource management, and their views on what are our most pressing research problems and how to solve them.

At the same time, our society is becoming more globalized. Not only are there people from every corner of the world living in the United States, but our environmental and social problems have become global in nature. Climate change and biodiversity loss are both global processes. Solutions to global problems require multiple perspectives to develop solutions. Climate change, loss of biodiversity, and erosion of social cohesion are all issues that we must solve together. They can only be solved with the support of inclusive research. Furthermore, these global problems are complex historically, socially, economically, institutionally, and ecologically, and they require diverse interdisciplinary teams to come up with innovative solutions. The inclusion of social and citizen scientists within a plant science research team can approach these challenges more effectively, as no one discipline can solve these wicked problems and no one perspective can either (see Rittel and Webber, 1973; Brown, Harris, and Russell, 2010; Thompson and Whyte, 2012).

If we start to engage in research that is responsive to and guided by the needs and questions of diverse communities, we will begin to see a change in the people engaged with our institutions and our institutions themselves.

These experiences and literature show us that diversity and inclusion can improve an institution's capacity to provide service to others. Research in particular can be understood as service. I am Potawatomi, a product of land grant universities, and a public servant. I see research as service. To me, service is a way to bring our scholarship, leadership, and advocacy together. Why do we research what we do? Why do we work on the subjects we do? For me, it has to do with service. Research for many is a calling to find answers to some of the most complex issues of our time. Research is enhanced by bringing distinct perspectives together to develop research questions, methods, analysis, and dissemination. Only when our research is of interest to diverse communities will we achieve truly groundbreaking results and interpretations to solve pressing complex problems. If we start to engage in research that is responsive to and guided by the needs and questions of diverse communities, we will begin to see a change in the people engaged with our institutions

and our institutions themselves. A critical mass of diverse employees within an institution is needed for this to happen, but the research also needs to be of interest to diverse communities to attract new students and employees to the pursuit. In the long run, if we work to answer questions of interest to minority communities, we will improve diversity within our own institutions and—maybe more importantly—these diverse institutions will give us new perspectives with which to solve the global environmental and social problems we face today.

I would like to share one more example to close my discussion on approaching diversity as a way to improve our institutional capacities to provide service to others. For nine years I had the privilege to be the Forest Service's liaison to the College of Menominee Nation, a tribal college located on the Menominee Reservation in Keshena, WI. The College of Menominee Nation and Forest Service have had a formal partnership since 2001 to do research and education based on sustainable forestry. Our goal is to work collaboratively with tribes and tribal communities to address tribal concerns. The partnership was specifically created outside of the USDA civil rights program. We did this, not because we did not support civil rights initiatives, but because we believed that if the partnership supported good research and education that meets tribal needs, everyone will benefit from the questions and answers.

We incorporated undergraduate students in all partnership projects. We had student interns working on the effects of Emerald Ash Borer on American Indian communities, Traditional Ecological Knowledge, climate change, and sustainable development. Students saw and worked with American Indian role models like myself who value their opinions and ideas, share values, and respect them. This partnership provided an opportunity for American Indian students to see that research and education can benefit them and their communities. Some students never thought that they could get a college degree or go to graduate school as a way to support their families and community. After their internships many students continued on with their educations and are now in positions of leadership throughout their tribal communities and beyond. This partnership shows that projects that embrace inclusion as a way to produce better results, address minority concerns from minority perspectives, and include minority students, faculty, and staff can create positive feedback loops that will simultaneously improve our research, our institutions, and our communities.

As this example shows, service can be a way to improve our research and management of natural resources and a way to increase the diversity within the Forest Service and professional societies. Service is listening to the community and using our expertise to answer questions of interest to them. Service is mentoring students. Service is engaging communities collaboratively. Service is teaching. When diversity and service are approached in this manner, students and communities become involved when they see scientists working on interesting projects that will have impacts within their communities. Some students will go on for more schooling and advanced degrees. Eventually these students enter into the tribal, Forest Service, or university work force where they become role models for others and the cycle continues.

All of these examples and research imply that institutions are strengthened by viewing diversity and inclusion as a core part of their mission. Scott Page (2008) argues that "[w]e should look at diversity as something that can improve performance, not as something that we have to be concerned about so that we don't get sued" (p. xxii). I would add that we should look at diversity as something that can help us achieve our core research, education, and land management missions. All too often diversity initiatives started by federal agencies, university campuses, and private industries focus on recruitment and retention---as if numbers of people add up to a diverse, welcoming, and inclusive environment. Furthermore, even if recruitment of diverse candidates is successful, retention and overall organizational performance may not improve if institutions do not view diversity as a means to achieve their mission.

This is beginning to change, however, as businesses have begun to make strong cases for diversity as a core part of their missions. While diversity is difficult to research within companies, some scholars argue that diversity provides an opportunity to learn better how to achieve a company's mission (Kochan et al., 2003). Some studies show that diversity can increase a company's revenue, market share, customer base, and creativity and innovation (Robinson and Dechant, 1997; Herring, 2009). Additionally, a whole new phrase has grown up from work on diversity, inclusion, and big-data—the wisdom of crowds—that argues,

among other things, that cognitive diversity facilitates better decision making by expanding the range of possible solutions to problems (Surowiecki, 2005).

Researchers have also been making a strong case for including diversity as a core part of the mission of the academy. Books and academic journals such as the *Journal of Diversity in Higher Education* are devoted to the subject. Journals have devoted special issues and individual articles to the topic (e.g., Uriarte et al., 2007; Allison and Schneider, 2008; Chin, 2010; Cheruvelil et al., 2014; Moss-Racusin et al., 2014). Many of these studies have shown that our research, problem solving, and outcomes can be improved with diversity, with collaborative teams, and with multiple perspectives. Diversity and inclusion are not just civil rights issues; it is imperative for us to ask the right research questions, to analyze the data from many different angles, and to develop robust solutions. In essence, research indicates that diversity, inclusion, and collaboration contribute to better science, better results, and stronger institutions.

Many of our institutions are taking these research findings seriously. Diversity and inclusion are becoming part of how we achieve our core missions and not only as a means to fulfill civil rights obligations. For example, the US Department of Agriculture and the Forest Service have embarked on a program called "cultural transformation" (http://www.dm.usda.gov/ct.htm). Leaders believe that they are better able to meet our mission for the public and employees by transforming the institutional culture to value and support inclusion as a way to promote a high-performance organization. Diversity is also important to the Botanical Society of America (BSA) where the issue is discussed through the Human Diversity Committee, and workshops and symposia sponsored by several sections of the Society (e.g., http://www.botany.org/diversity/). In addition to student travel awards provided by sections, the PLANTS (Preparing Leaders and Nurturing Tomorrow's Scientists) program provides travel awards for undergraduates to attend conferences and a mentors program designed to increase diversity at BSA meetings and within the profession. These initiatives are all supported by research that indicates institutional leadership, funding, and mentorship programs are important strategies for increasing student, faculty, and staff diversity (Milem, Chang, and Antonio, 2005; Turner, González, and Wood, 2008; Hurtado et al., 2009; Byars-Winston et al., 2011; Allen-Ramdial and Campbell, 2014).

Institutions that make progress toward diversity and inclusion have leaders that support these efforts by their words, actions, and development of collaborative plans to integrate diversity into their core missions. They provide support for student, faculty, and staff mentoring; support for transdisciplinary and collaborative research; support for including diversity as a topic of research; and support for working with communities. They also provide meaningful training on inclusion, collaboration, and building high-performing teams. Our leaders have important roles to play by setting the tone and providing support for creating diverse and inclusive institutions.

Leaders cannot do this on their own; we all need to come together to learn from one another, build community around our common institutional purposes, and take time to know each other and foster connections. One way to do this is to work together to build a community—a community of support and collaboration around inclusion and high-quality research. Offering a space to openly discuss inclusion is one way to build community. Another is through mentorship programs—for students, faculty members, and scientists. For example, BSA has an excellent mentorship program that aims to have their "[m]entors work with PLANTS students and attend talks with them, introduce them to colleagues, network and generally make the meetings a welcoming place for them" (http://www.botany.org/awards_grants/detail/PLANTS.php). My experience at the Human Diversity Luncheon in 2014 was that students, mentors, and BSA members were all excited to learn from one another, share experiences, and build productive relationships for future research. Society members report that undergraduates involved in these programs often go on to graduate school or biological professions. BSA's commitment to building a diverse community is exemplified through financial support for students to attend conferences, volunteer mentors, the Human Diversity Committee, Enhancing Scientist Diversity in Plant Biology Luncheon, and the PLANTS program.

In conclusion, there are several things we can do to foster diversity and inclusion within our institutions. First, we can view research as service. One way to do this is to foster collaborations with minority serving institutions—maybe institutions

Diversity and inclusion are not just civil rights issues; it is imperative for us to ask the right research questions, to analyze the data from many different angles, and to develop robust solutions. In essence, research indicates that diversity, inclusion, and collaboration contribute to better science, better results, and stronger institutions.

and community organizations we have not worked with in the past. Second, we can make diversity and inclusion part of our core institutional missions. This can be done by building inclusive communities within our institutions. We can develop specific plans to continue to move our institutions toward collaboration, inclusion, and interdisciplinary research. We can also provide space to share our personal experiences and support employee and student mentorship programs—particularly programs centered around research projects that are of interest to diverse communities. Finally, we need to believe that diversity and inclusion of perspectives enriches us all and that none of us can do this alone. We are living in an era where we cannot afford to leave out different perspectives. None of us can solve our unprecedented environmental and social problems alone. If we do not have diverse people with diverse perspectives within our institutions, and if we do not include diverse communities in our research, I fear we may not have the time needed to develop solutions to solve our problems. In the end, diversity affects all of us—our institutions, our communities, and our world.

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Acknowledgements

Thanks to my family friends, mentors, and colleagues who have helped me think deeply about diversity and inclusion, to the US Forest Service for letting me be a part of transforming our agency to be inclusive and expansive in our scientific agenda, and to the University of Wisconsin Madison Graduate School for inducting me into the Edward A. Bouchet Graduate Honor Society and inviting me to give a panel presentation on "The Future of the Academy: Maintaining and Strengthening Academic Diversity in the Midst of the Current Economic and Political Climate." I would also like to thank the Botanical Society of America, the Human Diversity Committee, and Brenda Molano-Flores, Chair of the committee, for supporting my travel to the Botany 2014 conference as the invited speaker for the Enhancing Scientist Diversity in Plant Biology Luncheon.

Postdocs: Improving our Visibility in the Research Workforce

By Jessica M. Budke, Katherine Esau Postdoctoral Fellow, University of California – Davis; jessica.m.budke@gmail.com

Do you know how many postdocs work at your institution? When I started my postdoctoral fellowship over two years ago, I had no idea that there are more than 6,000 postdocs in the University of California system with 600 of those postdocs working at the Davis campus. Over the past 30 years the number of postdoctoral positions in the United States has steadily increased to over 63,000 at more than 300 institutions (Einaudi et al., 2013). Postdocs are not only at large research universities, but we are working at primarily undergraduate universities such as Bucknell University and Willamette University, as well as research institutions such as The Field Museum and the Smithsonian. Despite the prevalence of postdoctoral researchers, we are often an invisible component of the research workforce.

The National Science Foundation (NSF), National Institutes of Health (NIH), and National Postdoctoral Association (NPA) define a postdoctoral position as "a temporary and defined period of mentored advanced training to enhance the professional skills and research independence needed to pursue his or her chosen career path." Although additional training acquired during a postdoc is an asset to our careers, it is important to remember that postdocs are PhD-holding, early-career researchers who contribute significantly to both our research groups and institutions. The contributions of postdocs often extend beyond the lab bench. Postdocs write grants and papers, mentor undergraduate and graduate students, present research at seminars and conferences, and teach courses in addition to our research responsibilities. Despite these contributions, the temporary nature of postdoc work, as well as the "trainee" rather than "staff" status, has been often used to justify low pay and minimal benefits for postdocs (Cain et al., 2014).

Postdoc Unionization At The University Of California

In order to push back against the undervaluing of our contributions, postdocs at the University of California voted in 2008 to form a stand-alone postdoctoral researchers' union: UAW 5810 (http://uaw5810.org/). Previously, postdocs negotiated individually for salary and benefits, resulting in uneven pay rates within and across departments and campuses. Salaries stagnated and in one instance, a full-time postdoc at the University of California was paid an annual salary of only $18,000 (Cain et al., 2014). After more than a year of negotiating, we won a 5-year contract that established a minimum salary scale, guaranteed annual salary increases, comprehensive health benefits at low cost, and a one-year minimum contract, in addition to many other benefits (Figure 1). These steps forward have significantly improved the postdoc experience at and beyond the University of California.

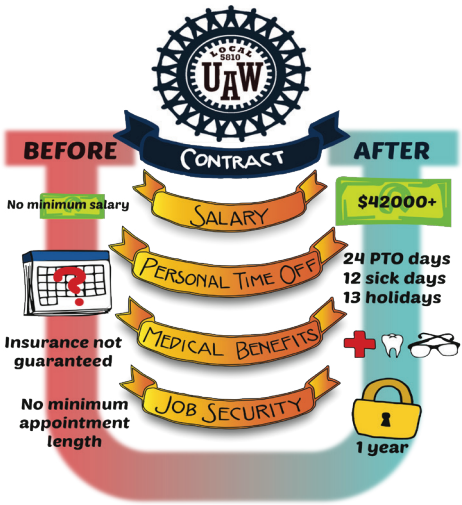

Figure 1. Union rights equal postdoc wins (Cain et al., 2014). The University of California (UC) Postdoc Union (UAW 5810) achieved a number of improvements for postdocs. Postdocs are now paid minimum salaries guided by the NIH NRSA Fellowship scale and receive guaranteed annual raises. Previously, time off was at the PI's discretion and there was no guaranteed leave. Now, postdocs at UC can have up to 6 weeks off at 70% pay for maternity leave. Postdocs have 24 days of personal time off (PTO) per year, in addition to 12 sick days and 13 UC "public" holidays. Postdocs and dependents also receive comprehensive health, dental, and vision insurance. Postdocs must be appointed for at least 1 year and many are appointed for longer.

I see unions not only as a progressive force advocating for early-career researchers, but I am also excited about the positive inroads unions can make for women in science. Significant biases against women still exist, which can influence both the evaluation and hiring of female scientists (Moss-Racusin et al., 2012; Jones and Urban, 2013). For university faculty, one way unions address these biases is by increasing transparency in the tenure and promotion process. Clarifying and communicating expectations equally to all faculty may be one reason why unionized faculty have a significantly higher percentage of women at the associate and full professor ranks compared to non-unionized faculty (May et al., 2010). Faculty unions also improve pay equity due to the presence of non-discrimination clauses in union contracts, resulting in a smaller salary gap between men and women (Rhoades, 1998). As a woman in science, I appreciate that the postdoc union at the University of California negotiated an experienced-based, minimum salary scale mirroring that of the National Research Service Award Fellowships (National Institutes of Health, 2014). These pay standards value the contributions of all postdocs equally and help to eliminate gender biases in pay.

Policies including maternity/paternity leave and subsidized childcare are not only critical for the retention of women in science, but they help to make science a more family-friendly career path for everyone. The median age of people finishing their PhDs in 2013 was 31.8 years old (Fiegener, 2014). This places many postdocs in the middle of prime parenting years when they are having and raising young children. In California the average cost of childcare is over $1000 per month (Child Care Aware of America, 2013), and at expensive campuses such as San Francisco, Berkeley, and Davis it can be up to $2000. For a starting postdoc making $3500 per month, these expenses can consume one third to one half of their salary, representing a significant financial cost. For University of California postdocs there is currently no reimbursement for childcare expenses and few campuses have university-sponsored childcare services with discounts for university affiliates such as postdocs. This places significant financial pressure on postdocs' decisions to start and maintain a family while continuing to work. This pressure may be especially acute for women, who often bear a larger proportion of childcare responsibilities (Bureau of Labor Statistics, 2014). A priority area for the postdoctoral union at the

University of California is to push for cost-of-living adjusted childcare subsidies or reimbursements for postdocs in our next contract. Decreasing the financial strains on postdoc families may also help to stem the flow of women leaving science during the postdoctoral phase of their careers.

Postdocs Taking Action

The postdoctoral union also gives members a voice in political decisions that directly impact our work. We launched a campaign to push for increased federal funding of science in the United States. Postdocs took photos of themselves with whiteboard signs stating why we support science funding and posted them to social media (Figure 2), similar to BSA's #iamabotanist campaign. Additionally we supported a "Dear Colleague" letter written by Congressional Representatives Jim McDermott (WA) and George Miller (CA) calling for congress to restore science and research funding that was cut from the 2013 federal budget during the sequester (http://uaw5810.org/wp-content/uploads/2013/09/McDermott_Miller_Letter_Color.pdf). This letter was ultimately signed by 39 members of Congress and then distributed to all congressional offices. In conjunction with other organizations around the nation, this campaign helped to restore US science funding to pre-sequester levels. By bringing together a group of people with common concerns and goals, the postdoc union enables us to have an impact on important issues beyond the University of California.

Another way postdocs are taking action to increase our visibility is by establishing new venues

Figure 2. University of California postdoctoral researchers sharing why we support science funding through a whiteboard campaign.

for sharing our research. In 2013, postdocs at UC Davis started a seminar series for postdoctoral scientists studying plants. This seminar series has featured postdocs from many fields including Botany, Plant Pathology, Ecology and Evolutionary Biology, Plant Biology, and Genomics, just to name a few. We have also hosted postdocs from nearby institutions, such as the Lawrence Berkeley National Laboratory, Stanford University, and UC Berkeley, thanks to the financial support of the UC Davis Plant Biology Department. In a similar vein, postdocs in the Plant Biology Department led the organizing of a Postdoctoral Research Symposium at UC Davis in May 2015 (https://sites.google.com/site/ucdavisprs/home). This included a full day of research talks, a networking lunch, poster session, and awards ceremony that featured the research of postdocs from many departments across campus. Through these events, postdocs have taken action to create professional development opportunities for sharing our research and honing our presentation skills in preparation for national and international conferences. By increasing the visibility of our research, postdocs demonstrate the value and importance of our contributions to the wider campus community.

POSTDOCS MOVING FORWARD

Within the sometimes hidden postdoctoral community I have found a passionate and engaged group of peers who have played a significant role in improving the postdoc experience at the University of California. By forming a union we not only came together to gain better working conditions for postdocs, but we also joined our voices to advocate for wide reaching issues, such as science funding and family-friendly workplaces. These experiences have broadened my perspective on what it means to be an active member of the scientific community. Identifying challenges and issues that impact science and scientists is an important first step that is best followed by actionable plans that move us forward toward progressive polices and solutions that can reverberate at and beyond our home institutions.

Our first postdoctoral contract at the University of California will expire in September 2015 (University of California, 2010). In the coming months I will be joining together with postdocs from across the ten University of California campuses to engage in the collective bargaining process with the university. During these negotiations we will continue to increase our visibility through public statements and petitions, outreach to state and federal elected officials, and demonstrations, which will build support for our next contract. Our goals are to negotiate a contract that supports the professional and personal lives of postdocs so that we can continue to produce cutting edge research that expands our knowledge of the world. Having the support of the broader scientific community, including botanists, will be critical toward our achieving these goals.

Tips for Building a Union

1. **Start the discussion by talking to your colleagues.**
   - Do you share concerns about your working conditions?
   - Are there common themes?
   - Compile a list of concerns and issues
   - It's best to have these discussions during non-work hours in a place where everyone can openly share their thoughts and opinions.
2. **Building support for a union..**
   - Develop an active and engaged group of colleagues from across your institution to form a core organizing committee.
   - Formulate a list of improvements you would like to achieve.
   - Evaluate the support for a union around your key issues by talking to a wide array of colleagues.
3. **Contact an organization that can help with the next steps of forming a new union.** Groups that have helped postdocs with unionization:
   - American Association of University Professors - American Federation of Teachers (AAUP-AFT)
   - The Canadian Union of Public Employees (CUPE)
   - Public Service Alliance of Canada(PSAC)
   - United Automobile, Aerospace, and Agricultural Implement Workers of America (UAW)
   - University Health Professionals (UHP)

Acknowledgements

Thanks to Dr. Mackenzie Taylor for inviting me to contribute my perspectives in this article. This piece is dedicated to my postdoctoral colleagues in the United States and abroad. I hope that each of you obtain a permanent position that enables you to continue to follow your scientific and botanical passions.

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Grady Webster Euphorbiaceae Virtual Herbarium and Publications

UC Davis Professor Dr. Grady Webster (1927-2005) was an internationally recognized expert on the Euphorbiaceae who helped countless scientists identify their Euphorbiaceae collections. Due to Dr. Webster's efforts, the herbarium at the UC Davis Center for Plant Diversity has a large, well-identified collection of Euphorbiaceae (>40,000 specimens). Now, we are pleased to announce that the Grady Webster Euphorbiaceae Virtual Herbarium and Taxonomic Resources site is available for use at our website: http://herbarium.ucdavis.edu/taxonomicresources.html.

This website, created with the support of the National Science Foundation (Award no. 1057391), provides specimen images of the genera *Croton, Dalechampia, Euphorbia*, and *Phyllanthus* and some of their segregate genera. We have provided at least one specimen image of each species that we house in our herbarium. Specimens were chosen for imaging by Dr. Paul Berry, Dr. Ken Wurdack, and Dr. Scott Armbruster; we thank them for their help.

In addition to the Virtual Herbarium, we have provided a list of Dr. Webster's publications as well as a list of his unfinished manuscripts with links to pdf versions, if allowed by the journal's publisher. In addition, we curated all Dr. Webster's unmounted specimens and databased all specimens associated with his Vascular Flora of Maquipucuna, Ecuador; label data from those specimens are available at our specimen search engine at: http://museums.ucdavis.edu/GIS_dataoption_mdb.aspx.

It is our hope that by providing these images, publications, manuscripts, and label data, we will both assist and inspire another generation of botanists to continue Grady's work.

—Ellen Dean, Curator, UC Davis Center for Plant Diversity, eadean@ucdavis.edu

The Bryological Works of Rudolf M. Schuster

by John J. Engel, Matt von Konrat, and Yarency Rodriguez, Science & Education, The Field Museum, Chicago, Illinois, USA

Qiu et al. (2013) wrote a detailed article in memory of the late Dr. Rudolf M. Schuster, who was an eminent botanist, hepaticologist, scholar, and world explorer. Dr. Schuster's career spanned almost six decades and had a major impact on botany, specifically hepaticology (the study of liverworts, Marchantiophyta, and hornworts, Anthocerotophyta). A major contribution was the astounding new diversity of liverworts he added to our knowledge. Mostly by himself and through collaboration with a small number of colleagues, he described 463 species, 83 genera, and 15 families new to botany (Qiu et al., 2013). He was ranked in the top ten authorities who had described the most liverwort taxa in botanical history and ranked number one in the 20th century (von Konrat et al., 2010).

Dr. Schuster also provided detailed analysis and evaluation of a number of subjects ranging from comparative anatomy to evolution, phylogeny and classification. Perhaps his best known works include the two multi-volume treatments, the Hepaticae and Anthocerotae of North America, east of the hundredth meridian, and Austral Hepaticae as well as two treatises on the hepatics of Greenland. As discussed by Qiu et al. (2013), R. M. Schuster's contribution to botany went beyond the study of liverworts. He provided pioneering historical biogeographical analyses discussing continental drift, Wallace's Line, and dispersal patterns (Schuster, 1969, 1972). Here we complement Qiu et al. (2013) with an exhaustive bibliography of R. M. Schuster with an effort to establish the effective date of publication (as defined by the I.C.B.N. for many of the references). Effective dates are included in parentheses at the end of the reference. Schuster's extensive publication record is reflected in over 250 publications that includes eight books, 11 chapters, several reviews, and 22 papers that are book-like in length, here assessed at over 100 printed pages. His papers appeared in over 30 scientific journals. Of equal significance and almost unparalleled by any other botanist in the 20th century was the countless hours painstakingly preparing a total of over 1500 illustrative plates throughout his career. As described by Qiu et al. (2013), these received outstanding reviews. The Field Museum is fortunate to have the original plates along with the recent acquisition of his entire herbarium of over 50,000 specimens. To help increase utility, URLs are provided to abstracts or full papers. The Biodiversity Heritage Library is greatly thanked for making many of these available.

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Mesophytification, not mesophication

Use of the term "mesophication" has increased over recent years in the ecological literature (Fig. 1). The term has been used to describe the process by which the species composition of a natural community changes to include a greater percentage of mesophytic species than before. Considering the ecological importance of these compositional changes (Nowacki & Abrams, 2008; Clewell, 2014), it is reasonable to assume that there will be continued interest in studying and understanding this process.

Consequently, a brief note on the proper construction of the term used to describe the process is warranted and a brief review of pertinent suffixes is necessary. The suffixes *-ic, -ify*, and *-ification* are quite useful in respectively forming adjectival, verb, and noun forms of certain conditions (e.g., acidic [adj.], acidify [v.], acidification [n.]; toxic [adj.], toxify [v.], toxification [n.]). In constructing these forms, it is important that the root is maintained, lest the meaning be obscured. For the adjective *mesophytic*, the proper verb form would be *mesophytify*, and the noun for the resulting state *mesophytification* (becoming more mesophytic in character). Although the tonal equivalency of "ph" and "f" appears to make "mesophication" *sound* correct at first listen, further evaluation based on established standards of construction reveals that the term is incorrectly formed, as the root is not maintained.

An appeal is made to continue to follow established standards and adopt "mesophytification" over "mesophication" when referring to an increase in the number of mesophytic species in a community.

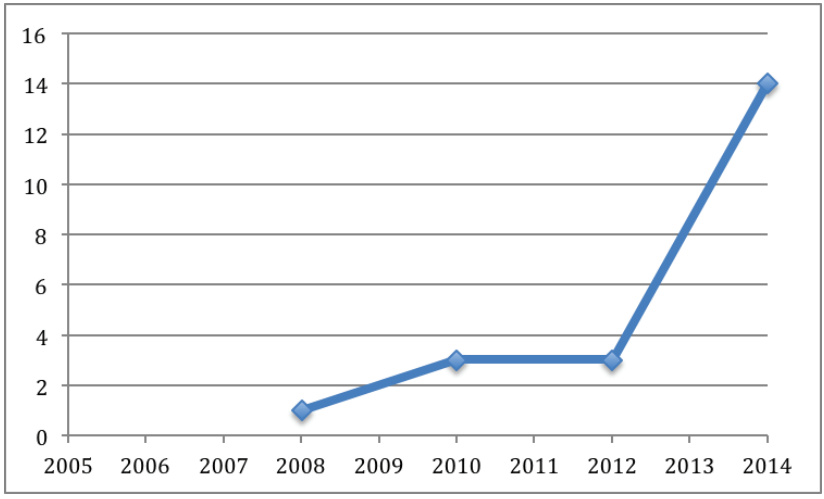


Fig. 1. Number of citations returned from a search for "mesophication" in ISIS Web of Science by year.

Literature Cited

Clewell, A.F. 2014. Forest development 44 years after fire exclusion in formerly annually burned oldfield pine woodland, Florida. *Castanea* 79: 147–167.

Nowacki, G.J. and M.D. Abrams. 2008. The demise of fire and "mesophication" for forests in the eastern United States. *BioScience* 58: 123–138.

— Alexander Krings, Department of Plant and Microbial Biology, North Carolina State University, Raleigh, NC 27695-7612. E-mail: akrings@ncsu.edu

By Catrina Adams, Education Director

BSA Science Education News and Notes is a quarterly update about the BSA's education efforts and the broader education scene. We invite you to submit news items or ideas for future features. Contact Catrina Adams, Education Director, at CAdams@botany.org.

Math and Biology: Improving Students' Quantitative Literacy

In the 21st century it is increasingly important for everyone to be able to make sense of data, understand how to reason quantitatively, and interpret a simple graph, regardless of whether they end up in a STEM career. Data are getting bigger and more easily shared, as when, for example, scientists begin harnessing the power of citizen scientists armed with GPS-capable and camera-ready phones to help expand the reach of their data collection efforts. As charts, graphs, data-dense maps, and infographics abound, it's important to empower our students both to be critical consumers of quantitative information, and to give them the tools to adequately use quantitative reasoning to support their own arguments.

In my efforts with the PlantingScience online mentoring community, I see middle- and high-school students struggle to use the data they have collected over the course of their experiments effectively in drawing conclusions about their studies. Some student groups have beautifully designed graphs and use some basic statistics, while others struggle with the best way to describe differences among their replicates. For many students, PlantingScience represents their first chance to draw their own conclusions using quantitative data. They are proud of the experimental designs they developed, but often struggle to make sense of their data. My observations from PlantingScience echo the 2009 Nation's Report Card, which noted, *"Students were successful on parts of investigations that involved limited sets of data and making straightforward observations of that data. Students were challenged by parts of investigations that contained more variables to manipulate or involved strategic decision making to collect appropriate data. The percentage of students who could select correct conclusions from an investigation was higher than for those students who could select correct conclusions and also explain their results."*

Whether you teach primary or secondary school, undergraduate students, graduate students—or even when discussing the latest infographic-heavy news story at a party—you may have found yourself in a position to help others become more informed about what it means to use quantitative reasoning effectively.

Although basic quantitative literacy is important for all students to help them be informed citizens, it is even more essential for students pursuing a degree in biology to have a firm grasp of data analysis. Students entering graduate school in biology need substantial skills in quantitative analysis, and they may come to their undergraduate institution underprepared. Many of you are experts in bridging the gap between the quantitative literacy that students arrive with in introductory biology courses and what they leave with when they graduate to pursue a career in science or graduate school.

Perhaps you have designed training programs or labs, or use particularly good (or particularly bad) examples to help people get up to speed quickly and add these skills to their toolkit. With so many biologists working to teach these same skills, there is a lot of potential for collaboration around best practices and developing resources. Many of you have created resources that could benefit students beyond your own classes or institution. Why not share and discuss these with a receptive community facing similar challenges?

We are happy to announce that the BSA has recently joined the QUBES consortium and we are looking forward to sharing the efforts of this group towards improving quantitative literacy in undergraduate biology. I'd like to share a recent update from the QUBES leadership team.

*****

QUBES stands for Quantitative Undergraduate Biology Education and Synthesis. We are a group working on developing a synergy of resources for faculty who are interested in incorporating biology into math and math into biology! For example, QUBES facilitates a mentoring program to help instructors implement quantitative skills in biology programs. Two pilot mentoring networks are currently underway: an introductory biology mentoring network at Radford University and a POPULUS mentoring network at the University of Pittsburgh.

QUBES near you: QUBES Leadership Team member D.B. Poli made an appearance at SICB this January. We also recently co-sponsored a summit on undergraduate quantitative biology with a Data Inquiry RCN-UBE at NESCent in February 2015. Upcoming talks and workshops with our leadership team this summer include: ASMCUE (both during and pre-conference), HHMI QuantiBio/BioQUEST, Gordon Research Conference on Undergraduate Biology Education, the Annual Meeting of the Society for Mathematical Biology, and the BOTANY 2015 meeting. Keep an eye out for us, and say hi!

*****

Science teacher Naomi Volain (center right) with former President Bill Clinton and the 9 other finalists for the Global Teacher Prize.

BSA member and PlantingScience high school teacher Naomi Volain honored in Dubai as one of the top 10 teachers worldwide in the Global Teacher Prize

The Global Teacher Prize is an annual $1 million award presented by the Varkey Foundation to an exceptional teacher. US News has dubbed the award the Nobel Prize of Teaching. Naomi Volain of Springfield Central High School was one of the 10 world finalists for the award, and one of three finalists from the United States.

Naomi has been a BSA member since 2010 and has been using PlantingScience regularly in her classroom since 2008. Her classes focus on environmental literacy and outdoor education, and she was instrumental in getting a greenhouse for her school, which she regularly used to teach botany. The greenhouse will be dedicated to Naomi this spring, as she leaves Springfield Central for California.

Naomi is a part of the NASA Network of Educator Astronaut Teachers, and she received the Presidential Award for Excellence in Math and Science and an Honorable mention for the Presidential Innovation Award for Environmental Educators. You can learn more about Naomi and her teaching in this video: http://www.globalteacherprize.org/top-10-finalist/naomi-volain

As botany classes become more rare, it is so important to have such a stellar teacher as a champion on the world stage for the importance of teaching about plants and ensuring that students understand the importance of the environment and the role plants play in their daily lives.

Congratulations Naomi and thank you!

PlantingScience as "Broader Impacts"

by Marsh Sundberg, Department of Biology, Emporia State University, Emporia, Kansas

Last June, a multidisciplinary group of biologists from the University of Illinois reported on their development of a graduate-level broader impacts training course (Heath et al., 2014). The primary driving force was the recognition that federal grant proposals commonly include broader impacts criteria in evaluating grant proposals, and that future scientists—graduate students—are given little if any training in how to accomplish this. Among their course goals were to: (1) introduce NSF's broader impact criteria and train students to design broader impacts into their proposals, (2) introduce how to design, implement and assess informal education outreach, (3) forge community connections, (4) promote communication of science to a broad audience, and (5) provide an authentic outreach experience. Post-course student surveys were highly favorable in response to questions about each of these goals. About half of the faculty mentors of the students in the course also responded to a post-course survey. Of these eight faculty members, three responded that they did not discuss the course with their students at all and three others discussed it only a little. Two discussed the course and broader impacts with their students a lot. Yet all eight responded that they would recommend the course to future advisees.

I suspect that the response of Illinois faculty is similar to what would be found at most institutions around the country. We all understand that to be successful, we must address broader impacts in our grant proposals, and it would be nice if somebody on campus taught our students how to do it and provided us with opportunities to easily participate. However, that's time away from research that I can't afford to take—much less to be involved in developing such a course at my institution.

So, is there an alternative? Yes, of course—***PlantingScience***!

PlantingScience is arguable the most effective training program developed by the Botanical Society in its 100+-year history. Designed in response to a challenge by then National Academies President Bruce Alberts, **PlantingScience** provides for many of the goals outlined by the Illinois group. It is an authentic outreach to schools, and the BSA has designed, and tested, the efficacy of the on-line format. The Master Plant Science Team program provides specific training to graduate student and post-docs on best practices for mentoring students in an inquiry-based format that introduces them to the nature and practice of science. The nature of **PlantingScience** promotes development of a broader learning community consisting of student groups, school teachers and the scientist mentor that typically span across the country and even internationally. Master Plant Science training develops skills at communicating science at a level understandable by high school and middle school students—a necessary skill (and at about the right level) for communicating science to the general population.

LITERATURE CITED

Heath, K. D., E. Bagley, A. J. M. Berkey, D. M. Birlenbach, M. K. Carr-Markell, J. W. Crawford, M. A. Duennes, et al. 2014. Amplify the signal: Graduate training in broader impacts of scientific research. *BioScience* 64: 517–523.

Be Sure to Attend BOTANY 2015: Science and Plants for People www.botanyconference.org

There will be a great line-up of education workshops, including "Planting Inquiry in Science Classrooms" and "Crowd sourcing and citizen science: engaging the public in natural history collections digitization." On Monday afternoon check out a symposium on "Blended Learning and Educational Technology to Enhance Biology," which includes D.B. Poli's talk on QUBES. And don't miss the PlantingScience mixer on Monday evening. We'll also have a PlantingScience discussion section where you can learn more about this program and about mentoring more generally. The Teaching Section has a great lineup of papers and posters this year as well. Check the website for details and schedule updates.

Where Goes the BSA Endowment: A Legacy Yet to be Written

by Harry T. (Jack) Horner, IC Chair, a Past President, and Distinguished Fellow of BSA

As a longtime BSA member (64 years), I have attended all but two BSA annual meetings and have literally rubbed shoulders with some of the best and most famous botanists in the world (in audience at my first talk as a young graduate student were Ledyard Stebbins, Katherine Esau, Ernest Gifford and Vernon Cheadle)! How fortunate (and scared) can one be! And now as a long-time member of BSA, I reflect on how I have committed part of my professional outside-of-the-university time in a variety of ways to the Society—they include financial support, oral and poster presentations, publications in *AJB*, section chair, committee member, Board of Directors and Council member, Treasurer, and yes, President. All of these involvements have been extremely rewarding to me both professionally and personally.

However, one of my most gratifying involvements has been to chair the Investment Committee (IC)—a committee that was created in the early 1990s from my concerns as Treasurer (1986-1992) that the Society funds at that time were not being adequately invested and overseen by any Society committee. This concern became clearer as I became President-elect in 1993-94. In 1993, the Financial Advisory Committee was established and consisted of: Joe Armstrong, Gary Floyd, Chris Haufler (Secretary, ex officio), Jack Horner (chair), Judy Jernstedt (Treasurer, ex officio) and Grady Webster (President, ex officio). The initial goals of the committee were to combine funds maintained in several, unrelated BSA accounts (total of $884,317) and to identify a professional investment firm to manage what has been called since then the BSA Endowment Fund. With the approval of the then Executive Committee, Smith Barney Shearson Investment Firm was chosen to initiate and manage a financial plan that included a diversity of investments from conservative to moderately aggressive.

Since those 'early' days, the goals for the Endowment Fund have remained the same—to enhance growth and protect the Fund, as well as to provide limited funding for Society initiatives. The Financial Advisory Committee name was changed to the IC, the investment firm has remained the same but is now called Morgan Stanley, the IC membership has changed periodically, grown (to eight) and added a student member, and the endowment has grown to about $5 million. The Endowment today includes general BSA funds (largest portion), society section funds, and awards and scholarships funds. The Endowment Fund is diversely invested to optimize return, and the IC oversees and approves any changes recommended by the investment firm.

However, with expanding Society outreach programs and other Society initiatives, and major changes in the publishing industry related to our publications and in particular, the flagship journal—the *American Journal of Botany*—the Endowment Fund is increasingly becoming a source for needed funds to maintain the Society's overall budget. As a result, growth of the Endowment has begun to slow (realizing also the impact on the global economy). These are concerns and challenges facing the Society leadership, and ultimately the BSA membership.

Two major initiatives by the Society have been developed in recent years that hopefully will help to sustain and grow the Endowment Fund to where it needs to be ($20 million) to remain significant in meeting the present and certainly the future financial needs of the Society. The first is the Legacy Society and the second is the Development Committee. The latter group is represented by BSA members who are committed to developing and implementing ideas that enhance the financial well-being of the Society. And the former group are BSA members committed to developing ways to financially support the Society by enlisting members who realize the importance of BSA to society and who are able to contribute financially in significant ways. Together, these two bodies represent the future welfare of BSA and its ability to serve Botany in the broadest sense.

Most importantly, it is all of the BSA members, *like you and me* (emeritus, regular and student members), who must embrace this concept because of who we are and what we believe in—Botany. Such support includes contributing one's time, talents, and (yes) money to the Society, not for just this generation but for future generations who love everything about plants and who realize their critical importance to all humankind. Our commitment, be it $5 a year or $5000 a year to the Endowment Fund, will make a difference! I ask you to become involved, be proactive and support your Society, like other BSA members and I are doing. It is up to you.

A Word from the Education Committee

by Phil Gibson, Education Committee chair

When I began taking on different service activities with the BSA, one of the first things I encountered that caused a bit of confusion was the existence of both a Teaching Section and Education Committee. While they are both very similar and their memberships unified in their ultimate goals of promoting and improving botany education, they approach this goal in slightly different ways.

In terms of the Education Committee, our mission is to serve as the face and voice of the BSA and the botanical sciences in national discussions of STEM education. For example, NSF has recently solicited input from the BSA Education Committee to provide information on how our society has responded to the Vision & Change Report that has been an influential guidepost for innovating and revitalizing STEM education. The Education Committee has also worked with related professional societies to put forth effective ideas about how to more effectively spread information about botanical education at outreach events such as the USA Science and Engineering Festival. We constantly work within the BSA to develop activities that will promote how our membership thinks about formal and informal botany education and how the BSA can support the development of botany educators for the future. For example, one of our plans for the Botany 2016 meeting is to hold a friendly competition among our graduate student chapters to develop a "trunk activity" that can be used as an effective way to teach a botanical concept at a public outreach event. If all goes according to plan, not only will student chapters submit ideas, but we will also try to arrange for an outreach day at an appropriate local venue during Botany 2016 to let students take their projects to the public. These trunk activities could then possibly become a set of resources that the BSA can provide when our membership wants to participate in an outreach event.

During my time as Chair of the Education Committee, I see that the value of this committee is that it provides a way for the BSA to continue supporting education in our chosen field. I'm certain that many of us can think back to the person, perhaps a family member or mentor, who was important in saying something that sparked our interest and promoted desire to further our education in botany. Simply put, the goal of the Education Committee is to make sure that those botanical voices are always there.

Recent Education Committee Activities

- **BSA Booth at USA Science & Engineering Festival, Washington DC**
- **Reviewing and publishing education materials on PlantED Digital Library http://planted.botany.org**
- **Promoting plant walks on Fascination of Plants Day**
- **Vision & Change in Botany Education Symposium at Botany 2014**
- **Botany In A Trunk Education Outreach Contest for Botany 2015**
- **Member of Life Discovery Conference Organizing Committee**

Public Policy News

by Marian Chau, and Morgan Gostel
Public Policy Committee Co-Chairs

In order to better serve the members of the BSA, the Public Policy Committee needs your input to build toward a public policy mission that is in line with the wishes and vision of our membership. In order to do so, we **need your help!** The Public Policy Committee has put together a very **brief, 5- to 10-minute** survey that asks you to share your view of the role public policy plays in botany and the role that **botany should have in public policy**! Your responses will help us pursue activities that reflect the advocacy needs of the Botanical Society of America.

THE SURVEY CAN BE FOUND AT HTTPS://WWW.SURVEYMONKEY.COM/S/DR9GG8C.

Note: ASPT members, we know that you recently took a similar survey, and since many of our members overlap, we will be coordinating or at least communicating on our policy efforts with ASPT's Environmental Policy Committee. However, your response to this survey will still be a great help!

The Public Policy Committee would also like to extend our congratulations to the awardees of the 2015 Public Policy Award, Andrew Pais and Dr. Ingrid Jordon-Thaden.

Andrew Pais is a Ph.D. Candidate in Plant and Microbial Biology at North Carolina State University, and Dr. Ingrid Jordon-Thaden is the David Burpee Postdoctoral Fellow, working with Dr. Chris Martine at Bucknell University. Dr. Jordon-Thaden also currently serves on the Environmental Policy Committee of the American Society for Plant Taxonomists (ASPT).

On May 13 and 14, 2015 Andrew and Ingrid traveled to Washington, D.C. to meet with their elected Congressional Representative and Senators to discuss the importance of federal funding for basic scientific research. We are proud to support travel and attendance to the Congressional Visits Day (CVD), organized by the Biological and Ecological Sciences Coalition (BESC) and the American Institute for Biological Sciences (AIBS) for these early career botanists, who have a chance to speak with policy makers about the critical role of scientific research as constituents, botanists, and high-achieving, early-career researchers.

Keep an eye out for a report on their experiences in the next issue of the Plant Science Bulletin! For more information on CVD, visit http://www.aibs.org/public-policy/congressional_visits_day.html and please consider participating next year! Very few researchers actually discuss their work directly with policy makers and our voices, as both botanists and constituents make a profound difference!

From the *PSB* Archives

60 Years Ago: Dr. Ralph Wetmore made the following remarks regarding the status of Botany in his address as retiring president of the Botanical Society of America.

"We need offer no apologies for our existence. Physics may have, for some time, to be concerned in destruction; botany is concerned in survival. I do believe we must recognize Botany for what it is, a science so concerned in man's affairs that we must see to it that all recognize its value. We must make it command the respect of the administrators, and of our zoological colleagues as well. . . (PSB 1(2):2-3)

50 Years Ago: BSA Merit Awards were presented at the Urbana meeting to:

Daniel Israel Arnon for his contributions to our knowledge of the mineral nutrients of plants and for his distinguished pioneering work on the way green plants utilize the energy of sunlight.

Harold Charles Bold for his classical research on morphology, cytology, and cultivation of unicellular algae and his scholarly surveys of the plant kingdom; an outstanding teacher and considerate editor. (*PSB* 11(2):5)

25 Years Ago: The BSA publishes a Resolution Critical of Transplantation as a Primary Means of Plant Preservation, adopted at the August 1989 BSA Council Meeting in Toronto, Ontario

A Word from the Student Representatives

by Angela McDonnell and Jon Giddens, Student Representatives

How to get the most out of the Botany 2015 conference

It's that time of year again! Our society's annual conference will be held July 25-29 at the Shaw Conference Centre in Edmonton, Alberta. This year, the theme is "Science for Plants and People." To get more information about the talks, symposia, and workshops and to register for the conference, be sure to visit the website (www.botanyconference.org) and the conference app (available this summer). For this issue of the Bulletin, our focus is to provide advice and tips on how to have a productive (and fun!) meeting and how to keep the momentum going after the conference is over.

Pre-conference: Funding

With registration, room, travel, and other costs associated with meeting attendance as they are, you should think of the conference as an investment of sorts. Think about things you can do in advance that will help you get the most out of the short time you're there. It's also important to think ahead about seeking support from multiple funding sources. This skill is useful while you're a student, of course, but it's also a technique many faculty and professionals still utilize to aid their own attendance at professional meetings. While it might be too late this year to apply for funds by the time this issue comes out, remember to apply for the annual BSA sectional grants, enter the Triarch Plant Images photo contest, and seek funding from your own institution. Student Government Associations, including Graduate and Professional organizations, many departments, and various clubs will often award grants-in-aid for conference travel. If you're a member of the ASPT, their travel lottery can also be a great resource in allowing students to pull together funding. By pooling monies from different sources, you can really reduce your out-of-pocket meeting attendance costs. To see the BSA's award application and nomination deadlines, go to http://botany.org/Awards/index.php#deadlines.

Pre-conference: Planning how you'll use your time

Other things to consider before the meeting include utilizing digital media to your advantage. Be sure to follow the societies you are a member of on social media. It's even a good idea to follow the societies you aren't a member of if you know they'll have a presence at the meeting. You never know what sorts of events you could attend or what sorts of information you'll glean! Be sure to find BSA on Twitter (@Botanical_) and Facebook (Botanical Society of America), as there are often posts that are relevant to students, including reminders about various deadlines and events that are of broad interest. Don't forget about the 'Students of the Botanical Society of America' Facebook page, too! We'll be posting there in the weeks before the meeting to remind you about opportunities at the meeting. Another important digital item to keep track of is the conference app. You can look up the conference schedule, find a map of the venue, select items you're interested in attending, and create your own personal schedule via the app. It's also possible to create your schedule through the conference website. In reading abstracts and creating a schedule in advance, you'll be less likely to miss events and you'll make the most of your time there.

At the conference: Important Student Events & Opportunities

While you're at the meeting, you'll probably have a slew of talks and sessions that you want to attend. Those are definitely important, but you should also attend coffee breaks, poster sessions, banquets, and other events as your schedule allows. Those events are where you're most likely to meet people and connect. There are also a few student events we'd like to highlight. First, there is the annual "Careers in Botany: Interactive Career Panel & Luncheon" event that's organized by your student representatives. We'll have panelists from different botanical career backgrounds available to meet with students and give brief synopses of what

they do along with tips and guidance about how to succeed in different career tracks. This event will happen Monday, July 27, from noon to 1:30 and is $5 for students (it also includes a great lunch!). Second, we'll have our annual Student Social Mixer on the evening of Monday, July 27, from 9:00 pm to midnight. This year, we have many more participating societies than usual, so we're making this event a collaboration between the American and Canadian Societies and should be a great party-like atmosphere. The event is $5 and includes a drink ticket and appetizers. We hope you'll join us for networking and socializing! Finally, we're also planning a brief Students of BSA meeting, with the date and time to be announced via Facebook. We hope you'll join us and give us suggestions and feedback to make the conference and the society better for students!

Post-conference: Keep the good things going

After the meeting is over, try not to lose the energy and momentum you may have gained. Follow up with the contacts you made (both faculty and the other students) via email. Don't be afraid to ask for more information about talks that piqued your interest. If you were a PLANTS grant recipient, stay in touch with your mentors. They can be a valuable resource as you develop your career goals and plans. The people you meet at the conference can be instrumental in terms of future research collaborations and career possibilities. The key is to stay in touch and be connected. Be sure to visit and interact with BSA online for society news, links to news articles and current publications, information on job vacancies, and so much more. We look forward to seeing you soon.

Student Events at Botany 2015

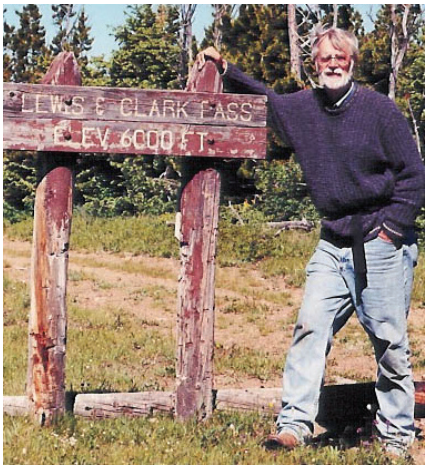
Professional Development Workshop: Graduate School - How to Apply and What to Expect
Sunday, July 26 1:00 pm to 3:00 pm

Non-Academic Botanical Career Panel
Sunday, July 26 3:15 pm to 5:15 pm

Interactive Career Panel & Luncheon
Monday, July 27 noon to 1:30 pm

Student Social & Mixer
Monday, July 27 9:00 pm to midnight at the Craft Beer Market
Sponsored in part by the participating societies and *IJPS*

In *memoriam*



James (Jim) Lauritz Reveal (1941-2015)

Professor James Lauritz Reveal, popularly known to the botanical community as Jim Reveal, died on the 9th of January 2015, at age 73. Jim's unexpected death sent a short wave within the botanical community, triggering emotional comments such as "Jim was much too young to abandon us," "even the most vigorous are mortal," and "one of the most energetic, dedicated, and productive people was lost."

By and large, Jim's research and writing pertained to the Polygonaceae subfamily Eriogonoideae, commonly known as the wild buckwheats in which he had contributed significantly, including volume 5 of the *Flora of North America*, published in 2005. Jim is recognized for his imprint on his special groups, as well as for his reviews of hundreds of articles that helped professionals and students alike.

Jim was born in Reno Nevada in March 1941 and graduated from Sonora Union High School in Sonora, CA in the spring of 1959. After graduation, he spent the summer working for the U.S. Forest Service in the Toiyabe National Forest. That fall, he joined the Utah State University with a major in forestry. In 1961, perhaps influenced from a meeting with Dr. Arthur H. Holmgren, Professor of Botany, he changed his major to botany and chose to study *Eriogonum*. In this regard, besides Prof. Holmgren, Jim received guidance from John Thomas Howell (CAS), Arthur Cronquist (NY), and George J. Goodman (OKL). For his senior Thesis, submitted in the spring of 1963, he prepared a checklist of the Intermountain Flora.

Jim continued his studies at Utah State and received his M.S. in 1965. For his doctoral program, Jim went to Brigham Young University where he worked with Stanley L. Welsh (botany) and LeRoy R. Hafen (western American history). Along with Noel Holmgren (NY; then a Ph.D. student at Columbia University), Jim traveled throughout the West collecting plants for the Intermountain Flora project and their doctoral studies. [Jim's passion for plant collection started quite early; in his high school days, he had collected plants for his advanced biology class.] During his 1966-67 academic year, Jim received a pre-doctoral fellowship from the Smithsonian Institution in Washington, D.C., so he could study numerous critical specimens of *Eriogonum*. During the summer of 1968, along with Janice C. Beatley, an ecologist, Jim worked on the flora of the Nevada Test Site, and this study led to the discovery of five new varieties confined to that site.

Jim had a distinguished botanical career spanning more than four decades. He spent three productive decades of his professional career at the University of Maryland (1969--1999). Immediately after completing his Ph.D. degree in 1969, Jim accepted an assistant professor position at the University of Maryland; in 1981, he became a full professor. For two decades (1979-1999), Jim served as director of the Norton-Brown Herbarium of the University of Maryland.

Besides teaching and herbarium administration, he focused his research on the flora of the Intermountain West, *Eriogonum* and its near relatives, the flora of Maryland, the history of scientific (especially botanical) explorations and discoveries in the West, and detailed examination of the suprageneric names, which eventually resulted in an important database. In this regard, he received funding from the National Science Foundation and other federal agencies. His interest and knowledge on American botanical history led to a project on the colonial flora of Maryland (1680-1725); Jim spent 18 months (1989-90) at The Natural History Museum in London (BM) and focused on American plants named by Carl Linnaeus (1753-1778). This led to Jim's participation in BM's project on the typification of Linnaean names, especially generic names. Jim was instrumental in enabling three

exhibitions of Sloane Herbarium's collections of these Maryland plant specimens in Maryland in 1983.

Jim's research on endangered and threatened species brought him into connection with the following institutions: Atomic Energy Commission (University of California at Los Angeles), the Endangered Species Committee of the National Museum of Natural History (Smithsonian Institution), and the Office of Endangered Species and International Affairs (United States Department of the Interior). Jim was instrumental in attaining the addition of endangered plant species to the original Endangered Species Act. At the 16th International Botanical Congress (IBC), held at St. Louis, MO in Jul-Aug 1999, at the concluding session, a resolution was passed urging the world community to recognize plant conservation as an outstanding global priority, and Jim urged the IBC President, Peter H. Raven, to communicate the same to the United Nations Organization.

Although a proposal on *registration* of plant *names* in the 16th IBC was defeated, Jim was of the opinion that it was only a matter of time for the acceptance of this concept. True to his thought, this principle is mandatory in Mycology and currently being discussed for the Algal and plant groups.

In late 1999, after thirty years at Maryland, Jim chose to retire; the university bestowed on him the honor of "Emeritus Professor." He and his wife, Carmen Rose Broome, moved to Montrose, Colorado.

From 1999 until 2007, he and Rose traveled widely, collecting throughout the West. From 2003 to 2005 they also visited much of the Pacific Northwest and the Great Plains including sites where Meriwether Lewis and William Clark collected plants from 1804-1806. Jim contributed much to the *Discovering Lewis & Clark* project; he coauthored with Scott Earle the 2003 publication of *Lewis and Clark's Green World: The Expedition and its Plants*.

In 2007, Jim chose to move back to the east coast and accepted an adjunct professorship at Cornell University. Perhaps because of his association with BHL, Jim encountered hundreds of names, which were validly published, but remained buried in the horticultural literature. He brought the same to the attention of the *International Plant Name Index* (IPNI) editors.

He was very generous with his time and always willing to share his knowledge and discuss ideas. Jim was very supportive of the *Eriogoum* Society and served as a mentor to the society's members. Dealing with plant nomenclatural discussions on a daily basis was a routine for Jim, and in this regard, he had an excellent relationship with Werner Greuter (B), John McNeill (E), John Wiersema (BARC), and Kanchi Gandhi (GH). His comprehension of complex problems and finding/accepting solutions were usually quick. In 1991 (or so), Jim argued for the authorship of "Nutt. in Torrey and A. Gray" for a name provided by Torrey and A. Gray to which Nuttall provided a description. When Gandhi responded stating that it was Torrey and Asa Gray, who provided a species name to Thomas Nuttall's description, that they did not ascribe the name to Nuttall, and that they are the authors. Jim recognized the logic and instantly agreed.

Jim's skills in fieldwork, floristic studies, taxonomic treatments, nomenclature, reviews for journals, teaching, and lecturing made him one of the few botanists recognized and respected internationally. His long working hours led him to be a prolific publisher, though this may also imply that he spent almost all of his time in academics. Not only he was a teetotaler and a non-smoker, he also avoided caffeine drinks. Jim's unique personality is a reflection of his modesty in all walks of his life and congeniality, which drew appreciation from everyone.

Jim authored and/or coauthored more than 700 plant names at various ranks (infraspecies—superorder). The 1982 publication of *Trillium pusillum* var. *monticulum* Bodikin & Reveal, reported from Virginia, received media attention, because for almost four decades there had not been any discovery of new taxa along the eastern seaboard

Jim will long be remembered for his relentless attention to detail and dedication to high standards, along with a refreshing smile. His enthusiasm for the botanical world captivated those around him for many decades. His website on vascular plant suprageneric names, the only such website (http://www.plantsystematics.org/reveal/pbio/fam/allspgnames.html) available on the web, had made him a formidable figure in plant systematics. As in line with other major international databases, such as the IPNI and Tropicos, Jim updated the data regularly. A summary of his professional career may be found at http://www.plantsystematics.org/reveal/pbio/WWW/cvjlr.html.

In Jim's death, we have lost a great gifted-mind far too soon. Ave atque vale!

---Kanchi N. Gandhi

Book Reviews

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ECOLOGICAL

Darwin's Orchids Then & Now

Retha Edens-Meier and Peter Bernhardt, editors

2014. ISBN-13: 978-0-226-04491-0 (cloth)
ISBN-13: 978-0-226-17364-1 (e-book)
Cloth, US$55.00. 384 pp.
University of Chicago Press, Chicago, Illinois, USA

Reading this book took much longer than I expected because it contains a tremendous amount of interesting and valuable information and also because it stimulates thinking and challenges the imagination. A good subtitle for the book could be a modification of the title of Chapter 2 (by Giovanni Scopece, Salvatore Cozalino [both of the University of Naples Federico II, Italy], and Amots Dafni [University of Haifa, Israel]): "Darwin [snip]: What He Taught Us and What We Can Tell Him Today," because most chapters start with Darwin's work or a reference to it and proceed logically to modern concepts and current research.

Much can be learned from every chapter, because of both the content and the logical progression in which information is given—from Darwin's work and times to the present. This being said, I think that trying to imagine Darwin's reaction to being told "what we can tell him today" is fascinating. I often stopped while reading the book and tried to imagine Darwin being told of what is known today. I also tried to imagine what it would it have been like to have a conversation with Darwin about orchids while standing in his Down House greenhouse (it has been restored and still exists).

My view is that he would greatly enjoy this book, learn from it, be amazed by the advances orchid science has made since his day, be fascinated by the techniques and apparatus used at present, be gratified but not surprised by the fact that all progress did is prove him right, and perhaps be bored by some discoveries made after 1882. Why? Because he predicted at least three of them.

One prediction was his "notion (no … firm conviction)" that germinating seeds "are parasites in early youth on cryptogams!!", i.e., fungi (Darwin, 1863). This was a prediction of the dependency of orchid seeds on mycorrhizae for germination, which was discovered in 1899 (36 years later) by the French botanist Noël Bernard (for a review and discussion see Yam et al. [2009]).

Another, perhaps less direct predication was that pollen contains and/or initiates the production of hormones (now known as auxin and ethylene), which bring about the senescence and death of the perianth of most orchid flowers. Darwin described the effects of pollen as "injurious and poisonous" (Darwin, 1880, 1890) as a result of his correspondence with Fritz Müller (1821–1897), who resided in Brazil. Müller's extensive correspondence with Darwin and his influence on him are discussed in the book. However, Müller's "poisonous pollen" idea is not discussed at length, even if perhaps alluded to.

Darwin was interested in the rostellum and wrote about it. He would certainly be amazed to

learn of its physiological functions and its role in the "injurious and poisonous" effects of pollen. The fact that one substance involved in this is the same substance that causes the bending of oat seedlings toward light would have intrigued him. The rostellum is discussed in this book, but its physiological functions are largely ignored.

His prediction of an insect with a long proboscis that pollinates *Angraecum sesquipedale* ("good heavens what insect can suck it" [Darwin, 1862, pp. 209–211]) brought ridicule at the time and caused Wallace to come to Darwin's defense (Arditti et al., 2012). He would be gratified to learn that today we can tell him that he was right and would be fascinated by photographs and videos showing *Xanthopan morganii praedicta* sucking a flower. How would he react to the use of his prediction in "intelligent design" discussions? And there is more. How would he react to modern orchid genetics, molecular taxonomy of orchids, cladistics and the concepts of ingroups and outgroups in orchid taxonomy, current views regarding plant phylogeny, intergeneric hybrids, and the current popularity of orchids?

As should be obvious from the preceding paragraphs, a short review would not do justice to this excellent collection of chapters. This book requires an essay that would not be appropriate for the *Plant Science Bulletin* and, even if it was, I am not prepared to write it. Therefore, I will limit myself to simply stating that this is an excellent anthology that not only imparts information and knowledge, but also challenges the mind and stimulates the imagination. With that said, I have a complaint about the title vs. the contents. Darwin was interested in much more than orchid flowers and pollination, but this is what the book deals with mostly.

–Joseph Arditti, Professor Emeritus, Department of Developmental and Cell Biology, University of California, Irvine, California, USA

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Essentials of Conservation Biology, 6th edition

Richard B. Primack
2014. ISBN-13: 978-1-60535-289-3
Hardcover, US$94.95. 603 pp.
Sinauer Associates, Sunderland, Massachusetts, USA

Having not read the earlier editions of this book, I decided to try to compare it to a similar book that I have read. The *Principles of Conservation Biology* (3rd edition) text by the same publisher but by different authors covers largely the same material (Groom et al., 2006). The current volume is directed more toward undergraduates, whereas the volume by Groom et al. is meant for more advanced courses based on reviews that I found on each volume. I have read sections of the volume by Groom et al. for graduate courses and think that it is probably a little more technical, with specific statistical methods and more in-depth case studies.

Essentials of Conservation Biology does have a lot to offer and is a well-written text, with current examples up to and including papers from 2014. Terms are well defined in the text, and the history of conservation biology as a field is well explained. Chapters are engaging and well thought out, including box articles, summaries, and suggested readings for each chapter. Terms such as *biopiracy* (collecting specimens without a permit) show the author's commitment to current events.

A great article (Box 6.2) in Chapter 6 discusses the role religion plays in conservation and how the attitude has begun to change over the years from one of dominion to that of stewardship. This chapter on ethical values also includes a discussion on the

intrinsic value of a species. Chapters on extinction, vulnerability to extinction, and habitat destruction tie together well the myriad of issues, including climate change, that endemic and imperiled species are facing. The discussion of the minimum viable population concept in Chapter 11 includes a recent study from 2013 that showed long-lived species such as turtles can stay viable even at smaller population sizes than expected.

Chapter 12 includes a reference to the new field of using environmental DNA (eDNA) to determine the potential presence of rare or cryptic species that can be difficult to locate during audio or visual surveys. An interesting section in Chapter 13 details how rare plants can be difficult to reintroduce due to their potentially requiring specific conditions (e.g., soils, light, nutrients). The section discusses how transplanting adult plants may work better than seeds but care should be taken to match donor sites with suitable transplant sites.

Chapters 15–17 deal with protected areas and the challenges they face. These areas need to include corridors between suitable habitats that are also protected to allow for areas to be re-populated in the event of a fire or other disturbance, as well as to promote gene flow between populations. Using a rapid biodiversity assessment tool is also discussed as a means to inventory the communities and species present, like a BioBlitz event tries to accomplish. The debate between single large or several small (SLOSS) protected areas is also discussed, although which approach is preferred seems to depend on the needs of the target species. Chapter 19 on restoration ecology discusses the importance of reference sites and knowing the potential a site can hold. This could probably be tied into what the Natural Resources Conservation Service has done in the western United States with ecological site descriptions (NRCS, 2014). Chapter 20 dives into the debate about conservation and sustainable development, which relies upon regulation and finding common ground (e.g., changing zoning to allow for cluster development) that includes conservation easements and open space. Finding ways to benefit both parties encourages stakeholder participation. Chapter 22 closes the volume with a discussion of the importance of citizen science in determining trends and providing valuable data. These data can be used in management decisions and would be costly to obtain without volunteers. This book would be a useful addition to any class—undergraduate or graduate—on this topic, especially with the suggested readings and incorporation of current research.

–David W. MacDougall, CWB Consulting Biologist (https://www.linkedin.com/pub/dave-macdougall-cwb/a/385/160)

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ECONOMIC BOTANY

Ireland's Generous Nature: The Past and Present Uses of Wild Plants in Ireland

Peter Wyse Jackson
2014. ISBN-13: 978-0-915279-78-4
Hardcover, US $60.00. xii + 750 pp.
Missouri Botanical Garden Press, St. Louis, Missouri, USA

This volume on Ireland's ethnobotany is generous in size, in breadth of coverage, and in interesting information about how the Irish have used plants since ancient times. Peter Wyse Jackson served for several years as director of the National Botanic Gardens of Ireland, at Glasnevin, Dublin. He has since become president of the Missouri Botanical Garden in St. Louis, and it is that garden's press that produced this well-organized volume. In the interests of full disclosure, I should say that both my parents were raised on farms in Ireland, and I am old enough to remember visiting Ireland when thatched cottages were not just tourist attractions and when peat fueled the fires we sat around in kitchens and parlors. I should also note at this point that Wyse Jackson's Ireland is a geographical rather than a political unit; he is referring to the entire island, including Northern Ireland, which is part of the United Kingdom.

Wyse Jackson is almost a decade younger than me, but he too remembers some of the traditional uses of plants that have faded away in Ireland as elsewhere. He also draws on the work of many others who over the years have documented medicinal and other plant uses by the Irish. The book is definitely in the tradition of works attempting to preserve

and encourage the native Irish culture, a culture that over centuries was suppressed by British occupation. This is where my prejudices surface, having lived with a very patriotic Irish mother. However, Wyse Jackson himself plainly makes this point in his introduction. He also notes that after the country recovered from the potato famine, the use of wild plants as food was denigrated because it was considered a sign of poverty and triggered memories of when foraging was a necessity.

A work that is meant to be as comprehensive as Wyse Jackson has aimed for here must be well organized if it is to be at all useful. He manages this successfully and begins with a brief introduction followed by a chapter on historical plant use. Then there are lengthy chapters on the use of plant materials in construction and crafts, as food, and as medicine. There are brief treatments on horticulture, plants as symbols (have to get the shamrock in there), and non-native plants; one on drift seeds and fruits is particularly interesting because the Gulf Stream carries tropical seeds to Ireland's western shores.

The bulk of the remainder of the book is devoted to a systematic list of Ireland's wild plants and their ethnobotanical uses, although even plants that have no known uses are given a mention. Not surprisingly, flowering plants receive the most attention, although the chapters on conifers and ferns have fascinating information, such as the use of pine logs dug up from peat bogs, and bracken mixed with straw as bedding for livestock. There is also a catch-all chapter on "Algae and Miscellaneous." With such a long coastline and a poor population, Ireland made good use of the seaweed that ended up on its shores for everything from medicine to food and even seaweed tea.

The entries are alphabetical by genus, with the full scientific name given. This ordering can be a little annoying because it would be nice to easily compare the uses of plants in the same family. However, the family name is provided along with common names, both English and Gaelic. Since the founding of the Republic of Ireland in the 1920s, there has been a serious effort to maintain the Gaelic language and to encourage its use. Wyse Jackson mentions the need to document Gaelic plant names as one of the aims of his book, and he not only gives the names, but references for each. He also draws on a wide variety of sources in his descriptions of how plants have been employed since ancient times, when that information is available. He doesn't neglect the plants the druids used in ancient times nor Viking habits when such information is available. For example, he mentions that wild celery roots were found in deposits dating back more than one thousand years in excavated pits at Fishamble Street in Dublin. In many cases, he writes about his own experiences—encounters with people who remember plant use in the past, meetings with those who still make such concoctions as jelly from hawthorn berries, and descriptions of various wild plant recipes he has prepared and eaten. He obviously relishes his subject and spent years amassing the information found here.

A book on plants that is aiming for a wide audience needs images, and this book is richly supplied. While there isn't a photograph for each plant, there is usually one for those with substantial entries. In addition, there are many photos of plant products, such as a chair with a straw-rope seat, an early 20th-century willow lobster pot, and a traditional boat called a coracle made from hazel rods. At the beginning of each chapter as well as scattered throughout the book are color reproductions of botanical watercolors done by Lydia Shackleton who worked as an illustrator at Glasnevin for 23 years, until 1907. These are a beautiful addition and another way in which Wyse Jackson is attempting to preserve Ireland's cultural heritage. And there is one more visual aspect that is particularly helpful: a pictogram system to denote plant use. In small black squares are such symbols as a white cross for medicinal use, a knife and fork for food, a flower for horticulture, even a harp to represent plants that are used to make musical instruments—harps, flutes, and bagpipes. These symbols would be particularly useful when leafing through the book with a particular function in mind.

Ireland's Generous Nature is definitely meant to be browsed rather than read straight through. Almost every page has something intriguing as Wyse Jackson doesn't limit himself to Irish uses of plants, but mentions ethnobotanical practices in other regions. However, his focus is on Ireland, the country he obviously loves and whose plants he knows intimately. While this is not an inexpensive book, it is definitely worth the price, not only because of its sturdy construction, profusion of illustrations, appendix of plant names that appear in Irish place names, and excellent bibliography, but because of the vast amount of information it

contains. In his introduction, Wyse Jackson writes that he undertook this project because when he went looking for information on Irish ethnobotany, he failed to find one usable resource; he had to go hunting in many. His solution was to write his own book, and he has definitely achieved his purpose, providing a comprehensive and heavily documented guide.

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PHYSIOLOGICAL

Plant Behaviour and Intelligence

Anthony Trewavas
2014. ISBN-13: 978-0-19-953954-3
Hardcover, US$94.95. 320 pp.
Oxford University Press, New York, New York, USA

The current volume is engaging, interesting, and thought provoking, with deep commitment and introspection into the world of plant behavior and intelligence from a multi-disciplinary and multi-dimensional perspective and is, most possibly, the first volume of its kind. The author explains the topic with simplicity, focusing predominantly on angiosperms (dicots) for the majority of his argument, a philosophical quest regarding plant intelligence that possibly raises more questions than answers. The volume is an intelligent mix of plant signaling, ecology, and behavior from the perspective of the latest research and traditional observations in plant sciences.

The volume is divided into an excellent preface and foreword (prologue), followed by 26 chapters and a helpful index at the end. Each chapter has a synopsis of the content at the beginning and a short reference section at the end. The author goes back to basics first and traces a well-worded evolutionary pathway for the plant, including establishment of multicellularity, convergent evolution, and the complexity of plant life in the context of angiosperms (Chapters 1–7). Next, the author steps into varied aspects of plant behaviors and self organization (Chapters 8–16), interpretation of game theory from the perspectives of plant competition (Chapter 17), ecological competition and cooperation between plants and recognition of self (Chapter 18), and finally elaborates on plant intelligence (Chapters 19–26). The language is kept simple and engaging, but is technical at necessary points.

The central theme of the volume stems from an outstanding observation by Nobel laureate Dr. Barbara McClintock: "A goal for the future would be to determine the extent of knowledge the cell has of itself and how it uses that knowledge in a thoughtful manner when challenged." The author explains how that challenge is responded to by plants, in the form of intelligent behavior, in order to cope with the challenges presented by the external and internal environment. The author establishes the concept quite meaningfully, with numerous examples from the natural world where plants are exposed to innumerable challenges and obstacles to successfully carrying-out and completing their normal life cycles. Several plant responses to their immediate environment and the unique ecosystems of which they are an integral part are conceived as intelligence and meticulously explored from the perspective of complex cellular architecture and metabolism, as well as from the standpoint of evolution. The author convincingly explains that the perpetual question of the animal brain as the cornerstone of the animal nervous system does not exist in plants and has been replaced by a highly intelligent genome that has shaped and designed itself in its evolutionary path to establish plant intelligence through numerous adaptations over the geologic past.

The basic questions are: Does intelligence always have to be equated with a nervous system? Can a biological system operate successfully without the so-called nervous system as observed in animals? The author must be commended for coming up with this fundamental idea and in opening a new field in plant science based on the integration of plant signaling, behavior, and behavioral ecology. By formulating these ideas, the author has jumped into an ocean of critical arguments and in-depth discussion explaining plant behavior and intelligence from a novel angle. To illustrate his points, the author discusses several pertinent examples from the plant world, highlighting morphological and anatomical adaptations, complexity of tissue systems and organizations, and the roles of different organs. Critical analysis of the physiological, biochemical, molecular, and genetic aspects of plant metabolism; sexual and reproductive systems and breeding behaviors; roles of different plant hormones and genetic regulation of plant behaviors; molecular signaling;

and advances in genomic sciences are all taken into consideration. The author highlights different scenarios of severe competition and cooperation between plants in the wild, their ecological implications, and how plant behavior moderates/regulates such behaviors, indicating different forms of intelligence in them. The author must be commended for his relative ease in moving back and forth among different kingdoms of life forms (bacteria, myxomycetes, fungi) and connecting them to his elaborate arguments. It has been delightful to note how the author successfully connects and balances his arguments, incorporating notes and observations made by Lamarck and Darwin, extensive studies on the plant nervous system by Sir J. C. Bose, and thought-provoking suggestions made by McClintock, to the latest modern-era plant genomic researchers with elegance and criticism.

The author convincingly suggests that the central dogma of intelligence is not simply restricted to the brain and nervous system, but has a more complex, multi-dynamic plant perspective that is overlooked by the majority of our scientific community. The author successfully links ecological and evolutionary perspectives of plant intelligence with highly advanced genomic sciences in exploiting the concept of "intelligent genetics" and "intelligent genomes." The author moves a step forward from the context of present-day science in explaining why plants behave in a specific manner under specific ecological and environmental conditions based on evidence provided through the latest molecular, biochemical, molecular genetic, and genomic research. The author provides a much broader definition of intelligence in the real sense of the term, stretching it beyond our brain-oriented and nervous system–specific notions.

The edition would be improved by the incorporation of additional plant groups, such as bryophytes, pteridophytes, and gymnosperms, into the discussion. Adding representative plant images, word diagrams, and flow charts to present some of the more-complex theories would better enable students and non-academic plant enthusiasts to understand the underlying principles with ease. In addition, more discussion of allelopathy and the different types of symbiosis observed in the plant kingdom and how these are associated with plant intelligence would have been greatly appreciated. The volume will be useful for both undergraduate and graduate students of botany, plant science, forestry, plant ecology, and evolution. This could also be helpful for introductory courses in biology, biological sciences, life sciences, and environmental sciences and as an introductory resource for agriculture courses. Enthusiastic readers outside academia interested in plant life, ecology, and evolution will also find this volume engaging.

—Saikat Kumar Basu, University of Lethbridge, Alberta, Canada

SYSTEMATICS

CITES and Cacti: A User's Guide

Maurizio Sajeva, H. Noel McGough, Lucy Garrett, Jonas Lüthy, Maurice Tse-Laurence, Catherine Rutherford, and Guilia Sajeva
2013. ISBN-13: 978-1-84246-485-4
Paperback with CD, US$50.00. 90 pp.
Royal Botanic Gardens, Kew, Richmond, Surrey, United Kingdom

This is not a book, but a PowerPoint presentation that was printed and bound regarding the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) data as applied to the cactus family. Notes to the presenter are included at the bottom of a few of the slides, but no real analysis or synthesis is provided.

The CD-ROM contains all of the images in the book, plus some other tangentially related files. The disk contains corresponding volumes on CITES and succulents, CITES and carnivorous plants, CITES and orchids, etc. This is a real bonus. However, I could not figure out how to make the CD-ROM searchable, which is regrettable given that the book lacks an index.

There are a few excellent notes on trade of various species, including method of propagation and comparisons over history, which I assume are from the CITES trade database. Some taxa have one year in which there were many more recorded exports than other years. However, I cannot discern any patterns. Are these export peak years due to fad for a taxon? Are these export peaks due to increased interdiction? It would have been nice to know which export numbers were for legally versus illegally exported plants.

Perusal of this book/slides surprisingly indicates that from 1998–2008 my home (Canada) was the world's leading exporter of most Appendix II cacti, such as *Astrophytum*, *Copiapoa*, *Echinocactus*,

Echinocereus, *Eriosyce*, *Escobaria*, *Ferocactus*, *Frailea*, *Leuchtenbergia*, *Mammillaria*, *Matucana*, *Melocactus*, *Neolloydia*, *Parodia*, *Rebutia,* and *Thelocactus*. The book/slides also states that Canada was one of the three leading exporters of Appendix I cacti from 1998–2008. [Thanks to Catherine Rutherford who verified that the CITES trade database shows that Canada was indeed a huge exporter of cacti.] I have hardly ever seen cacti commercially grown or sold in Canada, so am shocked. Canadian climates are not conducive for growing cacti (Gorelick et al., 2015). As I write this, it is –25°C outside (without wind chill), and I am only 100 km north of the U.S. border. Who in Canada was doing the exporting? Was it legal or illegal? Did it vary from year to year? Can we see the import, export, and re-export data, as was done by McCarthy (1987)? The data are tantalizing, but narrative and explanation are desperately needed.

All cacti are native to the Americas except for one species, yet the authors are solely European. Local knowledge matters (Kimmerer, 2013; Demaio and Chiapella, 2014), with lack of local knowledge frequently to the authors' detriment. Maps in this book/slides fail to include Alaska as part of the United States. The authors describe how cultivated *Pachycereus militaris* cuttings of reproductive shoots "cease to grow as cuttings start to branch with time below the cephalium. The plant then directs all resources to the new shoots and the cephalium withers." Well, that is also exactly what happens on perfectly healthy attached shoots of plants in the wild, in which mature cephalia naturally abscise (Mauseth et al., 2005). European bias also shows in the assertion that, "Until recently there was some confusion over boundaries between *Coryphantha* and related genera." Judging from the vigorous debates between Europeans and North Americans about whether *Escobaria* is a genus versus subgenus or section of *Coryphantha* (Gorelick, 2015), it is disingenuous to claim that the confusion is resolved. The authors also seem to entirely disregard the raging debate about whether *Trichocereus* is a valid genus, separate from *Echinopsis* (Albesiano and Kiesling, 2012). While usually the name game is not important, it is important to know synonyms when looking for illegally exported plants, especially because *Trichocereus* and *Eulychnia* are the main sources for rainsticks.

Having maps with a resolution only to country is probably appropriate for a political document such as this, but can be misleading. The map of global abundance of cacti herein has a huge number of African countries and Sri Lanka with the same number of species of cacti (here 1–75), as do countries in Central America and northern South America. Yet Africa and Sri Lanka only have one native cactus species, *Rhipsalis baccifera*. Similarly, distribution of the narrow endemic *Astrophytum asterias* is shown as all of Mexico and the United States, which could needlessly minimize conservation concerns.

This book/slides contains outdated nomenclature, such as *Opuntia ursina*, which is almost universally considered a shaggy-spined form of *Opuntia polyacantha* (Pinkava, 2003). There are old notions about *Pereskia*, which probably should be segregated into the two separate genera *Pereskia* and *Leuenbergera* (Edwards et al., 2005), and old notions about *Maihunenia*, whose two species probably deserve their own subfamily, Maihuenioideae (Parfitt and Gibson, 2003). Equally curiously, the page/slide on leaf-bearing cacti mentions *Pereskia*, *Quiabentia*, and *Pereskiopsis*, but not *Maihuenia*.

The second page/slide lists the bullet point, "AP vs. wild," where we later learn that "AP" stands for "artificially propagated." For one taxon, we read, "All trade is recorded as artificially propagated and is mainly in seeds." What exactly is artificial about propagation by seed? In the taxon-specific slides, the dichotomy is sometimes instead couched as "wild vs. propagated," sometimes as "habitat vs. propagated," and sometimes with all three designations ("wild, habitat, propagated"). Another false dichotomy occurs in the bar charts for exports, for which data are given for both "live" and "seeds." I assume "live" means "live shoots," even though seeds are also alive. That said, in Appendix II slides for a small minority of the taxa presented, bar charts for exports instead provide the more reasonable dichotomy of "stems vs. seeds."

This may make for a decent slide show, but more editing and reviewing should have occurred. For example, the specific epithet is inadvertently capitalized in *Matucana madisoniorum*. We read the nonsensical sentence, "Recently there has been some concern expressed by experts that there may be some element of detriment in the trade" of rainsticks. The authors state that *Strombocactus* is monotypic and *Pelecyphora* contains two species, but then seem genuinely surprised that only one species of *Strombocactus* and two species of *Pelecyphora* are listed in the CITES trade records. Some statements are utterly antithetical,

such as that *Blossfeldia* is endemic to Bolivia and northwestern Argentina, but that all wild collected plants are exported from Peru, not from either of its native countries.

Because this is a user's guide of PowerPoint slides, a revision could be published with relative ease. There is a genuine need for such multimedia presentations on CITES and cacti. Several experts from the Americas would undoubtedly be willing to help.

—Root Gorelick, Department of Biology, School of Mathematics and Statistics, and Institute of Interdisciplinary Studies, Carleton University, Ottawa, Ontario, Canada

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Anatomy of the Monocotyledons, Vol. X: Orchidaceae

William Louis Stern
2014. ISBN-13: 978-0-19-968907-1
Hardcover, UK£95.00. 288 pp.
Oxford University Press, Oxford, United Kingdom

This book is the latest addition to the *Anatomy of the Monocotyledons* after the publication of the previous volume in 2002 (on Acoraceae and Araceae) and is the result of over 30 years of effort and devotion by William Louis Stern, a renowned botanist who has conducted multiple studies in wood anatomy and identification, tropical forestry, and lately about relationships among members of the orchid family. Orchidaceae are one of the most cosmopolitan vascular plant families and, by far, the largest group of seed plants when considering the number of species described. Recent studies estimate an occurrence of 26,972 species of orchids distributed into 619 genera that are found in a wide variety of habitats. It is likely that even more occur in nature as new species are described every year, not to mention the thousands of varieties that have been produced in past decades. Orchid culture is nowadays a billion-dollar global enterprise with beguiled buyers. But, surprisingly, much information is still lacking about basic biological features like the type of mycorrhizal associations or even the type of pollination. This book is, therefore, a good addition to fill this gap by revealing the most important anatomic features within the main groups of orchids.

Within the book, the reader will find the most-comprehensive study of the vegetative anatomy of orchids, with specific notes about the structure and relationships among cells and tissues of leaves, stems, and roots across members of the orchid family. Within 255 pages, the work provides an up-to-date analysis of the vegetative anatomy of this family and, unlike other studies, it is organized systematically according to the latest orchid classification expressed in *Genera Orchidacearum*. Because it is illustrated with more than 100 photographs and detailed cellular illustrations, it is easy to differentiate structures

between different species of orchids. The drawings and SEM photographs are of excellent quality and clearly reflect the writings emphasized in the main text. Within each tribe and subtribe studied, there is a detailed description of the material examined together with a very instructive section about other reports from the literature. Taxonomic notes and the latest phylogenetic results are also included, as well as six tables containing a resumé of diagnostic characters.

I recommend this book for any botanist who wants to learn more about the anatomy of orchids but, above all, it should definitely be used when teaching the anatomy of orchids to young research students and orchid scientists.

—Isabel Marques, Biodiversity Research Centre, University of British Columbia, Vancouver, British Columbia, Canada

Catálogo de las Plantas Vasculares de Bolivia, Vols. 1–2

Peter Møller Jørgensen, Michael Harley Nee, and Stephan Georg Beck, editors
2014. ISBN-13: 978-1-930723-71-9
Hardcover, US$125.00. 1741 + viii pp.
Missouri Botanical Garden Press, St. Louis, Missouri, USA

In terms of botanical publications, Bolivia has been somewhat behind many other South American countries. Publications of several multivolume Floras were in progress for a long time (e.g., Argentina, Chile, Colombia, Ecuador, Guianas, Paraguay, Peru, Venezuela), and some extensive catalogues of vascular plants have been published recently (Cono Sur, Ecuador, Guiana Shield, Peru, Venezuela). *Catálogo de las Plantas Vasculares de Bolivia* fills in a big gap in our knowledge of the South American flora.

The introduction (pp. 1–81) presents a description of the vegetation zones in the area, a history of botanical collections, and, in 11 tables, extensive numerical analyses of the flora. In the two volumes of this catalogue, 15,345 accepted species are listed alphabetically by families (286) and genera (2782), and documented with bibliographic citations, references to herbarium specimens, and information on their distribution, habit, native status, elevation ranges, and synonymy. More than 22,300 synonyms are treated in this catalogue, and all are listed in the index (p. 1381–1721). There are 2343 endemic species (16.2% of the native flora) and 694 commonly cultivated species in Bolivia. It is not clear what makes the distinction between adventitious (*adventicias*) and naturalized (*naturalizadas*) species (267 and 221 species, respectively, p. 33). Many species classified as adventitious are most likely fully naturalized (e.g., *Arundo donax*, *Hyparrhenia rufa*, *Malva parviflora*, *Melinis minutiflora*, *M. repens*, *Panicum maximum*, *Rubus rosifolius*, *Vulpia myuros*). Therefore, the number of naturalized species will be probably

	Area (km^2)	Native species	Naturalized species
Angola[1]	1,246,700	6735	226
Bolivia	1,098,581	14,508	221+
Chile[2]	756,096	4295	743
Ecuador[3]	283,560	16,461	251
Peru[4]	1,285,216	ca. 18,000	200+
Queensland[5]	1,852,642	8344	1191
South Africa[6]	1,221,037	19,581	915

[1]Figueiredo and Smith, 2008; [2]Moreira-Muñoz, 2011, Fuentes et al., 2013; [3]Jørgensen and León-Yánez, 1999, Ulloa Ulloa and Neill, 2004; [4]Brako and Zarucchi, 1993; [5]Bostock and Holland, 2007; [6]Germishuizen et al., 2006.

around 300. The widespread orchid *Oeceoclades maculata* is not native (p. 955), but naturalized, introduced from Africa (Cohen and Ackerman, 2009; Kolanowska, 2014).

Comparison with six other areas of the Southern Hemisphere puts the species richness of the Bolivian flora into a broader perspective.

Considering areas of the countries listed above, the flora of Bolivia is among the richest, but, obviously, there is a gradient of increasing plant species richness toward the equator in South America and the richness of the South African flora is truly exceptional. Unfortunately, we will still have to wait for reliable numbers of vascular plant species from two South American plant diversity superpowers—Brazil and Colombia.

The *Catálogo de las Plantas Vasculares de Bolivia* is a monumental achievement. Together with other catalogues recently produced by the Missouri Garden Press, it will be an irreplaceable source of information for botanists and ecologists working in tropical South America.

–Marcel Rejmánek, Department of Evolution and Ecology, University of California, Davis, California, USA

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Weeds of North America

Richard Dickinson and France Royer
2014. ISBN-13: 978-0-226-07644-7
Paperback, US$35.00. 656 pp.
University of Chicago Press, Chicago, Illinois, USA

Weeds of North America is a comprehensive field guide including over 600 plants that are common weedy species across the continent. In general, I would expect that a field guide to plants of North America would be too broad a geographic area to be very useful. But weeds are the exception; they are often generalists by nature and spread quickly, and therefore tend to be ubiquitous and widespread, making a useful continent-wide field guide to weeds possible.

I usually prefer field guides with dichotomous keys, which this book does not have. But dichotomous keys can be limiting for the layperson not trained in biology or botany, and there can be a certain value in a key that is friendlier to untrained users. This guide does have a key, based upon plant type (trees, shrubs, herbs, vines, etc.), leaf arrangement, and flower color. It is surprisingly easy to use, particularly because a thumbnail photo is included in the key itself for each plant listed. Once the reader determines the plant type, leaf arrangement, and flower color, one can easily glance over the thumbnails of the plants that fit that combination of characteristics and find the one(s) that match the plant one is identifying.

The key then sends the reader to the page for that plant in the guide, where the reader finds a host of great information about many of the species. About 250 plants are covered in a very extensive, full entry, while another 350 are described in a more abbreviated form. Scientific and common names are listed, including authorities and synonyms. For each full entry, there is an extensive, detailed description of the species, including characteristics of the seed, seedling, leaves, flowers, and fruits. Full-color photos (or, in some cases, line drawings) accompany each main species entry, including

pictures of seeds, seedlings, and full-grown plants, as well as, in many cases, key characteristics such as fruits or flower structures. Information is also given on origin, life cycle, weed designations, and reasons for concern.

Within the guide, species descriptions are arranged by family, and the first page of each family section includes a good description of family characteristics. In addition to the key species featured within each family section, there is a section on "Other species of concern" in each family where more species are listed with shorter entries that include origin, species descriptions, weed designations, and in many cases, a drawing or photograph.

The back of the book includes a glossary of terms used, including illustrations for many of the terms. There is also an index listing species by common and scientific names, and I am pleased to find that species are listed by all common names listed in the entries, as well as by synonyms of scientific names.

In general, this guide is well organized, easy to use, and very informative. I often find that field guides are either geared well to amateurs or to botanists but not both. In this case, the authors have done an unusually admirable job straddling the line between being user-friendly to non-scientific audiences and being a relevant and well-researched resource for scientific audiences. Both audiences will find this guide a desirable addition to the botanical library.

–Amy Boyd, Department of Biology, Warren Wilson College, Asheville, North Carolina, USA

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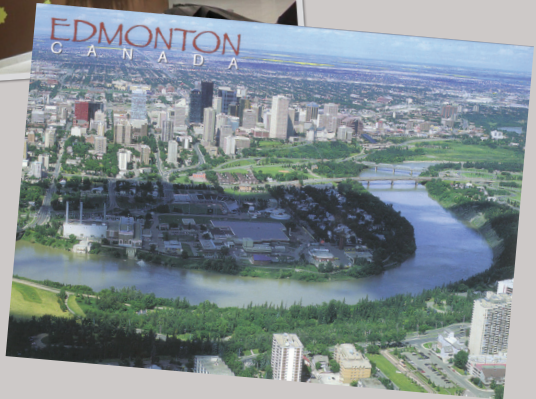

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Plant Science Bulletin

Botanical Society of America

ISSN 0032-0919
Published quarterly by
Botanical Society of America, Inc.
4475 Castleman Avenue
St. Louis, MO 63166-0299

Periodicals postage is paid at St. Louis, MO & additional mailing offices.
POSTMASTER:
Send address changes to:
Botanical Society of America
Business Office
P.O. Box 299
St. Louis, MO 63166-0299
bsa-manager@botany.org

The yearly subscription rate of $15 is included in the membership

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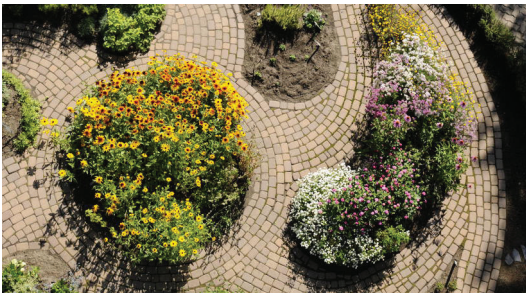

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