# PLANT SCIENCE BULLETIN

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# From the Editor

Greetings!

This is the first issue of *Plant Science Bulletin* of 2017. This new year is already proving to be a challenging one for many, including those of us who work in science and education in the United States. Nearly every day, scientific knowledge is being disputed, groundbreaking environmental legislation is being attacked, and the global network of scientists is being threatened. As botanists, we have the responsibility to act in whatever ways we can, individually and as a group, to mitigate the actions of an administration that is blatantly anti-science.

Some action is underway. In January, the BSA co-signed a letter with 151 other scientific entities protesting the Executive Order on Immigration banning travel from seven Muslim-majority countries. This letter pointed out that scientific progress requires the flow of ideas and people across borders. The BSA is once again supporting the travel of two members to the 2017 Biology and Ecological Sciences Coalition Congressional Visits Day and, in conjunction with ASPT, supporting local efforts with the Botanical Advocacy Leadership Award. Individual BSA members are planning to participate in the March for Science in Washington, DC in April.

It is my hope that we, the Botanical Society of America, will be at the forefront of this fight as it continues, providing avenues for action and support for other members and representing plant science within the broader scientific community. After all, as the BSA twitter feed is fond of reminding us, we are #notaquietscience.

Mackenzie






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Fort Worth ★ Texas

Are you ready for Botany 2017?

Fort Worth, Texas
June 24 -28

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- *Annals of Botany* Special Lecture - Anna Traveset
- Regional Botany Special Lecture - Barney Lipscomb and Jason Singhurst

## What can you expect from BOTANY 2017?

It is one of the friendliest places to present your research, make connections, and find collaborators.

***"The size of the Botany Conferences is perfect, not too big or too small," says Dr. David Gorchov. "And, I am exposed to the cutting edge research outside my discipline of ecology."***

***Dr. Ranessa Cooper started coming to BOTANY conferences as an undergrad 20 years ago. "This is my meeting," she stresses. "There is no better meeting to adopt. I love to come because of the great people and the breadth of science."***

## You are going to love our location!

Sundance Square and Downtown Fort Worth have so much to offer!
Other than great places to eat and drink, from cheap to fancy, be sure to devote a few hours to walking around and visiting the shops, the Sid Richardson Art Museum, Bass Hall, the Water Gardens, and more.
Molly the Trolley runs through downtown Fort Worth 7 days a week from 10am -10pm. Best of all—it's free!

Botanical Society of America · The American Fern Society · ASPT · Society of Herbarium Curators · iapt · abls American Bryological and Lichenological Society

**Register now**
**www.botanyconference.org**

# SOCIETY NEWS

## Public Policy Awards, 2017

Congratulations to Andre Naranjo and Maribeth Latvis, Ph.D., recipients of the 2017 BSA Public Policy Award, and Christopher Tyrell, recipient of the ASPT Congressional Visits Day Award! Andre, Maribeth, and Christopher will be traveling to Washington, DC to participate in the 2017 Biological and Ecological Sciences Coalition Congressional Visits Day (25–26 April 2017). Look for a write-up of their experiences in the next issue of the *Plant Science Bulletin*!

## ASPT and BSA at Plant Science Research Network

The Steering Committee of the Plant Science Research Network (PSRN) met February 9-10, 2017, in Tucson, AZ to discuss the current draft of the National Plant Systems Initiative (NPSI) and review progress on strategic planning for Plant Science, particularly in the areas of Training, Cyber-infrastructure, and Broadening Participation. The NPSI document was created by the PSRN, which is an NSF-supported Research Coordination Network ultimately consisting of 15 professional societies given the task to collectively imagine the future of plant sciences and its role in agriculture, biodiversity, and ecosystem and food security into the future. This effort has been in progress since 2011 with the publication of the Decadal Vision (http://bti.cornell.edu/our-research/enabling-technologies/decadal-vision/) and the establishment of the Plantae community (http://www.plantae.org/), and now is culminating in the development of the NPSI to help direct policy, education, and training decisions for establishing funding and developing research planning and collaboration across the plant sciences.

Our representatives who attended this February meeting from BSA and ASPT—Allison Miller and Chelsea Specht, respectively—along with BSA's official representative, Michael Donoghue, will help our societies' interests be represented in the planning and keep us informed on upcoming federal initiatives or opportunities for research, training, and broadening participation. Ecological Society of America (ESA) representative Evan DeLucia was also in attendance, representing additional support for the fields of plant research supported by BSA and ASPT. Be on the lookout for more information!



***By Marian Chau*** *(Lyon Arboretum University of Hawai'i at Mānoa) and* ***Morgan Gostel*** *(Smithsonian Institution), Public Policy Committee Co-Chairs, along with* ***Ingrid Jordon-Thaden*** *(University of California Berkeley), ASPT EPPC Chair*

## Public Policy Opportunities at Botany 2017

Want to know how to be more involved in public policy communication for science? Sign up for the AIBS Communicating Science to Decision-makers workshop at Botany 2017, held on June 25 from 9:00 AM to 12:00 PM. This three-hour workshop will be presented by Dr. Robert Gropp, AIBS Interim Co-Executive Director. Space is limited to 30 participants and will fill up soon!

If you have any questions, please don't hesitate to contact the ASPT Environmental and Public Policy Committee or the BSA Public Policy Committee. More details are in the call for applications.

## First Annual Botany Advocacy Leadership Grant Supports Outreach in Oklahoma

*Michael Dunn sent the following thank-you note to the ASPT Environment and Public Policy Committee and BSA Public Policy Committee regarding the Annual Botany Advocacy Leadership Grant that Dunn and the Oklahoma Native Plant Society received.*

Thank you for your support of botanical public outreach by your generous award of $1000 as an Annual Botany Advocacy Leadership Grant, through me, to the Southwestern Chapter of the Oklahoma Native Plant Society.

The goal of this grant is to bring together as many of the institutions and organizations in southwestern Oklahoma who are at least in part like-minded in that they attempt to use plants to enhance the quality of life of the region. And to use plants as they relate to natural history, anthropology and archeology, horticulture and agriculture, as well as plants as an excuse to simply get outside.

We are well on our way to achieving many of our goals with our partners including The Oklahoma Native Plant Society, Wichita Mountains Wildlife Refuge, Friends of the Wichita's, Fit Kids of SW Oklahoma, The Medicine Park Aquarium and Science Center, Cameron University, Oklahoma State University Extension Service, The Museum of the Great Plains, and the Greater Southwest Oklahoma Anthropological Society.

Our first sponsored event was 27 August 2016 at The Museum of the Great Plains, and was co-sponsored by the Greater Southwest Oklahoma Anthropological Society. Bob Blasing, a retired anthropologist with the Bureau of Reclamation spoke on "How Early Great Plains Tribes used Seasonal Travel to Obtain Resources". More than 30 people attended (Figure 1), including some unexpected, but most welcome guests. The Secretary of Agriculture for the Comanche Nation attended, and he and I were able to discuss historical plant use by the Comanche Tribe. This is particularly exciting as the tribes here in "The Nations" (a.k.a. Oklahoma) have been very protective of their ethnobotanical heritage, and this was an incredible breakthrough. Our collaboration continues.

On 8 October 2016, we sponsored the Annual Meeting of The Oklahoma Native Plant Society. We met that morning at The Environmental Education Center of the Wichita Mountains Wildlife Refuge (WMWR) and several field trips were available including Aquatiic Plants of the WMWR, and a discussion/walk

**Figure 1.** *Bob Blasing speaking to a mixed crowd at the Museum of the Great Plains. The Secretary of Agriculture for the Comanche Nation is in the fourth row, far right in a red shirt, hidden except for his cowboy hat.*

about designing and constructing self-guided plant tours. Lunch was provided by the Friends of the Wichitas, and Susan Howell, the Visitor Services Coordinator for WMWR, spoke after lunch on "Maintaining the Health of the Mixed Grass Prairie." The Keynote Speaker that evening was David Redhage from the Kerr Center for Sustainable Agriculture, who spoke on "Pollinators and Native Plants."

In April or May of 2017, we will join with The Medicine Park Aquarium and Science Center, Fit Kids of SW Oklahoma, and Lawton Public Schools to bring eighth graders to The Medicine Park Aquarium and Science Center for a native plant and pollinators workshop. These details are still being worked out.

To date most of the funds provided by the grant have been used to pay travel expenses for our speakers, but we hope to have enough money left to pay for the busses to bring the eighth graders to our workshop.

Thank you to the American Society of Plant Taxonomists and The Botanical Society of America for this Botany Advocacy Leadership Grant. I hope we have used, and are using your funds as you had hoped. To future r ecipients of this grant, I cannot express how rewarding it is to work with these grassroots organizations. But they are grassroots volunteer organizations that require patience and understanding, but believe me, that patience will be rewarded as you will be working with some truly dedicated and enthusiastic amateur botanists and other types of plant people.

**To future recipients of this [Botany Advocacy Leadership Grant], I cannot express how rewarding it is to work with these grassroots organizations. But they are grassroots volunteer organizations that require patience and understanding, but believe me, that patience will be rewarded as you will be working with some truly dedicated and enthusiastic amateur botanists and other types of plant people.**

*-By Michael T. Dunn, PhD, Professor, Department of Agriculture and Biological Sciences, Cameron University, Lawton, Oklahoma 73505 USA*

# Convergent Evolution of National Science Education Projects: How BSA Can Influence Reform (Part 2)

## *Remarks from Botany 2016 by President-Elect Gordon E. Uno*

*The first part of Dr. Uno's speech, taken from his address at the Botany 2016 conference, can be found at http://cms.botany.org/file.php?file=SiteAssets/publications/psb/issues/PSB-2016-62-3.pdf.*

## Convergence of National Science Education Projects

There are multiple signs that the scientific community in academia has accepted science education as a legitimate activity in which colleagues can engage. In Part 1 of my talk, I identified seven signs that indicate to me that we have reached the tipping point in science education. The eighth, and last, indicator is the fact that several national science education reform projects have converged on similar messages to the biology community. The Next Generation Science Standards (NGSS) from the NRC (2013), *Vision and Change* from AAAS (2011), the AAC&U's LEAP Initiative and High Impact Practices (2011), and the College Board's revision of the Advanced Placement (AP) Biology course in 2012 are just four of these large-scale projects that have and will continue to have great impact on science education in the United States.

***By Gordon E. Uno,***
*BSA President-Elect*
*University of Oklahoma*

How are these projects converging? I think there are five major ways these major projects are similar in their explicit and implicit recommendations to the science community:

**1. Student outcomes or competencies should be used to organize a course or program**—competencies are those characteristics that we desire students to possess at the end of instruction and are measures of student learning about subject knowledge and ability to use important skills. What is different from previous reports is that competencies help us determine how students should learn science practice skills while they are learning content; neither content nor skills are taught in isolation. For instance, there should not be a 50-minute lecture on photosynthesis without students working with data or graphs or designing experiments related to the subject. In

addition, we need to help students think about their own learning—what do they understand and what are they still confused about?

**2. These national science education projects emphasize that the investigative process of science, including critical thinking and inquiry skills and student investigations, should be the cornerstone of all science courses.** Critical thinking and inquiry skills (Box 1) have often been limited to laboratory settings, but we know that they should be practiced throughout a course. In terms of research, students should be able to conduct authentic research to the extent possible and be exposed to science as a process as soon and often as possible. Thus, faculty need to find ways to allow students to practice the skills shown in Box 1 every day—while not all of them can be used on the same day, students should be engaged in at least one of them every day.

**3. Faculty should focus on student learning and understanding instead of worrying about what to teach, i.e., become more "student-centered."** This happens when a faculty member is more concerned about helping students understand whatever information is taught instead of just being worried about what to teach.

**4. To do all of the above, faculty are urged to use "evidence-based" activities (Box 2), those teaching methods that science education literature indicates are effective in helping students learn science.** As one might expect, these activities are infused with inquiry and critical thinking skills, and faculty are encouraged to use these activities every day in both lecture and lab. The important issue here is that, although we have a good idea of what works in the classroom and although most faculty have heard about some evidence-based activities, few faculty have the knowledge or experience to implement these activities effectively. This raises the importance of faculty professional development to inform faculty of these methods and to let them practice and think about how these practices would be used intentionally in their classrooms.

**5. National science education projects have also converged on their position regarding the teaching of science content;** while content is essential, less is definitely more, and it is equally important for students to be able to apply the content they have learned to new situations and to connect ideas, facts, and concepts to each other. Additionally, there

### Box 1. A List of Critical-Thinking and Inquiry Skills

1. Make careful observations and ask good questions.
2. Develop appropriate hypotheses and explain predictions.
3. Design a controlled experiment.
4. Collect, process, and interpret data (quantitative skills).
5. Discuss ideas and draw conclusions.
6. Infer and generalize.
7. Distinguish between cause and effect vs. correlation.
8. Recognize assumptions and biases.
9. State, evaluate, and justify claims using evidence.
10. Communicate science effectively (explain concepts in your own words).
11. Apply knowledge to new situations; make connections between concepts.

is the recommendation to use themes in the teaching of biology courses, themes such as evolution or biological interactions, so that whatever content is taught, students are able to connect that information to a theme. This allows students to form a framework for their understanding of all biology. Finally, several reports recommend that attention be paid to the interdisciplinary nature of biology.

While the major science reform projects were developed mostly in isolation from each other, they were informed by the same science education literature; thus it is not too surprising that there was convergence on some of the central tenets for change. For instance, the NGSS recommends that science education should reflect real world interconnections (as noted in #5 above); concepts should be integrated with multiple core concepts throughout (the use of themes); science concepts should build coherently (scaffolding of skills and content); focus should be on application of content (applying knowledge to new situations); and science education should coordinate with mathematics standards (quantitative reasoning). *Vision and Change* from AAAS recommended that courses "integrate core concepts (themes) throughout the curriculum," and "integrate scientific process skills throughout the course," and that "fewer concepts should be taught, but in greater depth." *Vision and Change* also recommended that the course be inquiry-driven and introduce research experiences as an integral component in the course.

As with other documents, *Vision and Change* identified desirable student competencies, including the abilities to: (1) apply the process of science, (2) use quantitative reasoning, (3) use modeling and simulations, and (4) tap into the interdisciplinary nature of science. The AACU's Liberal Education and America's Promise (LEAP) project identified essential learning outcomes for students, such

### Box 2. What Works: A List of Teaching/Learning Methods Demonstrated to Be Effective in Helping Students Learn Science

1. Authentic Student Research
2. Experience Science as a Process Throughout Course
3. Metacognitive Activities
4. Drawing to Explain
5. Writing for Understanding
6. Explaining Concepts in Their Own Words
7. Creating Summaries of Content and Research
8. Peer Instruction
9. Communicate Science and Discuss Concepts/Problems
10. Problem Solving (problem-based learning)
11. Making Connections
12. Concept Mapping
13. Applying Knowledge to New Situations
14. Creating a Scientific Explanation Using Evidence
15. Focusing on Basics First
16. Using Themes to Organize Content
17. Clicker Questions (some)
18. Critical-Thinking Skill Activities
19. Formative Assessments (concept inventories)
20. Case Studies
21. Dealing with Misconceptions
22. Constructivist Lessons (scaffolding knowledge and skills)
23. Getting Students to Ask Questions and Make Careful Observations
24. Focusing on How We Know
25. Using Stories to Learn about Science

as their ability to: (1) focus on Big Questions (problem-solving) in society, (2) focus on intellectual and practical skills, (3) practice progressively more challenging problem-solving (scaffolding of skills), and (4) demonstrate application of knowledge, skills, and responsibilities to new settings and complex problems. In addition, included in the AACU's High-Impact Practices (HIPs) recommendations is the focus on undergraduate research throughout the undergraduate program, culminating in a capstone course or project that requires a student to synthesize all that he/she has learned and is able to do. Successful participation in HIPs has been found to: (1) increase the retention and graduation rates of students, especially for historically disadvantaged students, (2) generate more positive student attitudes about college, faculty, learning, and themselves, and (3) increase self-reported students gains in learning (Kuh, 2008). As a HIPs Institute Faculty Mentor for the past four years, I can attest to many changes institutions around the country have seen in students after they implement HIPs into their undergraduate degree programs.

The last major project I would like to discuss is the revision of the College Board's Advanced Placement (AP) science courses. These courses are taught in high schools around the country, but are designed to be similar to a freshman-level undergraduate class. I was the co-Chair of the AP Biology Development Committee for the last eight years; this committee helped revise the AP Biology course, to create a curriculum framework used by all the AP Biology teachers (~12,000 teachers), and to develop the new Biology exams. The problem with the former AP Biology course was that it was content-driven, and students and teachers tried, unsuccessfully, to "cover" an entire college biology text in complete detail. The new course emphasizes a reduced breadth of content and an increased depth of student understanding while increasing the use of essential reasoning and inquiry skills. Also, there is now a major focus on "science as a process" in the course, and content is melded with science practice skills to create student learning outcomes. The new AP Biology curriculum framework focuses on four "Big Ideas" (themes) that inform the content of the course: (1) evolution, (2) energy and homeostasis, (3) information transfer, and (4) interactions among organisms, systems, and their parts. The seven Science Practices (Box 3) have been adopted by all the new science courses that AP offers, including biology, chemistry, and physics, and serve as the foundation for all the skills that students need to possess.

The new AP Biology course emphasizes inquiry-based and student-directed labs. Whereas the old course had many teacher-directed labs, in the new course, students generate their own questions for investigation, and design, conduct, and report on their own experiments. Not only has the course changed dramatically, the exam has too. No longer are any low cognitive level, declarative knowledge, recall questions asked, such as "What is the name for this structure in the cell (with a picture pointing to a chloroplast)?" Now, students must engage with evidence—either with evidence they produce by working with data or with evidence that is provided to them—to answer a question that incorporates both biological content and one of the seven science practice skills. In addition, students are given six new "grid-in" questions, which require students to work with data and then to provide numerical answers that they grid into a template, without the benefit of any answers from which to choose. The final new piece of the exam are six short essay questions in addition to two of the familiar long essay questions

### Box 3. Science Practices Adopted by and Incorporated into Advanced Placement (AP) Biology, Chemistry, and Physics Courses

1. Use representations and models to communicate scientific phenomena and solve scientific problems.

2. Use mathematics appropriately.

3. Engage in scientific questioning to extend thinking or to guide investigations.

4. Plan and implement data collection strategies in relation to a particular scientific question.

5. Perform data analysis and evaluation of evidence.

6. Work with scientific explanations and theories.

7. Connect and relate knowledge across various scales, concepts, representations, and domains.

that students must answer in the second half of the exam.

The immediate impact of the new AP Biology course was that 12,000 high school teachers changed the way they taught biology at the same time, and each May, approximately 250,000 students take the new exam. Many teachers had to replace all their laboratory investigations or incorporate many more labs into their course. They all needed to incorporate inquiry and mathematical activities throughout their course, not just in a few labs. On one of the old AP biology exams, about 11% of the questions related to evolution, but because evolution is a theme of the new course, approximately 35% of the questions on one new exam involved evolution. In 2012, before the revision, about 19% of all students received a "5" on the exam (highest score), while 34.8% received a 1, and only 14% received a 3. After the revision, about 5% of students received a "5," 7% received a "1," and "36% received a "3." Thus, the old exam had a bi-modal distribution of scores (with many 1s and 5s), which was an exam that rewarded those who could memorize a lot of material, even if they didn't understand the material or couldn't design an experiment. The results of the new exam show a normal distribution of students with many fewer 5s and 1s and many more students receiving an "average" (3) score. To me, this indicates that we are no longer just rewarding (or penalizing) students based on their memory of a lot of biological facts, but that AP Biology is now measuring students' ability to design experiments and to apply, connect, explain, and use information and data.

## How BSA Can Influence Educational Reform

Based on the information I have provided at the beginning of this article and in Part 1, I think there is growing acceptance of science education as a research discipline. And, we know what works in a classroom to help students learn science and stay committed to biology as a major. Finally, we know there is continued relevance of plants in future basic and applied research. So, it's incumbent upon us to integrate these factors as we work toward solution to our educational problems. The question is, "How can BSA help to influence science education reform?" I have several recommendations.

First, we botanists need to keep educating students, the public, and other scientists about

the essential nature of plants to humans and to the future research initiatives in the United States. Also, if one of our goals is to get more undergraduates interested in plant biology as a viable career choice, then introducing more students at the freshmen level to the wonders of botany is important. We must encourage the best botanical instructors to teach large, basic courses, and support them when they do, so that young undergraduates can be hooked on botany before they choose a different path.

There are over 2,000,000 freshmen entering U.S. colleges and universities each year (U.S. Bureau of Labor statistics, 2016), and most of these students are going to take an introductory biology course. If we can infuse more botany into these courses, then we have a better chance of having students take future botany courses. Currently, over half of the students take their introductory biology course at a community college. So, if you have finishing graduate students who are looking to enter the teaching profession, then don't neglect the opportunities at a 2-year institution. (At the 2016 annual conference, we invited faculty from regional community colleges near Savannah to attend a workshop on inquiry instruction that was led by Marsh Sundberg, Catrina Adams, and myself.) Another point about community colleges is that their student populations are extremely diverse, and if we value a BSA with membership that reflects the diversity of America, then we need to cultivate students who begin their educations at these regional institutions. (In terms of diversity, the BSA has a wonderful program, PLANTS, that is funded by NSF [A. Sakai and A. Monfils, PIs, with BSA Staff, H. Cacanindin] and that has been bringing a diverse group of undergraduates to our annual meeting since 2010 [http://botany.org/awards_grants/detail/PLANTS.php]).

The higher education system in the United States is unique in the world in that almost all post-secondary institutions require students to take general education courses, including at least a year of science, with one lab course. Scientists often lament that this requirement is really insufficient for any college graduate entering a world that is impacted by science and technology. However, one can also see this as a half-full glass and a huge opportunity to influence young undergraduates by placing the best botanical instructors in general education courses. For many students, including future politicians, journalists, citizens, voters, and some teachers, this may be the only biology course they ever take. In general, BSA

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should help botanists obtain faculty positions in biology departments. Perhaps we can offer mock job interviews and continue our resumé-building workshops to help our graduates gain faculty positions where they can have influence on students and curricula.

**We must encourage the best botanical instructors to teach large, basic courses, and support them when they do, so that young undergraduates can be hooked on botany before they choose a different path.**

Another important way that BSA can influence reform is if members improve our own botany/plant biology courses, implementing what we know works to help students learn and focusing on competencies identified as critical for student success. To help faculty improve, BSA can offer additional faculty professional development opportunities—not just at BSA conferences, but at other meetings and at individual institutions. Again, we know that some BSA members are already leading professional development activities for faculty and graduate students—perhaps we can advertise activities you are leading to promote your work and provide greater access to them. In terms of professional development, one of the newest Research Coordination Networks for Undergraduate Biology Education (RCN-UBE) projects is the Faculty Developers Network (Deborah Allen, PI; Uno, co-PI), and one part of this project is to determine what scientific societies are doing to help their members do a better job in the classroom. BSA can contribute a lot to this discussion.

One hidden aspect of getting more botanists into introductory classes is the fact that AP Biology conducts a "higher-ed validation" study to determine what topics/concepts should be included in the course. A list of potential topics is sent to undergraduate faculty who teach Introductory Biology courses, and if insufficient numbers of them identify plant topics as relevant to their course, these topics will be eliminated from consideration for the AP Biology curriculum. This kind of unexpected consequence of having botanists in the right place at the right time can have a significant impact on what is taught in classrooms all across the country. Consider working with national educational testing services such as the Educational Testing Service (ETS) to help develop questions for the AP and SAT exams. Getting more botanical questions on these exams means that pre-college teachers will devote more time teaching about plants.

I think that BSA also needs to think about ways to increase our outreach to the general public. Perhaps we can cultivate secondary members—for instance, amateur botanists or other non-botanical professionals who are interested in plants, the environment, and perhaps even in basic plant research to become members or attend our conferences? Can we encourage more BSA members to offer demonstrations and talks, and to lead field trips for environmental groups, Native Plant societies, gardeners, youth groups, and groups such as the Botanical Society of Washington (a long-standing forum for all things botanical)? I know that many BSA members are already engaged in a number of such outreach activities—perhaps we just need better advertisement of these events so other members can learn about what you are doing and to use

your activity as a model.

I think that BSA must continue to collaborate with other scientific organizations to promote scientific and botanical literacy of our students and the general public. BSA and the American Society of Plant Biologists (ASPB) have collaborated on the development of "Core Concepts and Learning Objectives in Plant Biology for Undergraduates" (http://cms.botany.org/file.php?file=SiteAssets/outreach/botany-pbiologycoreconcepts.pdf). In addition, we are currently working with the ASPB and other plant societies in the Plant Science Research Network, a network funded through an NSF grant from the RCN program. The purpose of the network is to discuss common issues that all plant biologists may experience as professionals, including issues related to funding, publishing, graduate students, and education.

We have a very good Education Department whose work was recently rewarded with an NSF grant to continue ramping up PlantingScience activities. We must continue to support the work of the Education Department; perhaps you would be interested in signing up as a PlantingScience mentor? This department has several other projects that have been initiated or are being discussed, but this is an area where more BSA members can become engaged and more activities and projects can be developed. Do you have any ideas or recommendations for the Education Department and BSA?

I also think we need to engage more undergrads in activities in our own departments and to bring more students to our meetings so they get hooked on plants and BSA at an early point in their career. We can encourage and engage students who are interested in botany by starting a BSA Student Chapter at our own institution. Currently, there are only 19 such chapters in the United States. Information about how these can be started is found at: http://www.botany.org/students_corner/chapters/.

Most importantly, I encourage each of you to seek opportunities in which you can increase your impact on students and colleagues, whether it is in your own classroom or through projects at the national level or in communicating science to the general public. I urge you to think about how you can promote plants and educational reform and improve the botanical literacy for all, and I would gladly accept suggestions from you for how BSA can continue to have an impact on students, botanical friends, and faculty colleagues. Thank you very much.

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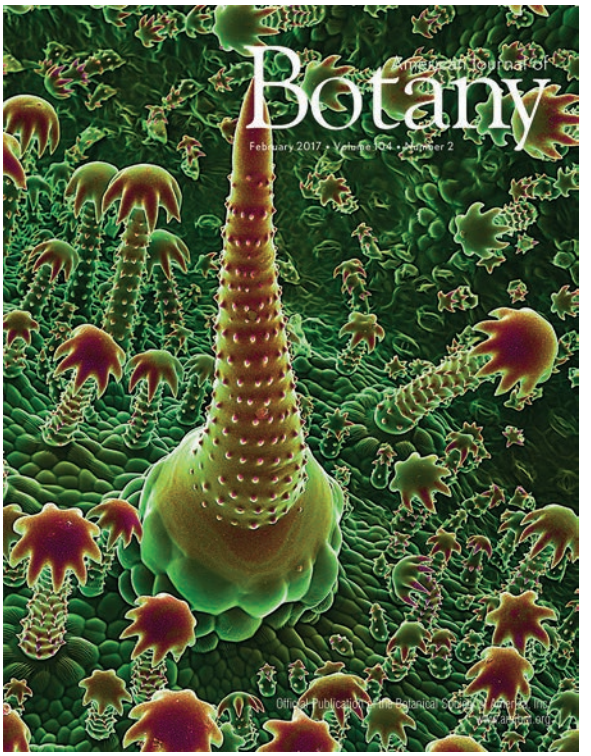
# The *American Journal of Botany* welcomes your collaboration in 2017

In an editorial in the January 2017 issue of the *American Journal of Botany*, Editor-in-Chief Pamela Diggle presented a current "state of the journal" and extended an enthusiastic invitation to BSA members and colleagues (potential future members!) to contribute to the success of the Society's flagship journal.

Authors face many challenges in publishing these days: the growing number of publishing options, the importance of relating their work to a broad audience, Open Access policies and funder mandates, and changing data-sharing and journal standards are just some of the issues adding pressure on authors. This is all beyond doing the actual research and then undertaking the sometimes arduous process of writing a manuscript, submitting it to a journal, responding to reviews and revising it, and hoping for acceptance. (Not all papers are accepted at the first journal chosen, so sometimes the paper is reworked for another journal with differing requirements, different reviewers, etc.) And then after the acceptance, there is the expectation that authors will help promote their work and communicate their science, keep doing science, review papers from other authors, perhaps teach, travel, present at conferences, answer questions from the public, speak up (or even march) for science—and oh, yes, have a life!

*AJB* understands these challenges and wants to work with its authors:

- We are a proud Society-owned journal;
- Our Editor-in-Chief is a well-respected scientist with an impressive career, who is also a fellow BSA member with experience in all levels of publishing;




- We have a strong and expanding group of Associate Editors (http://www.amjbot.org/site/misc/edboard.xhtml) and reviewers from the United States and around the world;
- We work hard for quick turnarounds (currently ~30 days) and rapid publication;
- We have a dedicated editorial staff who can assist authors from pre-submission through publication and post-publication promotion.

The journal succeeds when we receive strong submissions with broad appeal to the botanical community. We encourage you to submit your best work to your Society journal at http://www.editorialmanager.com/ajb/default.aspx. We also encourage you to consider submitting an essay to our "On the Nature of Things" (OTNOT) series (send ideas directly to the Editor-in-Chief) and participating in publications sessions, and conversations, at the annual meeting. We are open to your ideas for making your journal the go-to place for botanical science.

Dr. Diggle best summed it up in her editorial, "As *AJB* begins its 104th volume, one standard remains constant: our adherence to the mission of the Society and to serving our authors with the highest standards. The *American Journal of Botany* reflects what its authors and reviewers choose to make it, so I encourage all of you to 'roll up your sleeves' along with me to maintain and increase the strength of our society's flagship journal as we enter 2017." Let's do this!

**Look for the following AJB Special Issues in 2017–2018:**

- "The Tree of Life," aimed at revisiting the highly successful special issue on this topic published in 2004 with the latest results yielded up by phylogenomics and "big data"
- "The Tree of Death" on the critical importance of the fossil record in understanding the complete history of plants
- "Wood: Biology of a Living Tissue" based on a highly successful symposium at Botany 2016
- "Patterns and Processes of American Amphitropical Plant Disjunctions: New Insights," also based on a highly successful symposium at Botany 2016

## Why publish your next methods paper in *Applications in Plant Sciences?*

**Rapid publication with fast and thorough peer review**: Manuscripts are evaluated by editors within a few days of submission and are peer-reviewed by two to three outside reviewers. Average time to first decision is approximately 26 days.

**Available in major indexes**: *APPS* is included in discoverability services including Web of Science, Journal Citation Reports, PubMed, WorldCat, Scopus, and Google Scholar. The impact factor is 0.911.

**Open Access:** All *APPS* articles are Open Access upon publication. OA fees are kept as low as possible to help authors with limited funding. BSA members are charged US$450–800 per article (depending on length of membership); non-members are charged US$1400 per article.

**Society-published journal:** *APPS* is published by the Botanical Society of America, which maintains rigorous standards of peer review and is committed to working with authors to strengthen their published research.

**Research promoted on news and social media outlets:** Press releases are prepared for noteworthy articles, and articles are also promoted on Twitter and Facebook, which have over 24,000 combined followers. Research published in *APPS* has attracted attention from outlets including the National Science Foundation's Science360, CNBC, and ScienceDaily.

***APPS*** is a monthly, peer-reviewed, open access journal focusing on new tools, technologies, and protocols in all areas of the plant sciences. *APPS* is available as part of BioOne's

Open Access collection (www.bioone.org/loi/apps).

Article types and detailed Instructions for Authors can be viewed at http://www.botany.org/APPS/APPS_Author_Instructions.html. Please contact the editorial office (apps@botany.org) with questions.

*-By Theresa Culley (Editor-in-Chief), University of Cincinnati*

Editorial office contact: Beth Parada, Managing Editor, apps@botany.org

## What do authors think about the experience of publishing in *APPS*?

"Thank you for such a quick turn-around on our submitted manuscript. This is the most efficient journal editing any of the authors have experienced!"

"I was impressed by the quality and speed of your publishing services, and I am looking forward to seeing the article in press. "

"It has been a pleasure working with you on this review article. We truly appreciate your time and attentiveness and are thrilled with the final result."

"I just saw the press release for my paper on ScienceDaily and all over the internet. Thanks a lot!"

Applications in Plant Sciences

**Press releases for recent articles published in *APPS***

Measuring trees with the speed of sound: http://bit.ly/2hYHZUD

Drones take off in plant ecological research: http://bit.ly/2f0YrS2

HybPiper: A bioinformatic pipeline for processing target-enrichment data: http://bit.ly/2ls5VkC

To view all of APPS recent press releases, visit http://cms.botany.org/files/main/folder/SiteAssets/publications/apps/press-releases.

# Careers Beyond the Academy

Last year, I was honored to be invited by the BSA Graduate Student Representatives, Rebecca Povilus and Angela McDonnell, to give the keynote presentation at the "Interactive Career Panel & Luncheon" during Botany 2016 in Savannah, Georgia. They suggested that I share my thoughts on choosing a career in botany and on making the most of a degree in the plant sciences. As I pondered what I might have to contribute on those topics, I realized that I didn't really choose a career in botany—it chose me. The most important thing that I've learned along the way is to do what you love, and #iamabotanist.

My passion for plants has dictated most of my career and choices along the way. It may sound trite or self-indulgent: do what you love. But I find that by focusing on what I personally find most rewarding, I am at my most creative and I have my best insights. It also helps me withstand those long hours of things that are not so fun (insert your most dreaded task here), like the gazillionth plant part that you have measured or weighed. But how does identifying what you find rewarding translate into a career?

**By Pamela Diggle**

*Professor, Department of Ecology and Evolutionary Biology*
*University of Connecticut*

As an academic at a research 1 university, mentoring graduate students is part of my job. And it is a terrific part of my job that has given me an opportunity to interact with amazing people who share my love of plants. Over the years, however, I have come to understand that not all students—creative, accomplished, and driven as they may be—aspire to careers in academia. I also realized, however, that I was ill equipped to help graduate students navigate the world outside of academia, given that other than a brief interlude after college, I have only ever been an academic. How can I advise and mentor students who aspire to jobs beyond the academy?

As I continued to contemplate this topic of careers in botany, and particularly jobs outside of academia, I was struck by the juxtaposition of two articles published just over a week apart in the *New York Times*: "So Many Research Scientists, So Few Openings as Professors," and "The Incalculable Value of Finding a Job You Love."

The first article, by Gina Kolata, highlights Emmanuelle Charpentier, who is widely known for her role in deciphering the mechanisms of the CRISPR-Cas9 system (https://www.nytimes.com/2016/07/14/upshot/so-many-research-scientists-so-few-openings-

as-professors.html). She recently became the leader of the Max Planck Institute for Infection Biology, but had spent the previous 25 years moving through non-tenure track positions, in nine institutions, in five countries. The article paints a fairly gloomy picture of the outlook for new PhDs. It focuses more on biomedical science, which has been particularly hard hit by job shortages, but resonates across the life sciences. The article's author summarizes a commonly held view (emphasis added):

> "The lure of a tenured job in academia is great—it means a secure, prestigious position directing a lab that does cutting-edge experiments, often carried out by underlings. Yet although many yearn for such jobs, fewer than half of those who earn science or engineering doctorates end up in the sort of academic positions *that directly use what they were trained for.*
>
> Others, ending up in industry, business or other professions, do interesting work and earn lucrative salaries and can contribute enormously to society. But by the time many give up on academia—four to six years or more for a Ph.D., a decade or more as a postdoc—they are edging toward middle age, having spent their youth in temporary low-paying positions *getting highly specialized training they do not need.*"

These kinds of statements encapsulate commonly held assumptions about graduate school: they assume that being a professor and researcher with a giant lab is the ultimate goal of all graduate students, that anyone in any other job is an inferior also-ran, and that academia trains you for nothing but academia. All of which, in my experience, are false and didn't merit much further thought. But I was motivated to explore the last assumption, that academia prepares you for only academia.

What kinds of preparation are employers in non-academic professions looking for? In all that I read, and in discussions with people in the private sector and various government agencies, I heard over and over again that it is easy enough to learn hard skills on the job (various lab techniques, for example), and for many non-academics, the job they have did not exist when they were in graduate school, so they could not have trained for it anyway. The critical skills that non-academic employers are looking for include:

- Initiative
- Creativity
- Leadership skills
- Organization
- Project management
- Budget and finance
- Communication, both written and spoken
- Social media creation management
- Flexibility

Clearly, completing and publishing your dissertation research requires all of these skills and more. But you have to be able to demonstrate this to a prospective employer. Coming up with a dissertation project requires initiative and creativity, problem solving, insight, and thinking on your feet. What are some specific examples from your research? Non-academic employers look at a CV very differently than a search committee in academia and will want specific examples of each of the attributes listed above. In this day of

highly collaborative work, it is critical that you clearly establish ownership and take the intellectual lead on your dissertation research. You need to be able to demonstrate that you know how to ask and answer original questions and follow through until you get an answer. What experiences do you have that most clearly illustrate these qualities?

Employers are looking for leadership skills. Did you direct a team of undergrads? How did you ensure quality control? How did you deal with problematic students? Did you take the lead in a collaboration? How did you negotiate maintaining leadership within a group of peers?

Organizational skills. Have you managed large data sets? Complex experiments? Budget and finance? You raised grant funding and managed the budget for your research. Communication? You give seminars and write papers for publication. Many of you teach and do outreach.

**Flexibility!** Flexibility was valued highly by everyone I spoke with: be flexible in where you might live, how you see yourself, what you view as science, what might be fulfilling. For example, I had an interesting conversation with a Zeiss Microscope representative. He has a PhD in microbiology and says he never saw himself as a sales person (and was perhaps a bit disdainful of this career). But as a grad student, he became an expert on many different types of microscopy, primarily through troubleshooting and problem solving as needed for his research. Now he has a career solving microscopy issues for others. His career combines his deep knowledge of biology with his talent for optics and problem solving and, he says, it is deeply satisfying.

You certainly gain skills from your dissertation research that are valuable well beyond academia. But, beyond your research, I also encourage you to do other stuff! Everyone I spoke to about careers outside of academia emphasized that networking is critical and so is serendipity. Take advantage of opportunities to meet people and enhance your "soft skills." Serve as a teaching assistant, even if you are not required to and even if you find it difficult at first. Teaching enhances your communication, management, organizational, and leadership skills. Go to department seminars no matter what the topic and sign up to meet with the speaker. If nothing else,

**Many faculty and graduate students view as ideal the research fellowship that allows you to devote your attention to research full time with no need for the distraction and time commitment of a TA. This view is reminiscent of a "trade-school" mentality; that graduate school trains you to "be" a research scientist and nothing else. I prefer to think of graduate school as an opportunity to develop the kinds of skills that you need for the career you want.**

the seminar will give you a greater knowledge base that increases your ability to connect with other people, and talking with the speaker will enhance your networking skills. And you can never predict who that person knows. Take a leadership role in something outside of your department, such as a professional society or an advisor to an undergraduate club. Use LinkedIn to find people with interesting jobs and ask them questions. Contact people who do interesting things and ask if you can shadow them for a day. People are generally accommodating and often happy to be asked. Take advantage of your university alumni association to make contacts with people who have interesting careers.

Many faculty and graduate students view as ideal the research fellowship that allows you to devote your attention to research full time with no need for the distraction and time commitment of a TA. And, many faculty advise their students not to get "distracted" with extra courses or activities. This view is reminiscent of a "trade-school" mentality; that graduate school trains you to "be" a research scientist and nothing else. I prefer to think of graduate school as an opportunity to develop the kinds of skills that you need for the career you want.

Which takes me to the second article, which I highly recommend: "The Incalculable Value of Finding a Job You Love" (https://www.nytimes.com/2016/07/24/upshot/first-rule-of-the-job-hunt-find-something-you-love-to-do.html) by Robert H. Frank.

There are many thoughtful resources concerning careers for PhDs in academia and beyond. A few of these include:

- The Chronicle of Higher Ed "Vitae" section (https://chroniclevitae.com/job_search/new)
- *Nature* and *Science* have jobs sections with interesting essays on careers in the sciences (http://www.nature.com/naturejobs/science/news; http://www.sciencemag.org/careers)
- Alumni associations and career services at your university
- "Next Gen PhD: A Guide to Career Paths in Science" by Melanie V. Sinche (http://www.hup.harvard.edu/catalog.php?isbn=9780674504653)

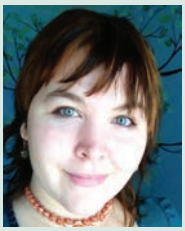
You have already found something that you love doing, or you would not be in graduate school. For those of you who are considering career options beyond kinds of R1 institutions where you are now, this article suggests that rather than compiling a list of jobs that are out there, think hard about what aspects of graduate school bring you the most satisfaction. When you are really "in the zone," so absorbed that you haven't even looked at your phone for hours, what are you doing? What would it be like to do more of that? Then seek out the kinds of experiences and contacts that you will need for that career path.

# SCIENCE EDUCATION

## Over 2000 Students Conduct Plant Science Investigations This Fall Through PlantingScience.org

This past fall marked our largest PlantingScience session ever. Thousands of students worked with scientist mentors on their own plant science investigations. Serving this many students is only possible thanks to our long-awaited new website, developed using Purdue's science collaboration platform HUBZero. Thanks to all of our mentors, new and experienced, who are volunteering their time to inspire the next generation of plant scientists. If you have been thinking about volunteering, next fall would be a perfect time to join us. We're expecting to double our numbers for fall, and we can use all the mentors we can get. It's a small time commitment, but you can make a big impact on middle- or high-school students. Most plant scientists had a plant mentor at some point in their early lives, someone who sparked an interest in plants through their own enthusiasm. Through PlantingScience you can be that plant mentor that sparks a lifelong interest and enthusiasm for plants. Sign up or direct your colleagues to http://plantingscience.org/newmentor to sign up.

Congratulations to the Fall 2016 Star Project teams (see the following page)! Each session we choose 10 to 15 projects to feature in our Star Project gallery. These projects represent projects that have excelled in one of several categories. Check out our Star Project Gallery at https://plantingscience.org/starprojectgallery to see what makes these 15 projects exemplary.



***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.*

### Visit BRIT during Botany 2017 for a Tour or Workshop

The Botanical Research Institute of Texas (BRIT) will be welcoming Botany 2017 attendees to join them for a tour. Keep your eyes on the schedule for times and details. Join Gordon Uno and Marshall Sundberg for a Sunday morning workshop, "Planting Inquiry in Science Classrooms," hosted at BRIT to learn many practical techniques and activities you can use to support your students' active learning. Attendees at the workshop will receive a free print copy of the book "Inquiring About Plants."


*The "Power Plant Girlz," one of 15 Star Project winners for the Fall 2016 Planting-Science Session, conduct leaf disk flotation experiment around how different colors of light affect photosynthesis. See more from the team on their Star Project Gallery Page at* https://plantingscience.org/spshingletonppg.

## Life Discovery Conference— Data: Discover, Investigate, Inform (October 19-21, 2017)

Please consider joining us at this year's Life Discovery Conference, a stand-alone education conference for high school and undergraduate biology educators. The 2017 conference will be held at the University of Oklahoma. This year's theme is on data and quantitative literacy, and will feature a number of workshops, field trips, and short presentations around best practices and tested activities for bringing data into your classroom. Have an activity under development yourself that you'd like to share? We're accepting proposals for the Education Share Fair where you can share your in-progress ideas and get feedback from your peers. This is a great conference for networking with others passionate about biology education, and there is lots of time to get to know other participants. For more information, visit http://www.esa.org/ldc/.

Hope to see you there!

# STUDENT SECTION

# Round-up of Student Opportunities

It's a new year! You may be trying to figure out what you can do in 2017 to help you reach your education, research, and career goals. Gathered here are upcoming opportunities you might be interested in. Some deadlines may have already passed, but they might be things you'll want to keep in mind for 2018!

We have four categories below for easy browsing: Grants and Awards, Broader Impacts, Short Courses and Workshops, and Job Hunting.

## Grants and Awards

Grants and awards can fund your research, provide assistance for travel related to training or fieldwork, and even contribute to your cost-of-living and tuition expenses (e.g., fellowships). Additionally, applying for grants and awards is a great opportunity to plan and articulate your research. Lastly, remember to check with your department or university for internal grants that you can apply for.

| BSA Graduate Student Research Awards | |
|---|---|
| $500 | Botanical Society of America |
| Research Funds | Support and promote graduate student research in the botanical sciences. Includes the J.S. Karling Award. |
| Deadline: mid-March | |
| More info: | www.botany.org/Awards |
| **BSA Undergraduate Student Research Awards** | |
| $200 | Botanical Society of America |
| Research Funds | Support and promote undergraduate research in the botanical sciences. |
| Deadline: mid-March | |

*By **Becky Povilus** and **James McDaniel***
*BSA Student Representatives*

| | |
|---|---|
| More info: | www.botany.org/Awards |
| **BSA Student Travel Awards** | |
| Variable, up to $500 | Botanical Society of America |
| Travel (conference) | Several awards support student travel to the annual BOTANY conference:<br>- Cheadle Student Travel Awards<br>- BSA Section awards |
| Deadline: early-April, variable | |
| More info: | www.botany.org/Awards |
| **NSF Graduate Research Fellowship Program** | |
| $32k/yr + tuition aid | National Science Foundation |
| Stipend & Tuition | Support outstanding graduate students in NSF-supported disciplines who are pursuing research-based Master's and doctoral degrees at accredited U.S. institutions. |
| Deadline: October | |
| More info: | www.nsfgrfp.org |
| **NSF Doctorial Dissertation Improvement Grant** | |
| up to $13,000 | National Science Foundation |
| Research Funds | Provide partial support of doctoral dissertation research for improvement beyond the already existing project (check that your project falls within the scope of associated Divisions). |
| Deadline: October | |
| More info: | Click the "Funding" tab at www.nsf.gov |
| **Torrey Botanical Society Fellowships and Awards** | |
| up to $2,500 | Torrey Botanical Society |
| Research Funds & Travel | Support research/education of student society members (fund field work, recognize research in conservation of local flora/ecosystems, fund course attendance at a biological field station). There are awards for graduate students and undergraduates. |
| Deadline: mid-January | |
| More info: | www.torreybotanical.org |
| **Prairie Biotic Research Small Grants** | |
| up to $1,000 | Prairie Biotic Research, Inc. |
| Research Funds | Support the study of any species in U.S. prairies and savannas. |
| Deadline: late-December | |
| More info: | www.prairiebioticresearch.org |
| **Botany In Action Fellowship** | |
| $5,000 | Phipps Conservatory and Botanical Gardens |
| Research Funds | Develop new, science-based plant knowledge and chronicles traditional knowledge of plants. BIA promotes interactive scientific education about the importance of plants, biodiversity, and sustainable landscapes. |
| Deadline: mid-January | |
| More info: | https://phipps.conservatory.org/green-innovation/for-the-world/botany-in-action/call-for-proposals |
| **The Lewis and Clark Fund for Field Research** | |
| up to $5,000 | American Philosophical Society |
| Research Funds | Encourage exploratory field studies for the collection of specimens and data and to provide the imaginative stimulus that accompanies direct observation. |
| Deadline: early February | |

| | |
|---|---|
| More info: | www.amphilsoc.org/grants/lewisandclark |
| **ASPT Graduate Student Research Grants** | |
| up to $1,000 | American Society of Plant Taxonomists |
| Research Funds | Support students (both master's and doctoral levels) conducting fieldwork, herbarium travel, and/or laboratory research in any area of plant systematics. |
| Deadline: early March | |
| More info: | www.aspt.net/awards |
| **Richard Evans Schultes Research Award** | |
| up to $2,500 | The Society for Economic Botany |
| Research Funds | Help defray the costs of fieldwork on a topic related to economic botany, for students who are members of the Society for Economic Botany. |
| Deadline: mid-March | |
| More info: | www.econbot.org |
| **Sigma Xi Grants-in-Aid of Research** | |
| up to $1,000 | Sigma Xi |
| Research Funds | By encouraging close working relationships between students and mentors, this program promotes scientific excellence and achievement through hands-on learning. |
| Deadline: mid-March and October | |
| More info: | www.sigmaxi.org/programs/grants-in-aid |
| **Young Explorers Grant** | |
| up to $5,000 | National Geographic Foundation |
| Research Funds | Support research, conservation, and exploration-related projects consistent with National Geographic's existing grant programs. In addition, this program provides increased funding opportunities for fieldwork in 18 Northeast and Southeast Asian countries. |
| Deadline: mid-March and October | |
| More info: | http://www.nationalgeographic.com/explorers/grants-programs/yeg-application/ |
| **Systematics Research Fund** | |
| up to $5,000 | The Systematics Association & The Linnean Society |
| Research Funds | Besides research focused on systematics, projects of a more general or educational nature will also be considered, provided that they include a strong systematics component. |
| Deadline: Mid-February | |
| More info: | www.systass.org/awards |
| **The Exploration Fund Grant** | |
| up to $5,000 | The Exploration Fund Grant |
| Research Funds | Provides grants in support of exploration and field research for those who are just beginning their research careers. |
| Deadline: mid October | |
| More info: | www.explorers.org/expeditions/funding/expedition_grants |
| **CIC Smithsonian Institution Fellowship** | |
| $32,700 for 1 year | CIC & the Smithsonian Institution |
| Stipend | One-year fellowships to support research in residence at Smithsonian Institution facilities. All fields of study that are actively pursued by the museums and research organizations of the Smithsonian Institution are eligible. |
| Deadline: early-December | |
| More info: | www.cic.net/students/smithsonian-fellowship |

| Ford Foundation Fellowship Programs | |
|---|---|
| $24k-45k, for 1-3 years | Ford Foundation |
| Stipend | Three fellowship types are offered: Predoctoral, Dissertation, and Postdoctoral. The Ford Foundation seeks to increase the diversity of the nation's college and university faculties. |
| Deadline: late-November | |
| More info: | http://sites.nationalacademies.org/pga/fordfellowships/index.htm |
| **The Arnold Arboretum Awards for Student Research** | |
| $2,000-10,000 | The Arnold Arboretum |
| Research Funds | Multiple awards or fellowships are offered for graduate students and for undergraduates, with topics that focus on Asian tropical forest biology and comparative biology of woody plants (including Chinese-American exchanges). Check website for full information on each award. |
| Deadline: late-November | |
| More info: | www.arboretum.harvard.edu/research/fellowships/ |
| **Garden Club of America Scholarships** | |
| $2,500-8,000 | Garden Club of America |
| Research or Training Funds | Many awards are offered to support botanical research, with foci ranging from public garden history/use, field botany, medicinal botany, and horticulture. Check website for full information on each award. |
| Deadline: January - February | |
| More info: | www.gcamerica.org/scholarships |
| **PLANTS Grant** | |
| Varies | National Science Foundation and Botanical Society of America |
| Travel (conference) | The PLANTS program will pay the expenses of up to 12 undergraduates to participate in the BOTANY meetings as well as provide mentoring from both peer and senior mentors in the plant sciences. |
| Deadline: March 1 | |
| More info: | http://botany.org/Awards/F_PLANTS.php |
| **SMART Program** | |
| $25-38k/yr + tuition | American Society for Engineering Education |
| Stipend & Tuition | The SMART Program aims to increase the number of scientists and engineers in the U.S. Department of Defense. The program is particularly interested in supporting individuals that demonstrate an aptitude and interest in conducting theoretical and applied research. |
| Deadline: December | |
| More info: | https://smart.asee.org/faq/ |
| **The Mohamed Bin Zayed Species Conservation Fund** | |
| up to $25,000 | The Mohamed Bin Zayed Species Conservation Fund |
| Research Funds | The Mohamed Bin Zayed Species Conservation Fund is a new and significant philanthropic endowment established to directly support the cause of species conservation. It is open to applications for funding support from conservationists based in all parts of the world dealing with plant and animal species. |
| Deadlines: February 28, 2017 & June 30, 2017 | |
| More info: | http://www.speciesconservation.org/ |

| Fulbright U.S. Student Program | |
|---|---|
| Varies | U.S. Department of State, Bureau of Educational and Cultural Affairs |
| Travel (abroad) | Offers a variety of grants for one year of study or research abroad to over 100 countries. Applicants must have proficiency in the written and spoken language of the host country. |
| Deadline: September | |
| More info: | http://www.iie.org/fulbright#.WITr-rYrKrZ |
| **STAR Graduate Fellowships** | |
| $44k/yr + tuition | U.S. Environmental Protection Agency |
| Stipend & Tuition | EPA's STAR Graduate Fellowship program supports Master's students and doctoral candidates in environmental studies. |
| Deadline: between April and May | |
| More info: | https://www.epa.gov/research-grants#CurrentStar |

## Broader Impact Opportunities

These opportunities are not just for NSF grants! Sharing your passion for plants and science with a wide range of audiences will help develop speaking skills as well as help you reconnect with why you decided to go to grad school.

| PlantingScience | |
|---|---|
| What it is: | A learning community where scientists provide online mentorship to student teams as they design and think through their own inquiry projects. |
| What you can do: | Interact with grade school-to-college students online, as they work on plant-focused learning modules in the classroom. |
| More info: | www.plantingscience.org/ |
| **Science Olympiad** | |
| What it is: | Competitions are like academic track meets, consisting of a series of 23 team events in each division (middle school or high school). Each year, a portion of the events are rotated to reflect the ever-changing nature of genetics, earth science, chemistry, anatomy, physics, geology, mechanical engineering, and technology. |
| What you can do: | Mentor local students in person on a variety of science and engineering–oriented topics and skills; help organize and run competitions |
| More info: | www.soinc.org/ |
| **Local Arboretums, Parks, Museums, and Herbaria** | |
| What it is: | These institutions often depend on volunteers to donate their time and expertise to help people of all ages enjoy their collections and grounds. They may already have programs in place that allow you to lead tours or interact with visitors at special events, so that you can share your interests and passion. |
| What you can do: | Lead tours; help organize and run events |
| More info: | Look up local parks/arboretums/museums/herbaria online, or inquire at visitors' centers. |

# Short Courses and Workshops

These are a great way to learn new research skills, which can also be added to your CV or resume. Here are a few of the many options available to grad students for part of a semester or summer.

| Advanced Field Botany | |
|---|---|
| University of Idaho<br>June or July | This two-week course is open to upper division undergraduates and early career graduate students. In the course, you'll gain valuable experience and botanical knowledge in the field. You'll also get acquainted with the flora of Idaho in the Inland Northwest. Interested students should look for an announcement in the spring. |
| More info: | www.webpages.uidaho.edu/dtank/AFB/Advanced_Field_Botany.html |
| **Tropical Botany Summer Course** | |
| University of Florida<br>June or July | This course highlights the biology and systematics of tropical plants, specifically the extensive holdings of tropical vascular plants at Fairchild Tropical Garden, The Kampong of the National Tropical Botanical Garden, and the Montgomery Botanical Center. Field trips will also be offered to the Everglades, the Florida Keys, and other adjacent natural areas. Be on the lookout for an announcement during the winter months. |
| More info: | www.flmnh.ufl.edu/herbarium/news/tropicalbotany.htm |
| **OTS Courses in Tropical Field Biology** | |
| Organization for Tropical Studies<br>Variable dates | Courses through the Organization for Tropical Studies (OTS) are a well-renowned way to spend a summer or semester in the field, learning about the biology of tropical ecosystems in Costa Rica and South Africa. Course offerings include Tropical Plant Systematics, but check their website for the full list of offerings. |
| More info: | www.ots.ac.cr |
| **microMORPH & Arnold Arboretum Short-Course in Organismic Plant Biology** | |
| Arnold Arboretum of Harvard University<br>July 30 – August 12 | microMORPH summer short-courses give students a 2-week immersive learning experience amid the expansive living collections and the state-of-the-art microscopy facilities of the Arnold Arboretum. The topic for 2017 is Plant Anatomy: Development, Function, and Evolution, and applications are due by mid-April. |
| More info: | projects.iq.harvard.edu/micromorph/courses-0 |
| **Molecular Evolution Workshop** | |
| Marine Biological Library at Wood's Hole<br>July 17-27 | This 10-day course features a series of lectures, discussions, and bioinformatics exercises. Included are sessions on phylogenetic analyses, population genetics analyses, databases and sequence matching, molecular evolution, and comparative genomics. Applications for participation are due on April 7, 2017. |
| More info: | molevol.mbl.edu/index.php/Main_Page |

| Bodega Bay Applied Phylogenetics Workshop | |
|---|---|
| UC Davis and the Bodega Marine Laboratory<br>March 11-18 | This week-long course will cover topics in statistical phylogenetics and give students the opportunity to complete a project during the course. The schedule will likely include sessions on Bayesian interference, divergence-time estimation, MCMC diagnosis and model selection, biogeography, continuous and discrete trait evolution, species tree inference, and rates of lineage diversification. |
| More info: | www.treethinkers.org |
| **The R Basics Workshop** | |
| Missouri Botanical Garden<br>To be announced | This workshop is one way to get exposure and experience working with R, a powerful statistical software package. No dates are currently set for the next 3-day crash course, but it is likely that it will be taught again next May in St. Louis by scientists from the Center for Conservation and Sustainable Development. Look out for a formal announcement in December or January and watch the website. |
| More info: | www.rbasicsworkshop.weebly.com |
| **edX: Data Analysis for the Life Sciences** | |
| online<br>Variable times | edX, a free online course provider, offers a 7-part course on data analysis for the life sciences (PH525.1-7). These courses are a self-paced way to learn R for statistical analysis, starting with basic R use to dealing with genomic datasets. These courses combine video lectures, practical exercises, and a discussion board monitored by course developers. |
| More info: | Search "PH525" on www.edx.org |

## What's Next: Looking for a Job in Botany

Before you complete your degree, or if you are looking to switch jobs, it is important to consider your next step—whether it be finding a PI and lab to work in for continuing your education, finding a post-doctoral research opportunity, or finding a job that suits your goals and skills. Finding out about jobs often happens through personal contacts, but there are great online resources as well.

| Masters/PhD/Post-Doctoral Opportunities | |
|---|---|
| These types of jobs are easily searchable on the "EvolDir" website under "PostDocs" and "GradStudentPositions". Click the icon, and listings will pop up in a list from the newest to the oldest. This site shows positions from across the biological sciences, but it is a great option for plant evolutionary biologists. | |
| EvolDir | www.evol.mcmaster.ca/brian/evoldir.html |
| **Academic Teaching Positions** | |
| Check the BSA website: click on the "Careers/Jobs" tab, and you can select the "Post-doctoral, Fellowship, and Career Opportunities" link to see a current list of a variety of job postings. The BSA website is a great resource for one-stop-shopping for careers and other opportunities in a variety of botanical sciences. Another good resource for finding jobs (including post-doctoral opportunities) can be found through AAAS, at the Science Careers site. | |
| Botanical Society of America | jobs.botany.org |
| AAAS Science Careers | jobs.sciencecareers.org/jobs/botany-plant-science |

| Government Positions and Non-Academic Jobs | |
|---|---|
| Searches for government jobs can begin at usajobs.gov and americajobs.com. A good resource for non-academic jobs is the Conservation Job Board; this site allows you to search within various fields by state and is updated regularly. Networking sites like LinkedIn and ResearchGate will help you connect with and organize your professional contacts—be sure keep you profile pages updated and polished! | |
| Government Positions | www.usajobs.gov |
| | www.americajobs.com |
| Conservation Job Board | www.conservationjobboard.com/category/botany-jobs |
| | |
| **Use your University!** | |
| Many academic institutions have offices that focus on helping alumni succeed after graduation. Check with your department or institution for resources on job announcements, workshops focused on personal development (such as CV/resume writing or getting a teaching certificate), and networking opportunities. | |

# FROM THE *PSB* ARCHIVES

**60 years ago:** "The vote on the question posed in the Oct. 1956 number of *PSB*, namely, should *PSB* be continued beyond its two-year trial period, now stands at 293 in favor of continued publication, 2 opposed to continued publication. While this vote does not represent a majority of Bot. Soc's. members, it doubtless represents a fair sample of the opinions of our members. Thus, publication of PSB will doubtless continue, although the Council has not yet had the opportunity to render an official decision."

-Future of the Plant Science Bulletin *PSB* 3(1): 6

**50 years ago:** "Flora North America, as the project will be called, was officially launched on January 30, 1967 when the newly formed Editorial Committee held its first meeting at the Smithsonian Institution in Washington, D.C. This three-day meeting, convened by William L. Stern (Smithsonian), Chairman pro terra. of the Steering Committee, was attended by all members of the Editorial Committee."

-Shetler, Stanwyn G. Flora North America Launched *PSB* 13(1): 5.

# ANNOUNCEMENTS

## Eagle Hill Institute Natural History Science 2017 Field Seminars

Eagle Hill Institute, located on the eastern coast of Maine, will host seminars and workshops focusing on natural history during Summer 2017. These workshops are in support of field biologists, researchers, field naturalists, faculty members, students, and artists with interests in the natural history sciences.

Courses include "Sedges and Rushes: Identification and Ecology"; "Identification, Biology, and Natural History of Ferns and Lycophytes"; "Field Botany and Plant Ecology of the Eastern Maine Coast"; "Bogs and Fens: Maine Peatlands"; "Mosses: Structure, Ecology, and Identification"; "Survey of Grasses: Their Structure, Identification, and Ecology"; and "Field Botany and Plant Ecology of the Eastern Maine Coast", among many others. A full list of 2017 seminars and workshops, as well as registration information, can be found at https://www.eaglehill.us/programs/nhs/nhs-calendar.shtml.

## Pam and Doug Soltis Awarded the 2016 Darwin-Wallace Medal

Doug and Pam Soltis have been awarded the 2016 Darwin-Wallace Medal. This award, presented by the Linnean Society of London, recognizes their groundbreaking work in the study of evolution and diversification in angiosperms, including in phylogeny reconstruction, genome evolution, phylogeography, and many other topics. The official announcement of this award can be found in *The Linnean* 32(2): 35-36.

# In Memoriam

## Thomas Norwood Taylor (1938—2016)

It is with profound sadness that we acknowledge the passing of Dr. Thomas N. Taylor, Roy A. Roberts Distinguished Professor of Ecology and Evolutionary Biology at the University of Kansas, Curator of Paleobotany in the Biodiversity Institute and Natural History Museum at University of Kansas, and senior paleobotanist in the National Science Foundation U.S. Antarctic Program. Tom died at home in Lawrence, Kansas on April 28, 2016 after several years of battling cancer, and in so doing has left his discipline, his students, and his colleagues far poorer for his loss. In characteristic fashion for his indomitable personality, Tom was to be seen working at his desk less than a month before his death.

Tom Taylor was an Ohio boy, who earned his B.A. in Botany at Miami University (of Ohio) in 1960, and his Ph.D. in paleobotany in Wilson Stewart's lab at the University of Illinois in 1964. He then moved to Theodore Delevoryas' lab at Yale University for postdoctoral work in 1964 and 1965. At that time, coal ball studies were among the most active areas of paleobotanical investigation, and Tom focused his studies on the morphological and anatomical characterization of ovules assignable to medullosans and other seed ferns, on ferns, and on equisetophytes. In 1965, Tom accepted an Assistant Professorship at the University of Illinois at Chicago Circle, where he continued his studies of anatomically preserved Pennsylvanian and Mississippian age plants. During that period Tom worked closely with Donald A. Eggert, who he recruited from the University of Iowa and with whom he built massive collections and an extremely active program to study permineralized fossil plants at U.I.C.C. During those early years Tom began focusing on the ultrastructure of pollen and spores, for which he pioneered use of the scanning electron microscope in botanical studies, and developed many of the transmission and scanning electron microscopy techniques that are in common use today.

Although he had been promoted to Professor of Biological Sciences by 1971, Tom moved his laboratory and students to Ohio University in 1972, and then moved onto the Ohio State University in 1974, where he chaired the Department of Botany until 1978. In 1982 he joined the Byrd Polar Research Center at Ohio State, and began characterizing the Permian, Triassic, and Jurassic vegetation of Antarctica, a loving endeavor that he continued to pursue for the rest of his life.

Originally stimulated by the early Antarctic work of James Morton Schopf, Tom's studies of the late Paleozoic and Mesozoic plant biotas of Antarctica have dramatically expanded our knowledge and understanding of plant evolution and vegetational turnover on the continent of Gondwana. Also beginning in the 1980s, Tom hosted Argentine senior scientist Sergio Archangelsky, as well as postdoctoral researchers Georgina del Fueyo, Ana Archangelsky, Ruben Cuneo, and Ignacio Escapa. Those studies dramatically broadened the scope of studies on the South American biotas of Gondwana and produced life-long collaborations with Argentine colleagues.

In 1981, Tom hosted a sabbatical leave for his close friend and chytridalean mycologist, Charles E. Miller of Ohio University. That collaboration spurred his interest in fossil fungi, and laid the groundwork for Tom's pioneering development of the discipline of paleomycology. Initially focusing on fungi in Pennsylvanian age coal balls, Tom's interests quickly extended to the Lower Devonian Rhynie Chert, which he first studied with Winfried Remy. For more than 30 years Tom collaborated extensively with Hans Kerp, Hagan Hass, Michael Krings, and others to fundamentally reinterpret the scope of biological interactions that can be inferred from the fossil record. Those efforts have recently been compiled in the first comprehensive paleomycology textbook, "Fossil Fungi" (2015), which Tom co-authored with Michael Krings and Edith Taylor.

In 1995 Tom retired from The Ohio State University, but in characteristic "Taylorian" fashion, he did not retire from scholarship. Rather, Tom moved to the University of Kansas, where he accepted the positions of Distinguished Professor in Botany, Curator of Paleobotany in the Biodiversity Institute and Natural History Museum, and Courtesy Professor in Geology. Following establishment of the Department of Ecology and Evolutionary Biology at KU, Tom served as chair of the new department for three years before focusing his seemingly boundless energy on research, student mentoring, fieldwork, and classroom teaching.

Along the way, Tom found the time to deliver several hundred papers at scientific meetings, publish 468 peer-reviewed journal articles and book chapters, edit four books of scientific contributions, and author four textbooks, including three paleobotany textbooks and the first comprehensive compendium on fossil fungi. Tom's mentorship is legendary for the numbers of students graduated (M.S. = 11, Ph.D. = 14), postdoctoral researchers supervised (19), long-term researching guests to his laboratory (26), and for the creativity of his advice, the high level of his expectations, and the continuing support he generously provided to all. For his students, colleagues, and collaborations, he became both an inspirational colleague and a steadfast friend.

Tom was extremely proud of the nearly 60 externally funded research grants, including more than 50 years of continuous support from the National Science Foundation. More importantly, however, he was most gratified that such funding allowed him to offer unparalleled support for the mentoring of students and for the development of collaborations with colleagues from around the globe. While Tom took in stride his own unparalleled success in plant paleontology and paleobiology, his colleagues did not, and he was the recipient of numerous awards and honors. Among those that are most illustrative of the stature in which he is held are the Distinguished Teaching Award from The Ohio State University (1989) that recognized his commitment to students, the Alexander von Humboldt Senior Research Award (1994–1996) that initiated Tom's work on the Rhynie Chert, and the Paleobotanical Section of the Botanical Society of America Award for a lifetime of contributions to Paleobotany (2012). His colleagues' appreciation for his service is also reflected in his election as President of the International Organisation of Palaeobotany (1994–1997), and the National Science Board recognition he received for outstanding service to science (2006–2012). On the flight back from McMurdo Base in Antarctica in 1994, Tom replied to my prediction that he would soon be elected to the National Academy of Sciences by saying that he was far too independent to ever be accepted into that group. Only three months later we received the announcement that he had, indeed, been so elected.

Tom Taylor is clearly one of the most influential plant scientists of our time. Through his indomitable pursuit of excellence, his tireless development of new approaches and techniques, his thoughtful establishment of awards and programs to benefit students, his continuous contributions to the development of scientific societies and institutions, and his steadfast support of colleagues, Tom Taylor has dramatically elevated the quality and stature of paleobiological inquiry.

On a personal note, I shall always be grateful that in 1967 Tom accepted into his laboratory a masters student of rather equivocal potential, and also for the subsequent 50 years of guidance, support, criticism, encouragement, and inspiration that he continued to offer. I am delighted to recall that his passion for life was equaled by his fierce loyalty to those he loved. Tom was a devoted husband to his wife Edith Taylor, and a loving father to his seven children, and his grandchildren. Biological or scholastic, we were all family to Tom. It is hard to realize that I can no longer call his office to hear the familiar "Taylor" that would signal the beginning of a warm and enlightening conversation with my trusted mentor and fast friend. He is badly missed.

*By Gar Rothwell*
*Ohio University, and*
*Oregon State University*

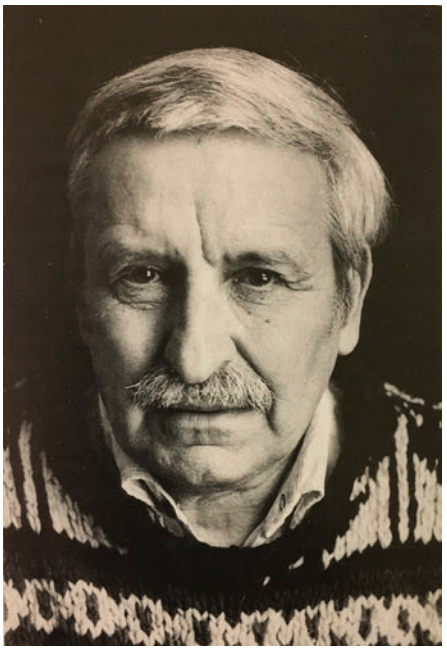


*Photo credit to Brent Nicastro.*

## Hugh Iltis (1925–2016)

Hugh H. Iltis, Ph.D., 91, passionate and outspoken advocate for preservation of the natural world, died December 19, 2016, after a long and full life. A larger-than-life figure to all who knew him, Iltis was born in Brno, Czechoslovakia on April 7, 1925. His father, Hugo, was a botanist, educator, and biographer of Mendel, the founder of genetics. Because Iltis's father was Jewish and a left-wing political activist, he was targeted by the Nazis and, with the help of Albert Einstein, the family left Brno for the United States in 1938, settling in Virginia.

After a year at the University of Tennessee, Iltis entered the U.S. Army during WWII, spending 1944-46 in Europe as a medic, interrogator of captured German officers, and later as an intelligence officer, preparing documents for the Nuremburg trials. He received his B.A. degree from the University of Tennessee and his Ph.D. at Washington University and the Missouri Botanical Garden in St. Louis.

Following three years of teaching at the University of Arkansas, Iltis spent nearly 40 years (1955–1993) as Botany professor and Director of the Herbarium at the UW-Madison, growing the herbarium to house over 1 million dried plant specimens. His taxonomic research focused on Capparidaceae and on Zea, working primarily in Mexico and the tropics. Iltis led numerous expeditions to many parts of the world to search for new plant species, travelling on mule or horseback when necessary.

Teaching his courses with enthusiasm and dramatic flair, he educated students on the importance of integrating taxonomy, biogeography, ecology, and evolution. He advised 36 graduate students, many of whom have gone on to impressive research and academic careers in botany. The lobby of Birge Hall for a few years was filled (to the dismay of some administrators) with donated scientific books and journals, ultimately filling two semi-trailer trucks, bound for the University of Guadalajara. In later years, he turned his book donating primarily to the UW-Madison libraries.

Iltis authored dozens of scientific papers and book chapters, environmental writings, and the *Atlas of the Wisconsin Prairie and Savanna Flora*, co-authored by Ted Cochrane.

In defense of the flowers, butterflies, birds and children, Iltis spoke out forcefully against the mindless consumption of material possessions, the heedless destruction of biological diversity, and the unsustainable increase in human population, the root cause of our environmental crisis. He was a strong supporter of abortion rights. His role in all aspects of his career was to stir up people, to confront people with the hard reality of what must be done to preserve the quality of the natural environment for human survival and for scientific study.

Of the world's nine known species of tomatoes, Iltis discovered two of them when he travelled to Peru on a $20,000 NSF grant from November 1962 to February 1963 accompanied by then wife Carolyn Merchant and Ph. D student Don Ugent and his wife. One of those two wild tomato species discov-

ered, proved 17 years later to be worth many millions of dollars a year to the industry—an over ten-thousand-fold sensational return on a small research investment, which may ultimately be dwarfed by the yet-unknown value of the over 20,000 specimens collected on that trip including many new endemic species. It is thus all the more inexcusable that while much of the world's biodiversity is disappearing overnight before we even know what has been lost, funding for basic scientific research continues to face sharp cuts.

His preservation efforts were successful in Wisconsin, Hawaii, and Mexico. Iltis was co-founder in 1960 of the Wisconsin Chapter of the Nature Conservancy. In 1967 he instigated formulation of Hawaii's Natural Areas Law, which was enacted in 1970, and on the 20th anniversary (1990) he was recognized "for outstanding service to the Hawaiian environment." In 1968 he was part of a small group, including Hugh's colleague Orie Loucks, whose activism led to the outlawing of DDT in Wisconsin, which led, ultimately, to a national ban. Following his sensational discovery with Mexican botanist Rafael Guzman, of *Zea diploperennis* (perennial teosinte, and close relative of cultivated corn, *Z. mays*) in Mexico in 1977, he played a pivotal role in establishing the 345,000-acre Sierra de Manantlan Biosphere Reserve in the State of Jalisco, the first time an international biosphere reserve was founded around the site of a rare, endemic species whose germplasm holds the only known source of genetic resistance to various corn viruses and corn rust disease and thus is of potentially enormous economic value. The Sierra de Manantlan is two thirds the size of the Great Smoky Mountains National Park, another place that Iltis loved and to which he led field trips. For this effort, in 1987 he received the Republic of Mexico's Presidential Award from then President De La Madrid. More importantly, it has launched the further education of a number of accomplished Mexican botanists and environmentalists.

Other awards that Iltis received during his career were the Sol Feinstone Environmental Award (1990), National Wildlife Federation of Merit Award (1992), Society for Conservation Biology Service Award (1994), the Asa Gray Award by the American Society of Plant Taxonomists (considered the top award in the field of taxonomy) (1994), the Merit Award from the Botanical Society of America (1996), the University of Guadalajara's Luce Maria Villareal de Puga Medal (1994), and an honorary degree from the University of Guadalajara.

He always shared liberally, be it authorship of papers, credit for discoveries, or even a place to live—as a number of Mexican students who gained Masters or Ph.D. degrees at the UW lived in his home for sometimes months at a time. He worked with dozens of institutions in Latin America, making a strong contribution to the development of science, and developing strong collaborative ties with researchers in those countries.

As early as 1964, Iltis argued that the most profound reason why we should preserve the natural world was human's innate need for natural beauty and diversity. The cover page of his copy of E. O. Wilson's *Biophilia* bears Wilson's inscription, "To HHI, the pioneer in the field." Iltis loved prairies, studied them, and wrote and spoke passionately in their defense. Two prairie and savannah areas in Wisconsin now bear his name.

Hugh is survived by his four sons, Frank and Michael of Madison, David of Salt Lake City, and John of Minneapolis, and friends and colleagues. He was preceded in death by his father, Hugo; mother, Anni; brother, Wilfred; and wife, Sharyn Wisniewski.

It is suggested that contributions in Hugh Iltis's name be directed to the Wisconsin Chapter of the Nature Conservancy or to The Prairie Enthusiasts.

http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/wisconsin/index.htm

http://www.theprairieenthusiasts.org/

*-By Michael Iltis*

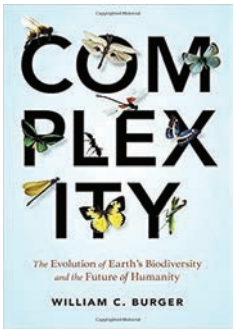
# BOOK REVIEWS



## CONSERVATION

### Complexity: The Evolution of Earth's Biodiversity and the Future of Humanity


William C. Burger
2016.
ISBN-13: 978-1-63388-193-8
Hardcover, US$26.00. 380 pp.
Prometheus Books, Amherst, New York, USA


*Complexity* describes the background of biodiversity on our planet, and, as the book's subtitle states, the future of humanity. In fact, when I came across it, this subtitle made me curious and prompted me to read and review this book. Who is the author? William C. Burger is a biologist, botanist, ecologist, writer, and has been Chair and Emeritus Curator of Botany at the Field Museum of Natural History in Chicago. He is highly qualified to write a book on this topic, and he claims to be a pessimist.

From the beginning, *Complexity* is different from standard ecological textbooks because

the author tries to involve interested readers with a general educational background as well as scientific peers. To do so, and to capture his audience´s attention, the author starts at comparably low level of biology, and proceeds stepwise to higher levels of complexity. The problem with complexity and biodiversity is that related research is rooted in many different disciplines. Systematics, phylogeny, biogeography, and ecology have to be covered, as well as conservation biology, biochemistry, and, when humans are involved, paleontology, anthropology, and cultural sciences. The author collects examples and insights from all these disciplines, keeping the reader fascinated, not at least because he is a dedicated teacher, as well as a brilliant researcher with ample experience abroad from many expeditions to unravel biodiversity.

Subdivided in 12 chapters, the book builds up stepwise like a series of lectures, covering basic knowledge in Chapters 1 to 6 and moving to more branched and outreaching aspects in Chapters 7 to 10. The first 200 pages cover the evolution of life on earth and the catastrophes that have shaped diversity in chapters that could well stand alone as essays.

In the end, the gentle reader has been guided through all kinds of different biomes or habitats, through the whole field of biodiversity, from billions of beetles to trillions of transistors. While the latter is not really biodiverse, but rather a technological means to understand its complexity, it is indispensable to understand human superiority on this planet. Did you know that gymnosperms are not very clever, and why that is the case? You´ll learn about that in this book. You will also learn why life on earth permanently opposes the second law of thermodynamics, or why you can mow your lawn but not your petunias. Or how bipedalism and swinging arms made our brains larger. Filled with impressive examples, sometimes purposefully redundant, with anecdotes and quotations from key publications on the topic, the book is more than fun to read—it is truly impressive. On one page, the author reports on being bitten in tender regions of his body by protective ants, a literary highlight in itself. Elsewhere, he describes how he has witnessed unexplainable but severe damage to old preserved forest reserves around the Great Lakes, and the loss of biodiversity due to the loss of pollinators in the Great Prairies. Even more important, William Burger´s book provides a plethora of facts about why our evolutionary history can never support a six-day creation 10,000 years ago.

Written in a colorful style and using brilliant examples, the first 10 chapters provide the foundation for Burger´s main argument. Hence, after having presented the reader with an outline of the evolution of diversity on earth, in Chapter 11 Burger summarizes the contents of the first 10 chapters in the book before focusing in Chapter 12 on human development and human prospects in an ever-challenging world. This last chapter is of utmost importance. We are adding more complexity to this world, and we are expanding the information content of the planet by exploiting all available resources, and permanently inventing or improving novel technologies. Burger describes optimistic viewpoints of fellow scientists, but nevertheless presents a pessimistic view of human future and development. Here he turns away from the biodiversity- or ecology-driven focus of the book—human complexity develops as our technologies emerge. In a modern society, the most important driver is information and the complexity within this information. He is afraid, as every insightful biologist should be, that our sheer numbers, the ever-increasing birthrates and the thoughtlessness of our

technologies are eroding the planet´s diversity so that we are, without any doubt, undermining the base of our own survival on the blue planet in the long term.

The monstrous volumes of coal and oil, the incredible amounts of minerals and ores that we consume daily, and the enormous energy that we use combine to dash hopes of reducing carbon footprints or stopping climate change. Burger is severely concerned about human life and future, and throughout the book, specifically in Chapters 10 to 12, he provides proof for his pessimistic view.

One shortcoming can be found, and that is the lack of explanatory figures throughout the book. Nowadays, the general public and our students are used to obtaining much information from pictures or other visuals. *Complexity* comes up with its first figure on page 170, and this is a poor representation of what the author describes. The second figure, about skull size and brain development in primates, is not much better.

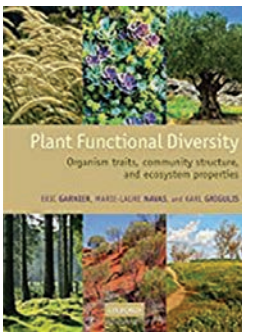
For me as a non-native speaker, the book, besides providing a plethora of scientific information and an exhaustive section of notes, has been a treasure of interesting phrases, from colloquial language and idioms up to biological terms. I enjoyed following its leitmotif, the development of its admittedly pessimistic plot, and the extraordinarily careful plotting of Burger´s argumentation. In a nutshell, the book is absolutely worth reading, is a valuable source of interesting facts on biodiversity and complexity of our home planet, and gives many examples for why mankind should act more responsibly to save the planet.

But what a pessimistic perspective we are given in the end: together with roaches and rats, our species will probably muddle on and survive even the next man-induced environmental catastrophes. Burger recognizes clearly that our inherent difficulties are the direct consequence of our best intentions. Hence, his book can only shed a dim light on the future of humanity, and personally, I would be even more pessimistic than the author, who leaves us with the message that these coming times might be "interesting."

*–Peter Schröder, Helmholtz Center Munich, German Research Center for Environmental Health, Neuherberg, Germany*

## ECOLOGY

### Plant Functional Diversity: Organism Traits, Community Structure, and Ecosystem Properties




Eric Garnier, Marie-Laure Navas, and Karl Grigulis
2016. ISBN-13: 978-0-19-875737-5
Paperback, US$59.95. xxii + 231 pp.
Oxford University Press, Oxford, United Kingdom

Plant functional diversity has increasingly become the focus of attempts to understand organization of plant communities and ecosystem functioning. The promise of this "trait-based" plant ecology is one of generalized prediction across organizational and spatial scales, independent of taxonomy. While taxonomic and phylogenetic aspects of biodiversity remain pertinent to answering many ecological questions, the functional approach provides many promising and often more cause-effect revealing alternatives. The use of functional traits, i.e., measurable attributes of organisms linked to their fitness, has a relatively long tradition in plant ecology, dating back to Warming, Schimper, and Raunki-

aer. However, the ever-increasing number of journal publications in this field over the past 20 years has become almost overwhelming. Interestingly, the modern trait-based plant ecology has been developing at about the same speed in many countries simultaneously (e.g., Argentina, Canada, Czech Republic, Estonia, France, New Zealand, Spain, United Kingdom, United States). The level of international cooperation in this field is really impressive. The recent article on the global plant trait spectrum (Diaz et al., 2016) is one of the best examples. Under these circumstances, it is surprising that recently published books have covered this research field only partially or idiosyncratically (Craine, 2009; Shipley, 2010; Grime and Pierce, 2012; Pla et al., 2012; Šmilauer and Lepš, 2014; Pawar et al., 2015). The book under review is the first attempt to summarize current achievements in trait-based plant ecology, from organisms to ecosystems. It is based on *Diversité Fonctionelle des Plantes*, published by the first two authors in 2013, but is substantially enriched and updated.

The book starts with a glossary and table of abbreviations that clarify the terminology and symbols used throughout the book. The text is divided into 10 major chapters, each summarized in four to six key points and supplemented by an extensive list of relevant references. Here are the major questions addressed by individual chapters: Chapters 1 and 2—What is a trait, and in what ecological context are traits used? Chapter 3—What are the appropriate traits to use in a given ecological context? Chapters 3 and 8—How do traits vary along environmental gradients? Chapters 5 and 8—What are the determinants of trait variability in a community? Chapter 5—What are the rules of community assembly in terms of traits? Chapters 6, 7, and 8—How do the values and variability of traits affect the functioning of ecosystems and the delivery of ecosystem services to human societies? Chapter 9—How are data on traits stored and accessed? Chapter 10—What are the most desirable future research directions?

Meaning, methods of actual quantification, and relationships among several important traits and ecosystem properties (e.g., specific leaf area, relative growth rate, residence time of nutrients, net primary productivity) are presented in sufficient detail. Verbal comparison of 13 indices used to describe the functional structure of communities (Table 5.1) is useful. However, if we want to know how to combine species data, trait data, and environmental data tables in meaningful multivariate analyses, how to choose among multi-trait indices, how to deal with missing trait data, how to compare the among- and within-species extent of trait dissimilarity, or how exactly we should test for biotic effects on community composition, we have to use more technical literature (e.g., de Bello et al., 2012, 2016; Pla et al., 2012; Šmilauer and Lepš, 2014). Two non-exclusive hypotheses have been proposed to explain the effects of plant functional diversity on ecosystem properties: (1) the dominance hypothesis, which states that traits of dominant species will be most influential, and (2) the functional complementarity hypothesis, according to which it is primarily the presence of different species (with different trait values) that use environmental resources in a complementary manner that will influence ecosystem properties. Many instructive examples of experimental tests of these two hypotheses are provided (pp. 119–147). The authors conclude that there is currently stronger support for the dominance hypothesis than for the complementarity hypothesis. However, the relative importance of complementarity effects remains to be established, and this importance may vary between systems an ecosystem prop-

erties. A unique feature of this book is a separate chapter dealing with functional diversity in agriculture (grasslands and crop weeds).

Trait-based plant ecology is a quickly developing field. Inevitably, this book only provides a snapshot of the field in 2015. Still, it will be an extremely useful source of information for both students and many advanced researchers for several years to come.

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

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## On the Forests of Tropical Asia: Lest the Memory Fade


Peter Ashton
2014. ISBN-13: 978-1-84246-475-5
Hardcover, US$180.00. 670 pp.
Kew Publishing, Royal Botanic Gardens, Kew, United Kingdom

With its large format, abundant color plates, and poetically tinged title, this work might at first glance be taken for a coffee table picture book intended for casual browsing. Closer inspection will quickly disabuse the reader of such a notion. This is a heavyweight treatise that details the major currents of research on Asian tropical forests, focusing on the trees and their community formations. The text is as dense as the forests described. It is packed with data, analyses, summaries, and italicized key questions for future research, with the look of a major scientific treatment that will be an essential reference for those who study tropical forests.

The book begins with a chapter on the physical environment of Asian forests, with discussions of the region's paleogeographic history, climate, geology, soils, and so forth. This chapter is particularly rough going for the outsider. There is no political-geographic map provided, which is problematic for those who don't already know the locations of, say, Sulawesi, Halmahera, Palawan, the Makassar Straits, the Western Ghats, etc. You can look them up in the place names index in the back of the book; there you're given a boldface number that will identify the locality on the rainfall map on the inside front cover, if you can find the corresponding number. But it will be much easier to get hold of a National Geographic (or similar) map of Asia and keep it on hand.

A distinctive feature of the Asian tropics, we learn here, is that its characteristic vegetation extends well outside the geographical tropics to the southern Himalayan foothills and coastally as far north as the southern islands of Japan. This is attributed in large part to a vast low-pressure system atop the Himalayan Plateau, which draws the moist tropical air masses—in particular, the southwestern and northeastern monsoons. The next chapters describe the lowland tropical vegetation and the complex interplay of light, moisture, nutrients, and disturbance patterns that sustain either a perpetually moist or a seasonal forest type. A following chapter details the lower and upper montane vegetation of the cloud forests, their development in relation to the cloud belt, and the transition to the subalpine zone. The diverse and fascinating interactions with pollinators and seed dispersers are then given attention in the chapter "Trees and their Mobile Links." That discussion is followed by one entitled "The Palimpsest of History," which analyzes distributions of species and higher taxa in the context of long-term climatic, geological, and tectonic history. A noteworthy theme here is that most angiosperm families comprising the tropical Asian forest flora actually originated in Gondwana in the late Cretaceous, reaching the region chiefly via the rafting of the Indian subcontinent onto Laurasia in the early Tertiary. A discussion of the dynamic factors that maintain and modify diversity in contemporary forests follows. The book then concludes with two chapters that expand the scientific focus on Asian forests to give attention to the long-standing human interactions. The first of these details the interface of the region's human history and culture with the forests and their resources. The second outlines the strategies proposed for maintaining what is left of Asian tropical forests, and evaluates their record and potential for success.

The extensive scholarship summarized in this book is thoroughly documented in an extensive reference list. However, accessing the references involves a two-step process that is not very user friendly. References are cited numerically; you then must find that citation number in a long list of continuous text in small print at the end of each chapter. But this effort gives you only the authors and year of publication; you must then search in the literature list at the end of the book to get the full reference.

I found few errors worth noting. Biology educators in the trenches who teach the seed plant life cycle may wince when reading (p. 311) that a higher plant's gametes are the pollen grain and the ovule. More immediately in need of correction: endomycorrhizae are formed by Glomeromycota (which are true fungi), not by oomycetes (which are stramenopiles; pp.46). There also appears to be confusion about the meaning of the term "(core) eudicots," which the author repeatedly uses as a synonym for basal angiosperms or magnoliids (pp. 382, 392, and Table 6.1).

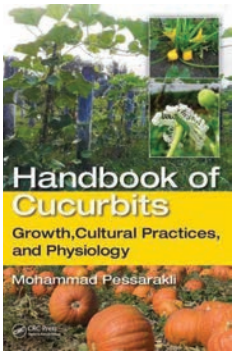
These minor complaints are overtopped and out-shaded by what is obviously a massive achievement, certain to find its place in the emergent canopy of tropical forest science.

*–William B. Sanders, Florida Gulf Coast University, Fort Meyers, Florida, USA*

# ECONOMIC BOTANY

## Handbook of Cucurbits: Growth, Cultural Practices, and Physiology

Mohammad Pessarakli (editor)
2016. ISBN-13: 978-1-4822-3458-9
Hardcover, US$279.95. 574 pp.
CRC Press, Boca Raton, Florida, USA




I was very impressed with the *Handbook of Cucurbits*. This handbook is a compilation of research articles covering many aspects related to cucurbits. The manual was edited by Dr. Mohammad Pessarakli, from the School of Plant Sciences at the University of Arizona, with the collaboration of more than 50 renowned scientists from around the world. The book is organized topically into 11 sections with 31 chapters. This organization facilitates the ability of the reader to select the articles that are most interesting to his or her needs.

I was very interested in learning more about this widely distributed group of plants. I was familiar with most of the New World pumpkins, squashes, and melons, but learned a great deal about many other types of cucurbits that are grown primarily in Asia. There is no doubt that with global warming and the drastic change of climate in many parts of the world, the adaptability of species in the Cucurbitaceae will bring a desirable food source to markets where traditional plants will no longer be able to survive. I would highly recommend the following chapters: "Cucurbits: History, Nomenclature, Taxonomy, and Reproductive Growth," by S. Ramesh Kumar, and "Cucurbits: Importance, Botany, Uses, Cultivation, Nutrition, Genetic Resources, Diseases, and Pests," by David O. Ojo. Both chapters contain detailed information on the history, uses, and taxonomy of this family, and include familiar names along with many that I heard for the first time. One of the curiosities described in the book is the origin of the common name "cantaloupe." Ojo mentions in his section about *Cucumis melo* L. (muskmelon) that the name "cantaloupe" derives from the 15th-century introduction of melon from Turkish Armenia to the papal residence at Cantalupi, near Rome. Another interesting chapter is "Carbohydrate Metabolism of Cucurbits" by Minmin Miao and Zhiping Zhang. Most plants follow a sucrose-translocating metabolism of photosynthates, but cucurbits translocate sugars mainly in the form of raffinose family oligosaccharides (RFOs). This is a different pathway that needs to be understood in order to take advantage of the rapid distribution of sugars to most parts of the plant. In many species, not only the fruits are edible, but young stems, leaves, and even roots are also consumed because of their starch and sugar content.

The *Handbook of Cucurbits* has many chapters related to the cultural practices related to cucurbits, as well as practices for weed and pest control. The sections on Genetics, Genomics, and Breeding of Cucurbits and on Cucurbit Grafting have up-to-date chapters that include the newest information related to plant breeding and practices to improve pest resistance using tolerant and/or resistant genes. Most interesting and relevant to the climatic changes our planet is experiencing are the following chapters: "Physiological and Biochemical Responses of Cucurbits to Drought Stress," by Amir H. Saeidnejad; "Soil Salinity: Causes, Effects, and Management in Cucurbits," by A. Sharma, C. Rana, S. Singh,

and V. Katoch; and "Growth Responses of Watermelon to Biotic and Abiotic Stresses,"by Satya S. Narina. There is only one chapter in the section Therapeutic and Medicinal Values of Cucurbits, but this chapter is full of nutritional information on 14 species of cultivated cucurbits, from the white gourd (*Benincasa hispida* (Thunb.) Cogn.) to the snake gourd (*Trichosanthes anguina* L.). This chapter also provides a detailed description of the domestication of cucurbits, their centers of diversity, and areas of cultivation.

The last section focuses on individual crops. There are two chapters devoted to different taxonomic, agricultural, nutritional, and medicinal properties of snake gourd (*Trichosanthes* L. sp.). The following crops: bitter melon (*Momordica charantia* L.), snapmelon (*Cucumis melo* var. *momordica* (Roxb.) Cogn.), kachri (*Cucumis callosus* (Rottler) Cogn. & Harms), and squashes and gourds, have a chapter devoted to the characteristics, uses, and cultivation of these useful cucurbits. The chapter on squashes and gourds lists and describes characteristics of five species within the genus *Cucurbita* L.: *C. argyrosperma* K. Koch, *C. ficifolia* Bouché, *C. maxima* Duchesne, *C. moschata* Duchesne, *C. pepo* L., as well as *Lagenaria siceraria* (Molina) Standl., and five species within the genus *Luffa* Mill.: *L. acutangula* (L.) Roxb., *L. aegyptiaca* Mill., *L. echinata* Roxb., *L. graveolens* Roxb., and *L. hermaphrodita* Singh & Bandhari.

All of the chapters have ample, up-to-date reference citations that are beneficial for all scientists interested in these subjects. Several chapters have pictures to illustrate some of the plant or fruit characteristics, and the pictures are reproduced in color plates as an insert in the center of the book. If there is one disappointment I had about this handbook, it is the lack of pictures identifying many of the species that are grown as common crops in Asia and Africa, but that are not common to growers in other parts of the world. Overall, this is a very informative book that is well presented and easy to follow, even for those who are not crop or agricultural scientists, and it offers complete references for those looking for research information on species in the cucurbits family.

*–Cecilia Bianchi-Hall, Ph.D., Lenoir Community College, Kinston North Carolina, USA*

## The Book of Spice: From Anise to Zedoary

John O'Connell
2016. ISBN-13: 978-1-68177-152-6
Cloth, US$26.95. 271 pp.
Pegasus Books, New York, New York, USA


The WorldCat record reveals that 1,936 book titles were published under the search keyword "spices" (qualified by "not juv, not fiction") during the past seven years (2010–2016); 300 of those books are not in English. Collectively, the topics include regional cookbooks, history, geography, nutrition, even phytochemistry. Why then, I wondered, is a new title about spices being published now?

Promotional literature states that author John O'Connell is a former Books Editor at *Time Out* magazine. He writes book reviews regularly for *The Guardian* and *The Times*. He is the co-author of *I Told You I Was Ill: Adventures in Hypochondria* and *The Midlife Manual.* O'Connell's experience with the literary scene enabled him to select a topic about which many readers have some general interest, and using various electronically available sources and a variety of other culinary works and a few classics, he's assembled a dictionary of spices from A to Z.

If you are seeking a romantic getaway to faraway places without a visa or having to remove your shoes for airport security, but instead within the comfort of your favorite armchair, *The Book of Spices* will take you there effortlessly and bring you delight. Each spice, arranged alphabetically, receives variable attention, from a mere paragraph to several pages. Anecdotal tales are woven describing historical or contemporary use, comparisons are made between cultures, and recipes old and new tempt the reader. The book may be read from cover to cover, as recreational reading, or simply as a handbook to the ingredients in one's cupboard. It seems to be accessible to a general audience interested in flavors used in cooking throughout history. I find the 18-page Directory of Spice Mixes at the dictionary's end a worthwhile contribution, introducing readers alphabetically to little-known blends from *advieh*, a Persian spice mix, to *zhug*, a coarse chili paste from Yemen.

This dictionary, unfortunately, is not illustrated, and offers only a three-page "select bibliography," rather than a comprehensive list of sources, although 369 notes on 15 pages document the information presented. I am disappointed to find that many are secondary sources and compilations. O'Connell leans heavily on Gernot Katzer's website for information; in the acknowledgments he wrote: "Anyone seeking more detailed botanical knowledge should google Katzer's spice pages—truly a feast of riches." I would caution botanists against overreliance, having studied that source myself for more than a decade.

Citing Katzer among his references for the entry about sesame, O'Connell relies on Katzer's very dated information: "Sesame is an ancient cultigen. Today, it is mostly grown in India and the Far East (China, Korea), but its origin is probably tropic Africa (although some other sources seem to favour an Indian origin)." This is one among several of Katzer's facts that remain unchanged since I read them initially; he's overlooked evidence published over the course of more than three decades about the domestication of sesame (Bedigian, 1984–2015).

Additionally, FAO statistics (2014 latest available) show remarkable changes in production figures, even since those data were presented in the monograph about sesame (Bedigian, 2010). Current as of 2014, Africa contributed 54.8% of the world's sesame production while Asia provided 41.6%, with the remaining 3.6% by the Americas. Those top 10 producers in descending order were India, Sudan, mainland China, Myanmar, Tanzania, Nigeria, Burkina Faso, Ethiopia, South Sudan, and Uganda.

*–Dorothea Bedigian, Research Associate, Missouri Botanical Garden, St. Louis, Missouri, USA*

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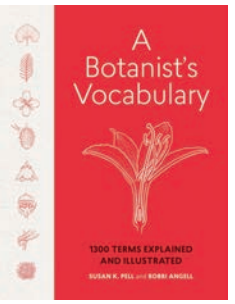
# EDUCATION

## A Botanist's Vocabulary: 1300 Terms Explained and Illustrated




Susan K. Pell and Bobbi Angell
2016. ISBN-13: 978-160469-563-2
Hardcover, US$24.95. 228 pages
Timber Press, Portland, Oregon, USA

This book is written for a general audience interested in botany and botanical terms. The authors focus on educating naturalists and gardeners by providing concise definitions important for plant biologists and detailed line drawings, which are beautiful as well. Susan Pell is on the staff of the United States Botanic Garden, and Bobbi Angell is a scientific illustrator for the New York Botanic Garden as well as for the *New York Times* garden column. Together, they make a great team and have produced this simple yet elegant book.

Pell and Angell do a great job in covering standard items in plant morphology and structure so that readers can identify plants and plant parts. For instance, leaf and flower structures are prominently featured and illustrated (e.g., simple and compound leaves, leaflets, palmate, pinnate). However, a broad range of topics in botany and plant biology are featured, but not every term has an illustration. As a physiologist, I noted apical dominance, chlorophyll, gravitropism, phototropism, photoperiodism, and photosynthesis (but not, for example, auxin and phytochrome).

Most, but not all, of the key plant groups are covered: angiosperms, gymnosperms, and mosses, but not ferns. However, ferns, particularly the sensitive fern *Onoclea sensibilis*, are used in many diagrams to illustrate concepts such as the fertile frond and sporangium. Terms important in plant ecology also are considered, including allelopathy, allopatric, clinal variation, and sympatric, among others. Additional botanical fields covered in the book include biogeography, genetics, horticulture, soil science, taxonomy, and tissue culture.

Professional botanists will enjoy having this volume on their bookshelf especially given the modest price. The book would also make a great gift to one of their friends who enjoys gardening and plants.

*–John Z. Kiss, University of North Carolina-Greensboro, Greensboro, North Carolina, USA; jzkiss@uncg.edu*

# HISTORY

## Plant: Exploring the Botanical World

Phaidon Editors
2016. ISBN-13: 978-0-7148-7148-6
Cloth, US$59.95. 352 pp.
Phaidon Press, London, United Kingdom


> "Botany–the science of the vegetable kingdom, is one of the most attractive, most useful, and most extensive departments of human knowledge. It is, above every other, the science of beauty."—Sir Joseph Paxton (using pseudonym Peter Parley, 1838)

*Plant: Exploring the Botanical World* displays the riches of the botanical world with assorted natural history drawings, etchings, paintings, watercolors, and photographs that circulated as objects among various participants in global networks of knowledge creation, historically as gifts with symbolic value exchanged in patronage relationships, and as embodiments of the plants they represent. It tells the story of intellectual and scientific collaboration, debate and competition, among naturalists for status and nations for profit. The Phaidon editors have prepared an assemblage set at the crossroads of botanical art work, colonial history, and the history of botany, united as a compelling chronicle that provides insight into the relationship between botany and art, while also probing an archive of some previously little-studied images. This anthology is as much about art and photography as it is about plants; diverse approaches to illustrating plant form are revealed in art and photographs.

Juxtaposition underlies the arrangement of this book of contrasting or complementary images, paired on facing pages as couplets with variable features, e.g., pp. 98–99 relate two species of *Eucalyptus* geometrically for their diagonal lines and varied angles of leaf pairs; pp. 100–101 seem to share the color red, contrasting rose and poppy (ca. 1760), with sweet cherry (ca. 1561–1562); pp. 142–143 compare tree trunks in cross-section, using a chromolithograph (ca. 1850), alongside a light micrograph of pine stem (2011); pp. 164–165 differentiate *Luffa aegyptica* with a Japanese woodblock (ca. 1900) showing a solitary yellow flower attracting a single bee, along with two fruits, one mature, the other juvenile, against a copper engraving from Venice (1640). Readers meet the storyteller's secret weapon—an element of surprise—contemplating two unexpectedly related works side by side. It may be that botanical illustration and art photography have been under-researched by historians of art.

*Plant* offers some new material and some that is usefully repackaged. A concise paragraph on each page tells readers about the artist and composition featured. Despite their number, all of the figures are referenced in the text; they are so skillfully interwoven that documenting the sources of each illustration does not strike the reader as a burden. Along with citing the essentials, the editors are subjective, adding analysis of the artworks. The book is beautifully designed, printed in Hong Kong, and rich with delicate yet vivid color illustrations, e.g., pp. 120–121, spotlighting the flush of a colored Japanese woodblock print of an iris garden (1857) against a dusky hand-tinted copperplate engraving of a majestic black iris from Nuremberg (1768). The volume offers a brief 10-page chronology and a limited 7-page index.

*Plant* resists comprehensiveness, acknowledging the necessarily fragmented nature of this history; as an art book it falls into a strange genre in contemporary botany, hovering between several different disciplines. Examining the work of specific artists is rewarding and informative, an opportunity to consider a diverse range of materials produced over the past 500 years within a discipline that insists on the importance of the graphic process.

Historically, traveling naturalists worked in concert with trained artists who drew and painted representative specimens. These images, in turn, were also described verbally and often accompanied by dried plants. Working with text, image, and dried specimen allowed naturalists around the world to participate in collective empiricism and communicate with one another.

Photography promised a new means of preserving and recording, and of quickly, efficiently, and authoritatively rendering views through an unimpeachable mechanical process, seen as free from the potential of human error. Already familiar with their original materials, botanist-scholars could look through a photograph to reanimate their recollection of previously studied materials, particularly when incorporating contemporary renderings such as three-dimensional visualizations of plant structures and other modern techniques meant to serve the needs of a scientific community.

Other books with which *Plant* might be compared include Blunt's (1955) *Art of Botanical Illustration: An Illustrated History*, which represents a benchmark in terms of documenting botanical illustration and provides a "comprehensive, critical and well-illustrated survey" of how plants and flowers have been illustrated over time by different artists in different places for different purposes. Rix's (2012) *Golden Age of Botanical Art* spans from 4500 B.P. through contemporary botanical art. It explores the origins of botanical art and the range of botanical art produced—from florilegiums to art produced as the result of travels to many different places. Rix also highlights the range of ways in which art and illustration have been produced and a number of the people who are key to its history.

Phaidon is recognized worldwide for publishing fine books about art, architecture, photography, design, performing arts, decorative arts, fashion, film, travel, and contemporary culture, as well as cookbooks and children's books, so this volume with its focus on botanical art through history is somewhat of a departure. Overall, *Plant* successfully raises many interesting issues in connecting the fields it represents. The disengagement of artworks makes them subject to meanings imposed on them by those who use them; indeed, reframed within this public domain, they achieve something new, something unforeseen by their creators. Looking at things botanically is looking for absence as much as for presence, setting up another tension found throughout the volume.

*Plant* is a singular book that should be read in print copy, taking one's time to meditate upon the beauty of the photographs, and the lessons they tell.

*–Dorothea Bedigian, Research Associate, Missouri Botanical Garden, St. Louis, Missouri, USA*

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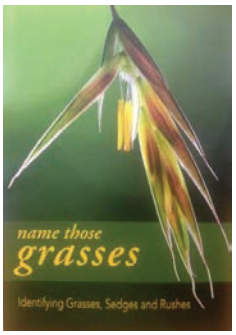
# SYSTEMATICS

## Name Those Grasses: Identifying Grasses, Sedges and Rushes

Ian Clarke
2015. ISBN-13: 978-0-9804076-4-8
Paperback, AU$48.00. 544 pp.
Royal Botanic Gardens Victoria, Victoria, Australia




*Name Those Grasses*, by Ian Clarke, is a beautiful and practical guide to learning to identify grasses and grass-like plants. It is not really a key or a flora, but instead emphasizes that the same process of identification can be used anywhere in the world and provides a practical primer for identification of these difficult families: Poaceae (grasses), Cyperaceae (sedges), Juncaceae (rushes), and Restionaceae (restios). The guide is intended to be used in conjunction with standard identification manuals for these plants in particular parts of the world. The author is based out of Australia, and his geographic bias comes through in some ways, but he focuses the book on species with wide geographic temperate distribution (often weedy) to broaden its usefulness.

A major emphasis of the book is the explanation of botanical language, both general and specific to these particular families. The author assumes no prior knowledge and does an excellent job in starting with the basics but also moving efficiently into the idiosyncrasies of the structures (and the language used to describe them) of the families of interest. He starts in Chapter 1 with an explanation of botanical nomenclature and classification. He then explains how to use the book and how it is structured. He suggests multiple approaches to learning how to identify the plants using this book, depending on one's background and interest. He also gives a detailed explanation of the illustrations to be very clear about how and why they are oriented and labeled as they are. He describes the techniques and tools he used for the botanical illustrations, which could be a very useful reference for other botanical illustrators.

Chapter 2 presents an introduction to plant structure in general, including basic morphological terminology and illustration of structures. It then gives an elucidation and comparison of these basic structures in six monocot families (Liliaceae, Orchidaceae, Iridaceae, Poaceae, Cyperaceae, and Juncaceae), as the author explains the reduced and simplified floral structure of the families that are the subject of this book. He also goes into detail about inflorescence and vegetative structure of the plants, again starting with a general botanical introduction before emphasizing the unique structures of grasses and grass-like plants.

Chapter 3 goes into much more detail than the first chapter about the rules of nomenclature and classification in plants, including recent understanding of broad-scale classification.

Chapters 4 through 7 are the heart of the book, each emphasizing one of four major families, giving an introduction to the family and the structures and characteristics particular to the family (and their variations within

the family). Clear illustrations for each are included, showing various views of flower and inflorescence structure, often including both intact and expanded views. These general guides will prove very useful for learning and understanding the structures of these tiny flowers. A review of recent understanding of the phylogenetic relationships within the family follows. Then for each of the major groups within the family, a narrative description, sometimes (such as with the tribes of grasses) with a table listing key characteristics and where they are illustrated. For each of these major groups, common widespread and representative members are described, with a detailed narrative description as well as multiple careful drawings including the whole plant, several views of the flowers and/or inflorescences, and (depending on what is most useful for identification) other structures such as the leaf blade/sheath junction, the fruit, or the culm anatomy. Thirty-four color plates are also included, many with multiple photographs, to illustrate the overall plant habit as well as the microscopic detail of flower structure of the key groups of plants described within.

On pp. 404-407, the author provides a condensed, one-page guide to each of the four major families, summarizing and illustrating their key characteristics. These pages will be extremely helpful for those beginning their understanding and ability to recognize and distinguish between these four groups.

Chapter 9 is a guide to the procedures of identifying plants in these groups. The author describes useful equipment, gives a list of key features for different groups, and discusses how to use keys of various sorts (including online keys). Then he provides keys to: (1) the families of grasses and grass-like plants, (2) the genera of Poaceae, (3) the genera and sometimes species of Cyperaceae, and (4) some species of Juncaceae. Although this book is not meant to be a flora or field guide per se, these keys could be useful for the most basic level of identification of plants in these groups; the user could then follow up with a more thorough guide to these plants in the user's specific geographic area.

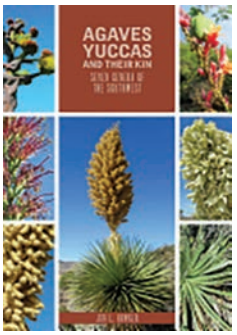
The author includes an extensive list of references at the end of the book, and to the left of each reference, gives an indicator of subject area. This is an interesting feature and could prove very useful for finding relevant sources of additional information on particular topics. A thorough glossary is also included at the end of the book.

Generously illustrated and carefully organized, this guide may be a welcome addition to the library of any botanist, professional or amateur. Despite inevitable limitations inherent in any book that tries to usefully summarize global diversity of grasses, sedges, and similar plants, the author has designed a primer that can serve as a practical introduction to these plants that are notoriously difficult to identify. I strongly recommend it to anyone who wants to become adept at identification of grasses and grass-like plants.

*–Amy Boyd, Department of Biology, Warren Wilson College, Asheville, North Carolina, USA; aboyd@warren-wilson.edu*

## Agaves, Yuccas, and Their Kin: Seven Genera of the Southwest

Jon L. Hawker
2016. ISBN-13: 978-089672-939-1
Paperback, US$49.95. 456 pp.
Texas Tech University Press, Lubbock, Texas, USA




This field guide aims to provide a thorough treatment of seven similar genera of desert-dwelling monocots in the American Southwest: *Agave*, *Dasylirion*, *Hechtia*, *Hesperaloe*, *Hesperoyucca*, *Nolina*, and *Yucca*. These genera all look alike to some degree, and indeed, six are members of the Asparagaceae. The genus *Hechtia* is not related to the others (it is a member of the Bromeliaceae) but is included due to its superficial resemblance.

This guide was not written by a professional taxonomist (Hawker says as much in the text) but by an enthusiast of these groups of plants. This brings both positives and negatives to the work. The reader can really tell that Hawker loves these plants and finds them fascinating—a welcome change from other, oftentimes dry, botanical works. The many photos that include Hawker's dog for scale are cute and add another personal touch to the book. However, the lack of keys within genera and the use of standard measurements instead of metric are unfortunate. There is also no glossary, which Hawker argues is not needed because this is not a technical guide. However, I counter that every professional started as an amateur and needed to learn all the terms used to describe plants, so if an amateur yucca enthusiast picks up this guide, how will he or she learn those terms?

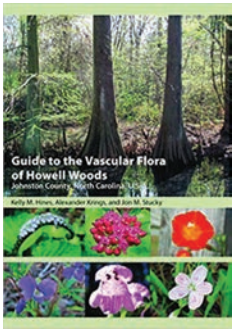
After an introduction covering what the book aims to provide, how the maps were made, and the region covered, the bulk of the book is broken into seven sections. Each section covers one of the aforementioned genera and all species within it that occur in California, Nevada, Utah, Colorado, Arizona, New Mexico, and Texas. The beginning of each section has a lengthy introduction to each genus covering taxonomy, biogeography, pollination, ecology, human uses, etc. These sections are well-written and fascinating. Again, Hawker's love for these genera really shines here. Each species is then treated alphabetically with information on geographic range, natural history, and how it can be differentiated from similar species. Again, technical keys would have been nice within these sections as this format means that the user is just "picture-matching" or "map-matching" (because many species have restricted ranges).

The photos are, for the most part, of high quality, with only a few being grainy (and these only being ones taken via a microscope). There are photos of all aspects of the plants: habitat shots, flowers/fruits, pollinators, leaves, and other characters useful for identification. Many photos are unique as well: I have never before seen photos of the copious cuticle being peeled off an agave leaf or of an entire agave plant cut longitudinally.

The book is easily portable and should be in any hiker's backpack when making a visit to the Southwest. Hawker does a wonderful job of cultivating an interest in these iconic plants.

*–John G. Zaborsky, Botany Department, University of Wisconsin–Madison, Madison, Wisconsin, USA; jzaborsky@wisc.edu*

## Guide to the Vascular Flora of Howell Woods, Johnston County, North Carolina, U.S.A.




Kelly M. Hines, Alexander Krings, and Jon M. Stucky
2015.
ISBN-13: 978-1-889878-47-8
Paperback, US$24.00. viii + 268 pp.
Botanical Research Institute of Texas, Fort Worth, Texas, USA

This is a large flora production for a small area comprising only 1155 ha (2854 acres), a full-fledged treatment of the vascular plants of just a part of a North Carolina county. Howell Woods is a tract of land presented to Johnston County Community College in 1993 by Rudolph A. Howell. As the authors note, this is the largest property gift to any North Carolina community college. On site is an educational center and a garden. Howell Woods is a remarkable resource for a community college, and the production of this work shows the depth of commitment to using it for education and research.

The book is well laid out and carefully edited. After introductory material dealing with collection methods, key construction, format, and illustrations, there is a helpful review of land use ("outdoor recreation, game-hunting, sand mining, and law enforcement firearm training"[!]). This is followed by a detailed description of soils and a discussion of the plant communities found within Howell Woods.

The main corpus of the book is keys. They seem workable and carefully prepared. For example, there is a helpful vegetative key to the species of *Utricularia* (bladderworts). There are no species descriptions, but names and synonymy are given as well as references to current literature. Also included is careful documentation of collections, either by the first author (mainly), from herbarium specimens, or from published floras. The authors present comparative floristic data for local floras in the region. Except for a few color pictures, illustrations are black and white and taken from earlier publications, mostly Britton and Brown (1913). An exception is the very helpful original close-up images of perigynia and achenes of sedges (genus *Carex*). Within each group (pteridophytes, gymnosperms, monocots, eudicots), families, genera, and species are listed alphabetically. A species checklist and references cited section complete the book.

I am the manager of an ecological preserve and would love to have a flora like this to put in the hands of my students. I imagine standing in a plant community defined in the book on named soils keying down sedges—what a great learning experience. While the *Guide to the Vascular Flora of Howell Woods* covers only a small part of a single county, it will find utility in other North Carolina counties. For a book that almost certainly has a very limited press run, the cost is reasonable.

*–Lytton John Musselman, Department of Biological Sciences, Old Dominion University, Norfolk, Virginia, USA*

## Native Plants for Southeast Virginia, including Hampton Roads Region

Virginia Witmer, editor
2016. No ISBN
PDF (available online) and paperback (both free; see below for details). 69 pp.
Commonwealth of Virginia, Department of Environmental Quality, Virginia Coastal Zone Management Program, Richmond, Virginia, USA

I was pleasantly surprised to learn of this very colorful, helpful publication from a local newspaper column. After the article appeared, more than a thousand readers responded, clearly indicating public interest in native plants. An exemplar of efforts to utilize native

plants for landscape and garden planting, this glossy booklet deserves wider recognition.

The level of presentation is ideal for the interested public. The bulk of the book consists of treatments of groups of plants: perennials, groundcovers, ferns, grasses, shrubs, and trees. Images are exceptional, the few bullet points for each species' image include plant habit, light requirements, whether native or not, habitat and wildlife use (especially birds and butterflies), and other items of interest. Large genera like *Solidago* and *Viola* are helpfully presented with lists of species enhanced by useful close-up diagnostic pictures.

Inclusion of native plants suitable for cultivation is not exhaustive, and there are several I would add, some are noted below.

Inexplicably, the section on ferns omits *Dryopteris ´australis*, Dixie wood fern, a native hybrid I have seen sold in Hampton Roads garden centers and that thrives in my Norfolk garden. Likewise, Christmas fern, *Polystichum acrostichoides,* is omitted despite being an excellent garden subject. On the other hand, I was pleased to see in the chapter on vines the beautiful climbing hydrangea, *Decumaria barbara,* a liana that deserves more consideration as a garden subject.

Sedges are discussed, as are rushes and grasses, although the omission of river oats, *Chasmanthium latifolium*, is surprising as this grass is frequently used in landscaping in Hampton Roads. In the section on shrubs, the black huckleberry leaves labeled as *Gaylussacia baccata* are likely one of the blueberries (species of *Vaccinium*) instead. Speaking of *Vaccinium*, I would have included deerberry, *V. stamineum*, because of its masses of white, showy flowers in the spring. The chapter on trees includes instructive notes and images for six oaks.

For landscapers, there are chapters describing plants for specific habitats such as streets, dry shade, sun shade, and especially germane for a region surrounded by salt water—plants for salty edges.

There is a list, albeit incomplete, of places to see these native plants in the region and a concise treatment of invasive plants. A helpful, although partial, list of additional resources of publications and websites completes the booklet.

I was told by the editor that this is a "marketing piece." Perhaps. But it is more—*Native Plants for Southeast Virginia* is a valuable contribution supporting planting of our native plants that shows how they can become part of our daily landscape. So as a marketing tool it is a wild success. Any serious gardener or plant lover will want one! This is a beautiful publication with wonderful images; it is packed with information and carefully edited. But you may have to wait for yours—demand is so great a second edition is needed.

This book is available online at http://www.deq.virginia.gov/Portals/0/DEQ/CoastalZoneManagement/Native-Plants-for-Southeast-Virginia-Guide.pdf. Limited print copies are available free; contact Virginia Coastal Zone Management, 629 East Main Street, Richmond, VA 23219 USA.

*–Lytton John Musselman, Department of Biological Sciences, Old Dominion University, Norfolk, Virginia, USA*

# March for Science

The Botanical Society of America has partnered with March for Science for their global event taking place April 22, 2017. The march is intended for scientists of all fields to engage with political leaders and policy makers to enact evidence-based policies in the public interest. Check out www.marchforscience.com for more information on a march near you.


## Botany is #notaquietscience: Make sure your voice is heard!

Botany 2017
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## Coming to Botany 2017? Sign up for this timely workshop Sunday Morning, June 24 9:00 am - 12:00 pm

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Limited to 30 participants - $30.00/person
Presented by: Robert Gropp
Sign up: www.botanyconference.org

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# Plant Science Bulletin Featured Image


In 2017, more and more scientists—including the BSA members shown above—are becoming more politically and socially active. From the #actuallivingscientist social media campaign to the March for Science planned throughout the world in April, botanists and fellow scientists are finding the need to make sure their voices are heard and concerns are addressed in relation to the importance of their research as well as its continued funding.

Thanks to the following for allowing us to use their photos here: Matthew Bond, Margaret Frank, Eve Emshwiller, Jeffrey Ross-Ibarra, Heather Schneider, Stacey Smith, Kevin Weitemier, Irene Liao, Ashley Morris, and Tanya Cheeke.


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