



PLANT SCIENCE BULLETIN

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A PUBLICATION OF THE BOTANICAL SOCIETY OF AMERICA



CONGRATULATIONS TO PLANTS GRANT RECIPIENTS!

IN THIS ISSUE...



*Executive Director
Bill Dahl retires...p. 145*



*International Botanical
Congress a success...p. 137*



*Meet BSA's new student rep,
Chelsea Pretz...p. 174*

From the Editor

Greetings,

In this issue of *PSB*, we bring you news of significant change underway for the BSA. At the end of September, long-time Executive Director Bill Dahl retired. In this issue, Bill reflects on his experiences with the Society and shares his perspective on the future of the BSA. I want to thank Bill, on behalf of *PSB*, for his dedication to, and direction of, the Society and for sharing his parting thoughts with us. Heather Cacanindin has stepped in as Interim Executive Director.

A change is also occurring in publications. Beginning with the January 2018 issues, the *American Journal of Botany* and *Applications in Plant Sciences* will be published as part of the Wiley family of publications. You can read more about what this means for those journals on page 148. *Plant Science Bulletin* will continue to be published in-house by the BSA and, thankfully, we will still have access to the fantastic production staff that puts together each issue. However, we will no longer use Editorial Manager to handle submitted articles. Instead, please send your submissions, including a cover letter, manuscript word document, and any image or supplementary files, directly to the editor at psb@botany.org. Articles will still undergo anonymous peer review and a revision process; we will simply handle them in a more personal manner through e-mail correspondence. As always, *PSB* welcomes unsolicited submissions from BSA members and hope that you will consider contributing to *Plant Science Bulletin*!



Mackenzie

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SOCIETY NEWS

Be an Effective Advocate for Plants: Lessons from the Botany Bill (H.R. 1054) and What You Can Do!

H.R. 1054 – Botanical Sciences and Native Plant Materials Research, Restoration, and Promotion Act, affectionately referred to as the “Botany Bill,” was introduced in the U.S. House of Representatives on February 14, 2017 by Rep. Mike Quigley (D-IL) and co-sponsored by Rep. Ileana Ros-Lehtinen (R-FL).

The Botany Bill has four main goals:

1. Promote critical plant materials and restoration-related research.
2. Enhance demand for botanical scientists through the authorization of federal agencies to hire more botanical staff and to create a student loan forgiveness program for botanists in federal agencies.

3. Drive demand for native plant materials by establishing a preference for the use of locally adapted native plant materials in federal land management activities, maintenance, and restoration. An amendment to the Surface Transportation Act and Federal Building Code would create a preference for the use native plant materials, to the extent practicable.

4. Support rare, endangered, and native plants via federal programs through the authorization of the Plant Conservation Alliance Inter-agency Plant Materials Efforts and implementation of the Seed Strategy, and the Bureau of Land Management’s Native Plant Materials Development Program. Additional amendments to the National Fish and Wildlife Foundation and the Fish and Wildlife Act of 1956 would authorize grants to the states to protect rare and endangered plant species.



By **Krissa Skogen**, *Northwestern University*,
and **Kal Tuominen**, *John Carroll University*

Benefits to the Botanical Community at Large

The development of the Botany Bill helped hone and answer the questions: what are the key issues in supporting plant conservation in the U.S. and what do we need to do to address them? The Botany Bill provides a tool for di-

verse stakeholders (botanic gardens, universities, garden clubs, native plant societies, and nurseries) to speak with one voice and provides an entry point for discussions with elected officials, agency heads, and appropriators.

The Most Impactful Things You Can Do

1. Meet with your Representative locally (district office) during congressional recesses. **Invite them to visit your lab/institution when he or she is in the District.**
2. Focus your message. **Let your Representatives know what you do and why it is important.**
3. Focus on one broad topic (e.g., supporting the Botany Bill; federal funding for research). Explain the issues affecting constituents, and how your “ask” (e.g., supporting the Botany Bill) will benefit them. **Avoid details, focus on the big picture, and use accessible language (avoid jargon).** Use your time wisely—you’ll usually have just 5 to 10 minutes of your Representative’s time.

4. Persistent contact is key. Follow up with a thank you and additional information.

Whether emailing, speaking with a legislative aid, or attending a town hall meeting, **maintain your relationships with your elected officials!**

5. Policy making takes time—stay involved! Some legislators are interested in supporting a particular bill but want to see support from legislators from a different political party before they will commit to bill sponsorship or a “yes” vote. This is where **connecting with botanists, friends, and family living in other districts and states on key issues can become powerful!**

How To Get Involved

To date, the bill has a total of 19 co-sponsors from ten states. Additional *bi-partisan* support is needed in the House of Representatives. Ask your Representative to co-sponsor the Bill!

Track the status of the Bill here and sign up for alerts: <https://www.congress.gov/bill/115th-congress/house-bill/1054>.

H.R. 1054



the Botany Bill

How to Be an Effective Conference Session Moderator¹

This paper grew out of a conversation by the authors following the Botany 2015 meeting. Observing that there were several examples of excellent moderators as well as a few cases in which further improvement would be helpful, the authors developed these suggestions based on their own experiences.

If you are a new researcher embarking on your career, one of the best and quickest ways for you to develop your professional network is to act as a session moderator at a conference in your field. Not only does this associate your name with a topic or area, but you will also have the opportunity to connect with your peers and to meet top senior researchers in your field. However, this is also a very public role that you may feel hesitant at first to embrace. Here are a few tips to get you started.

1. Thinking About Moderating? One of the key traits of effective session moderators is that they are there to facilitate the session, not to dominate it. As a moderator, you have mul-

multiple responsibilities: director, timekeeper, and enforcer. Ultimately, your job is to make sure the expectations are clear and participants are held accountable. Some of the top experts in a field can be some of the worst session moderators, whereas junior academics (graduate students, post-docs, or assistant professors) can be the most effective moderators. So feel free to give it a try and don't be intimidated by seniority.

2. Set the Stage for Success. To make sure that your session flows well throughout its assigned time, it is important to make adequate preparations beforehand:

- If you will be co-moderating the session with a second person, make sure that you discuss beforehand how to divide up the responsibilities. Most often one moderator will cover the first half of a session (if there is a break in the middle) and the second moderator will cover the second portion. If at all possible, it is a good idea to make sure that a moderator is not responsible for the part of the session in which he or she will be presenting (it can be very difficult to be one's own time-keeper!).

Footnotes

¹Manuscript received 9 May 2017; revision accepted 21 June 2017.

²Corresponding e-mail: Theresa.Culley@uc.edu

doi: 10.3732/psb.1700002



By **Theresa M. Culley**², Professor, Department of Biological Sciences, University of Cincinnati, and **Kathryn E. Theiss**, Assistant Professor, Department of Biology, California State University Dominguez Hills

- Confirm beforehand whether you will have an AV assistant to load each talk or whether that will be your responsibility.
- Make sure all presentation files are available beforehand on the computer with easily recognizable names and placed in order.
- Have a way to keep track of time, whether a separate timer or a stopwatch on your phone. The phone option can also be effective if it includes an audible alarm (but see below).
- Just as you would practice your own presentation for a conference, it is also important to practice all titles and names of presenters (assuming such information is available beforehand). On the day of the session, show up early to greet presenters and make sure that your pronunciation of their names and presentation titles is correct (ask if in doubt; they will thank you for it later).

3. Let the Force Be With You. As the moderator, your job is to make sure that the session is successful; this means that not only do all talks remain on schedule, but ideally your actions create an environment where researchers can form valuable contacts that may lead to future advances in their field. To make sure that the session stays on track, try the following:

- Begin on time. This is essential to demonstrate that you hold yourself accountable to the same expectations you have of the participants.
- At the beginning of the session, welcome attendees and participants. Be sure to mention the session name in case someone is in the wrong room. Finally, introduce yourself as the moderator of the ses-

sion, providing your name and affiliation.

- Outline the ground rules at the very beginning of the session. Explain when you will indicate how much time has passed (usually 12-14 minutes for a 15-minute time slot), and how you will indicate this (standing up, raising a hand, etc.). Most presenters greatly appreciate getting some indication of how much time they have left in their allotted time period.
- Ask presenters politely to please respect their time intervals so all talks can remain on track, but also clearly indicate the consequences for talking too long—injecting a little humor is often very effective (depending on your own personal style). For example, some moderators use an audible alarm that can be heard at the end of the presenter's time; this makes it quite obvious to everyone in the room that the time period has been reached. However, make sure that the alarm is not too distracting. Other moderators slowly walk forward at the end of the time interval (and who wants someone slowly walking toward them as they try to finish up their presentation?). This is usually quite effective in persuading authors to stick to their allotted time. And better yet, follow up. The crowd may laugh the first time the moderator starts to walk toward a presenter, but you can bet that all other presenters will be keeping track of their time!
- At the beginning of each talk, introduce the presenter, making sure to state the title clearly. If it has changed from what is printed, be sure to read it from the title slide. Some moderators prefer to instead mention some interesting facts about the presenter (his or her institution, status as

a graduate or undergraduate student, and the name of his or her research advisor).

- If the session will be stopping for a coffee break, be sure to announce the time when the session will resume (and stick to it!). When the session begins again after the break, welcome all the attendees once again, announcing the name of the session, in case some attendees may be in the incorrect room. Immediately introduce the next speaker and off you go!

4. Houston, We Have a Problem. As a junior researcher, you may have avoided serving as a moderator up to this point because of a deep-seated fear of having your session spiral out of your control. What if a particularly long-winded speaker goes on relentlessly or a series of presenters run past their allotted time, and the session falls hopelessly out of sync with all other sessions? Worse yet, what if that overly verbose, superfluous speaker is none other than the top researcher in your field, perhaps someone who may review your next paper or grant proposal? What if the computer malfunctions, the fire alarm goes off, or someone has a medical emergency? How do you recover and get things back on track?

- Although these problems are exceedingly rare, it may be helpful to think about some solutions, if at least to relieve any undue anxiety. In other sessions you have attended, how have any of these issues been handled? What worked? What did not? Learn from other moderators' successes and mistakes and incorporate that into your own personal style.
- For the overly verbose presenter, make sure to follow through on the rules that you have outlined at the beginning of the session and enforce the time signals.

If speakers are going over their allotted time and have ignored all signals, it will be necessary to interrupt them to ask if they are nearly done. This can feel awkward but it will be much appreciated by the audience. In the worst-case scenario, you can turn flash off the lights (if they are still on or dimmed) as a major hint—but use this only as a last resort!

- If one speaker talks too long, remember that all subsequent presenters should still receive their full-allotted time. To get back to the normal session schedule, you should ask that the audience hold their questions for the break.

5. What NOT to Do. Never, ever, move talks from their allotted time period, even in the very rare occasion a previous talk has been canceled. This is critical as attendees may be moving between sessions and are relying on the talk being given at its published time period. If there is a cancellation that is known ahead of time, be sure to mention it at the beginning of the session and at any session breaks. Your attendees will be grateful for the information.

6. To Infinity and Beyond. Just as you have spent time carefully introducing the session and setting it up for success, you also need to bring it to its final conclusion. There is nothing more disheartening after a series of exciting talks than awkward silence or just a casual “Thanks for coming.”

- Move to the front of the room and signal the end of the session, such as, “And that concludes the session on [topic here].” Thank all participants (especially if they all stayed on time!) as well as your audience for their attention. This is especially important for those sessions that occur at the end of the day or on the last day of

the conference when attendance is usually light.

- If appropriate, you can also suggest that any interested attendees gather afterwards to exchange information or join one another for an impromptu meal.

Overall, the most helpful way to learn how to effectively moderate a scientific conference session is to watch how others perform the task. You will need to figure out which tactics are most effective and which you would feel comfortable implementing. What have you seen that works? What would you do differently? In addition to being a much-appreciated service to your society or organization,

moderating a session is an ideal opportunity to expand your network, meet new researchers, and ultimately benefit your own research program. Both of these authors have benefited immensely from the experience. Give it a try and you may just realize how exciting it can be!

[The authors thank several mentors who first encouraged them to gather the courage to become session moderators: A.K. Sakai, S.G. Weller, A.A. Snow, S. Kephart, and K. Holsinger. They also deeply appreciate past moderators who have served at meetings hosted by the Botanical Society of America over the past 20 years.]

FROM THE PSB ARCHIVES

60 years ago: In an editorial, Harry J. Fuller recognizes the advantages of organization and support for science on a national level, but warns against allowing bureaucracy to dictate the focus of science:

“Thus, in his conviction that science must be kept as free as possible from the intrusions of bureaucracy into its domain and administration, the Editor has written this editorial to:

1. Remind members of the Botanical Society of America (and other scientists who may read this) that increased complexity of organization and increased centralization of policy-making efforts lead often to increased worship of conformity and to the birth of powerful and unwieldy bureaucracies.

-Fuller, Harry J. “Editorial PSB” 3(3)

50 years ago: In response to the timeless goal of attracting people to careers in botany, Robert M. Page announces the availability of the pamphlet “Botany as a Profession.”

“The selection of a mate and the selection of a career are the most important choices most people are called upon to make. The selection of a mate is a problem that is shared by other animals, but choosing a career is a task that is exclusively human. The desire to influence this choice also appears to be deeply ingrained in our species. There are doubtless many reasons for this deep-seated desire of elder humans to have the young follow in their footsteps. Some elders would claim that their important work must be continued or that essential skills and traditions must be preserved. A cynic might be more inclined to suggest that by inducing a young person to follow his occupation, the elder builds his ego or hopes to achieve a sort of vicarious immortality. Perhaps from similar motives, professional societies and other groups desire to perpetuate themselves; hence, they attempt to influence the choice of a career by the young, and for this purpose they employ such devices as career pamphlets. . .

“As the supply [of Careers in Botany] neared exhaustion, the question of a new edition was referred to the Committee on Education, which undertook the preparation of a revised careers booklet as one of its projects.”

-Page, Robert M. “Thoughts on Botany as a Profession” PSB 13(4)

Botanical Society of America's Award Winners (Part 2)

In the previous issue of the Plant Science Bulletin (63 [2]), we listed the award winners from Botany 2017 just as the conference was underway. Here are the remaining award winners.

Donald R. Kaplan Memorial Lecture

This year's lecture was given by **Dr. Dan Chitwood**, Independent Researcher, on "*Persistent homology and organismal theory: quantifying the branching topologies of plants.*"

The Grady L. Webster Structural Botany Publication Award

This award was established in 2006 by Dr. Barbara D. Webster, Grady's wife, and Dr. Susan V. Webster, his daughter, to honor the life and work of Dr. Grady L. Webster. The American Society of Plant Taxonomists and BSA are pleased to join together in honoring Grady Webster.

Naoko Takahashi, Chieko Kami, Isao Ota, Nana Morita, and Ryoko Imaichi, for their article: *Developmental morphology of the typical cordate gametophyte of a homosporous leptosporangiate fern, Lygodium japonicum (Lygodiaceae), focusing on the initial cell behavior of two distinct meristems. American Journal of Botany 2015. 102 (2): 197-207, 2015.*

Jeanette Siron Pelton Award

The Jeanette Siron Pelton Award is given for sustained and imaginative productivity in the field of experimental plant morphology. The award goes to **Dr. Shirley Tucker**, University of California, Davis.

Margaret Menzel Award (Genetics Section)

The Margaret Menzel Award is presented by the Genetics Section for the outstanding paper presented in the contributed papers sessions of the annual meetings.

This year's award goes to **Juan Diego Palacio-Mejia**, University of Texas at Austin for the paper "*Population genomics in the native grass Panicum hallii*" Co-authors: Taslima Haque, Edgardo M. Ortiz and Thomas E. Juenger.

Samuel Noel Postlethwait Award

The Samuel Noel Postlethwait Award is given for outstanding service to the BSA Teaching Section. This award goes to **Phil Gibson**, University of Oklahoma, for his long-term service to the Teaching Section.

Edgar T. Wherry Award
(Pteridological Section and the American Fern Society)

The Edgar T. Wherry Award is given for the best paper presented during the contributed papers session of the Pteridological Section. This award is in honor of Dr. Wherry's many contributions to the floristics and patterns of evolution in ferns.

This year's awards go to:

Dr. Lisa Hooper, Truman State University, for her paper "*The current status of Aleuritopteris (Pteridaceae) based on recent molecular analyse*" Co-authors: George Yatskievych, Layne Huiet, Kathleen Pryer and Michael D. Windham

Dr. Alejandra Vasco, Duke University, for her paper "*Leaf evolution and development: building better models from fern leaf diversity*" Co-author: Barbara A. Ambrose

Genetics Section Student Research Awards

Genetics Section Student Research Awards provide \$500 for research funding and an additional \$500 for attendance at a future BSA meeting.

Colby Witherup, Northwestern University and the Chicago Botanic Garden, Advisor: Dr. Norman Wickett, for the proposal "*Investigating the evolutionary history of meiosis genes in genera with diploid and polyploid clades*"

Isabel Cookson Award
(Paleobotanical Section)

Established in 1976, the Isabel Cookson Award recognizes the best student paper presented in the Paleobotanical Section.

Michael Donovan, Pennsylvania State University, for the paper "*Insect herbivore communities tracked the conifer Agathis (Araucariaceae) from Paleogene Patagonia to modern Australasia and Southeast Asia*" Co-authors: Conrad C. Labandeira, Peter Wilf, Ari Iglesias, and Rubin Cunio

Katherine Esau Award
(Developmental and Structural Section)

This award was established in 1985 with a gift from Dr. Esau and is augmented by ongoing contributions from Section members. It is given to the graduate student who presents the outstanding paper in developmental and structural botany at the annual meeting.

This year's award goes to **Monica Carvalho**, Cornell University, for the paper "*Leaf hydraulic architecture of Populus and Ginkgo*" Co-author: Karl Niklas

Physiological Section Li-Cor Prize

Taylor J. Kriss, Fort Hays State University (Advisor, Dr. Brian Maricle), for the poster “*Photosynthetic action spectra of etiolated beans during greening*” Co-author: Brian Maricle

Maynard Moseley Award

(Developmental & Structural and Paleobotanical Sections)

The Maynard F. Moseley Award was established in 1995 to honor a career of dedicated teaching, scholarship, and service to the furtherance of the botanical sciences. Dr. Moseley was known to his students as “Dr. Mo,” died Jan. 16, 2003 in Santa Barbara, CA, where he had been a professor since 1949. He was widely recognized for his enthusiasm for and dedication to teaching and his students, as well as for his research using floral and wood anatomy to understand the systematics and evolution of angiosperm taxa, especially waterlilies. The award is given to the best student paper, presented in either the Paleobotanical or Developmental and Structural sessions, that advances our understanding of plant structure in an evolutionary context.

Maya Bickner, Humboldt State University, for the paper “*New fossils from the Battery Point Formation of Gaspé (Quebec, Canada) expand the anatomical diversity of Early Devonian euphyllophytes*” Co-authors: Selin Toledo and Alexandru Tomescu

Ecology Section Student Presentation Awards

Nicholas Flanders (Graduate Student), Old Dominion University, for the paper “*The Role of Generalist Avian Frugivores in Determining the Distribution of the Mistletoe Phoradendron leucarpum*” Co-authors: Eric Walters, Christopher P. Randle and, Lytton Musselman

Michelle Gaynor (Undergraduate Student), University of Central Florida, for the paper “*The Influence of Genome Duplication on Brassicaceae and Rosaceae Communities Across the United States*” Co-authors: Julienne Ng and Robert Laport

Ecology Section Undergraduate Student Poster Awards

Melissa Vergara, University of California at Santa Cruz, for the poster “*Do herbivores prefer flower buds over leaves? Evaluating caterpillar preferences in evening primroses (Onagraceae)*” Co-authors: Krissa Skogen, Tania Jogesh, and Kathleen Kay

Nic Diaz, Bucknell University, for the poster “*Examining niche divergence of cryptic species within the Hawaiian Coprosma foliosa Complex (Rubiaceae)*” Co-authors: Jason Cantley and Christopher Martine

Genetics Section Student Presentation Award

Jason Paul Joines, Clemson University, for the poster “*Local adaptation to the environment drives genetic variation among populations of an herbaceous plant*” Co-authors: Saara J. DeWalt and Joan L. Walker

Tropical Biology Section Student Presentation Award

Manuel A Lujan, Rancho Santa Ana Botanic Garden, for the paper “*Playing the taxonomic cupid: Matching incomplete species of Clusia (Clusiaceae)*”

Carlos Jose Pasiche Lisboa, University of Manitoba, for the paper “*Elevation and historical events shape moss community traits and functional diversity in Puerto Rico*” Co-authors: Catherine M. Hulshof and Ines Sastre-De Jesus

Physiological Section Student Presentation Awards

Jennifer Blake, Rutgers University, for the paper “*Sugars, stress, and sex-change: environmental sex determination in striped maple*” Co-author: Lena Struwe

Physiological Section Student Poster Awards

Scott M. Warner, Michigan State University, for the paper “*A comparison of dendroclimatic relationships in three co-occurring forest species in the context of climate change*” Co-authors: Andrew M. Jarosz and Frank W. Telewski

Developmental & Structural Section Student Travel Awards

Ya Min, Harvard University

Aniket Sengupta, Kansas University

Ecology Section Student Travel Awards

Matthew Haynsen, George Washington University (Advisor, Dr. Keith Crandall) for the Botany 2017 presentation “*Population Genetic Analysis of Invasive Kudzu (Pueraria montana var. lobata) throughout Asia and the United States*” Co-authors: Mohammad Vatanparast, Liu Luxian, Fu Cheng-Xin, Keith A. Crandall and Ashley N. Egan

Sarah Augusta Maccracken, Smithsonian Inst. National Museum of Natural History (Advisor, Dr. Conrad Labandeira) for the Botany 2017 presentation “*Insect Herbivory of the Kaiparowits Formation Flora, Late Cretaceous (Campanian) of Utah*” Co-authors: Ian M. Miller, Charles Mitter and Conrad C. Labandeira

Carlos J. Pasiche-Lisboa, University of Manitoba (Advisors, Drs. Michele D. Piercey-Normore and Rene Belland) for the Botany 2017 presentation “*Survival of fragments from three boreal mosses to extreme temperatures*” Co-authors: Rene Belland and Michele D. Piercey-Normore

Genetics Section Student Travel Awards

Matthew Haynsen, George Washington University, for the Botany 2017 presentation “*Population Genetic Analysis of Invasive Kudzu (Pueraria montana var. lobata) throughout Asia and the United States*” Co-authors: Mohammad Vatanparast, Liu Luxian, Fu Cheng-Xin, Keith A. Crandall and Ashley N. Egan

Aniket Sengupta, Kansas University, for the Botany 2017 presentation “*Searching for more: Antirrhinum corolla symmetry genetic network in carpel development*” Co-author: Lena Hileman

In your own words....Comments from the post-conference survey!



I really like the Botany conferences. People are really nice, things are well organized.



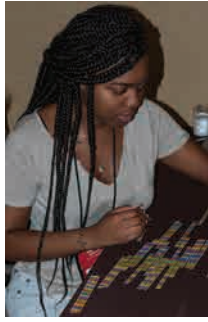
It was an excellent conference. The society helped me keep the costs to a minimum which were a huge help and greatly appreciated. Everyone was very kind and welcoming, which you don't find with every scientific group/conference. Great speakers.



The people! The people at Botany are so fantastic! Up-all-night-Wednesday was particularly awesome this year! I don't know why, but it was great.



...visiting with old friends, keeping up on the science, supporting a colleague receiving an award



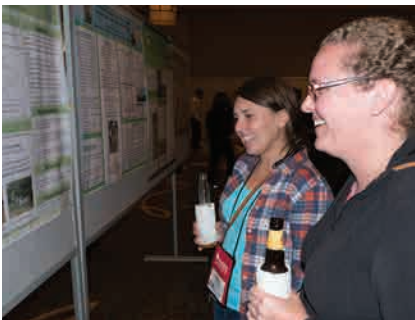
Thank you for being so student friendly. My undergraduates had a great time.

I had not attended the previous botany meetings since I live in Venezuela, it was a very enriching experience!



I really enjoyed the opportunity to hear more about current research and interact with my colleagues.

I would go to a Botany conference wherever it is located because it introduces me to new places I would've never considered previously traveling to.



I was going to go to ESA, but I missed the abstract deadline. Boy, am I glad I did, because Botany was a great conference!



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A chat about publishing: Scholarly Collaboration Networks

Hello! And welcome—make yourself comfortable. I'd like to talk with you today about your Society journals.

I get that you read and publish papers, but you're not that interested in what happens in an editorial office. I thought it would be really great, though, if we could, on occasion, discuss a few items of possible mutual interest.

Today, let's chat about those persistent, and frequent (!), opportunities you receive in your email Inbox to upload your published article PDFs to third-party sites such as ResearchGate and Academia.edu, sometimes referred to as Scholarly Collaboration Networks, or SCNs.

In 2012, an author I'll call "Martin" contacted the editorial office of *AJB* and wondered what we, as editors and publishers of a Society journal, thought of these sites.

The question posed by Martin was: "Bad for business, or a good way for people to access more papers?"

He liked the article-level metrics these sites provided. He liked sharing his work widely and being discovered by other researchers. But

he was worried about whether he was violating copyright. And he wondered what impact these sites might have on a Society publisher.

That was 5 years ago: SCNs have definitely grown over that time, and they're very popular. On the one hand, we (your Society publishers) want our authors' work to be *discoverable* (and citable). Heck, we work with you to promote your work on Twitter and Facebook; we work with writers and press offices on press releases; we encourage you to share your work; we are about to increase our outreach through our partnership with Wiley. We offer an Open Access option, all abstracts are always freely available, and all articles are freely available after one year. BSA members have free access to *AJB*, do not pay page charges, and receive discounts on OA charges (APCs).

On the other hand, your Society publisher is not crazy to have readers directed away from our site. When your PDFs are posted on an SCN, they take readers away from the version of record on our site, and with them, the usage data and article-level metrics. We'd like to know, too, when your article is viewed, downloaded, shared, mentioned, etc., as would the libraries who subscribe to *AJB*. Librarians carefully review usage data to determine whether or not to renew their subscription (our lifeblood). Library budgets have been tight and either declining or holding steady, at best, for years; librarians have to make tough decisions every year.

Journals and librarians do not get usage data from Academia.edu or ResearchGate. Authors get article-level metrics, but the data are



By Amy McPherson
Director of Publications,
BSA; Managing Editor,
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not standard (i.e., not COUNTER compliant). These sites also don't necessarily have the supplemental data that was uploaded with the article, and they miss any addenda to the article (corrections, retractions, etc.). And yes, you might be violating the copyright or licensing agreement.

When we're asked, we suggest that authors include *links* to, not PDFs of, their articles—but we know most people don't ask, or even know what they have the right to post.

For *AJB*, we allow posting of the accepted *manuscript*, and sharing of the PDFs with interested researchers, but we *prefer* that the PDF be accessed on our site if possible, or shared with individuals; we support the “Voluntary Principles for article sharing on scholarly collaboration networks” (see below).

We know it's tough to figure out what's considered permissible in this crazy day and age of scholarly publishing. If you are unclear of what's allowed based on the agreements you have signed with publishers, do not despair. Check out <http://www.howcanishareit.com/>.

I think this concern over where the PDF of your article is posted is temporary and will be resolved in the not-too-distant future, because it is essentially a technical issue. And we all know that technology moves constantly and fast.

You are reading this in the *Plant Science Bulletin*, so you are taking advantage of a Society publication. If you are a BSA member, I assume that you are also interested in the *American Journal of Botany* and *Applications in Plant Sciences*—I hope you are. Like other Society journals, we are *mission-driven*: we exist to support botany and our members (see BSA mission in accompanying box). Some Society journals are self-published, as we have been for over 100 years; some partner with a

publisher, as we will begin doing in 2018 with Wiley (see the note elsewhere in this issue of *PSB*).

We are honored to work with you, and we look forward to continue doing so well into the future. Go Botany!

That is all for now. If there is another publishing item you'd be interesting in chatting about, please let me know.

Mission of the Botanical Society of America: “[to] promote botany, the field of basic science dealing with the study and inquiry into the form, function, development, diversity, reproduction, evolution, and uses of plants and their interactions within the biosphere.”

Additional Reading:

- To explain what COUNTER is: <https://www.projectcounter.org/>
- Voluntary Principles: http://www.stm-as-soc.org/2015_06_08_Voluntary_principles_for_article_sharing_on_scholarly_collaboration_networks.pdf
- What's acceptable in sharing research articles: <http://www.howcanishareit.com/>
- After I wrote this essay, the following blog post regarding copyright compliance appeared on The Scholarly Kitchen. If you are interested in the topic, you will no doubt be interested in this and the comments that accompany the post: <https://scholarlykitchen.sspnet.org/2017/10/06/researchgate-publishers-take-formal-steps-force-copyright-compliance/?informz=1>

Recap of the 2017 International Botanical Congress

The 19th International Botanical Congress was held at the Convention and Exhibition Center in Shenzhen, China, from July 23 to July 29, 2017. The nomenclatural session was held the previous week, with 155 participants from 30 countries/regions. There were many noteworthy highlights for this Congress: the first time it was held in China; a record attendance of 7358 individuals from 110 countries/regions, with 6850 participants from 77 countries/regions; and the first awarding of the Shenzhen International Award in Plant Sciences (to Peter H. Raven). There were 1444 talks in symposia, distributed over six themes:

- 243 in T1 – Biodiversity, Resources and Conservation
- 462 in T2 – Taxonomy, Phylogenetics and Evolution
- 180 in T3 – Ecology, Environments and Global Change
- 254 in T4 – Development and Physiology
- 221 in T5 – Genetics, Genomics and Bioinformatics
- 84 in T6 – Plants and Society

There were nearly 1000 posters on display, or found on the electronic kiosks as e-Posters: 160 in T1, 332 in T2, 162 in T3, 140 in T4, 128 in T5, and 49 in T6. The number of simultaneous symposia, combined with the huge size of the convention center, limited the opportunity for popping in and out of sessions. However, all the Plenary Lectures were conducted in the largest venue of the convention center (Fig. 1), without competition, and the Keynote Lectures were also scheduled with minimal conflicts.



Figure 1. The main hall of the convention center, before the opening ceremony.

All-in-all, the scientific program was amazing, and all of the abstracts and posters were available through an app. There were Wi-Fi connections throughout the convention center.

In addition to the stimulating symposia, lectures, and posters, the Congress offered an incredible program for the opening gala, the Congress banquet, and the closing ceremony. The performances for the opening gala included ballet, Chinese opera, and acrobatics. Similar entertainment was offered for the banquet, and a chamber orchestra provided music for the closing ceremony. The Botanical Society of



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America co-sponsored a reception to honor this year's corresponding member awardees. Loren Rieseberg did the honors, and there was quite a "who's-who" in attendance.

The convention center was bedecked in the Congress colors, posters, video screens, and live plant sculptures (Fig. 2). The surrounding skyscrapers provided nighttime light shows, celebrating botany. There were several art exhibits on botanical themes, and a couple on conservation themes, including a huge display that ran the length of the convention center, and a sculptural display featuring live plants from the unique biomes of China (Fig. 3). Student volunteers were abundant and very helpful to the linguistically challenged. Refreshment breaks (Figs. 4 and 5) presented a challenge in foraging, with long lines and food or beverages running out early, but that was one of the few logistical problems presented by a record-breaking attendance. There was also an incredible trade show, which was adjacent to the poster display area, electronic kiosks for the e-posters, and the press room. Highlights from each day of the Congress were published in the daily newspaper, and members of BSA were prominently featured.

The major theme of this Congress was conservation and sustainability, which was reflected



Figure 2. *The main plaza at the Shenzhen Convention and Exhibition Center, featuring numerous plant sculpture displays.*



Figure 3. *The conservation walkway in the convention center.*

in the Shenzhen declaration on plant sciences. The call for action listed seven priorities:

1. To become responsible scientists and research communities who pursue plant sciences in the context of a changing world.
2. To enhance support for the plant sciences to achieve global sustainability.
3. To cooperate and integrate across nations and regions and to work together across disciplines and cultures to address common goals.
4. To build and use new technologies and big data platforms to increase exploration and understanding of nature
5. To accelerate the inventory of life on Earth for the wise use of nature and the benefit of humankind.
6. To value, document, and protect indigenous, traditional, and local knowledge about plants and nature.
7. To engage the power of the public with the power of plants through greater participation and outreach, innovative education, and citizen science.

The Shenzhen declaration was passed as Resolution 4 during the closing ceremonies.



Figure 4. *The trade show and poster hall also served as a primary break area each day.*

Four additional resolutions passed, including one from the nomenclatural session, one for working actively for gender equity in the plant sciences, one for fostering international cooperation between the International Association for Plant Taxonomy and the Chinese botanical community through establishment of an IAPT-China office, and, finally, to establish that the XX International Botanical Congress will be held in Rio de Janeiro, Brazil, in 2023.

Major themes throughout the Congress were the use of big data from all sort of “-omics,” integrating information from various databases for innovative data analyses, and a new ini-

tiative for genomics: the 10KP project, where 10,000 plant genomes are to be sequenced.

The scale of this Congress was overwhelming—not only in the number of attendees, presentations, posters, and sheer size of the venue, but on the amount of new information to assimilate, as well as the efforts put forth by the Chinese botanical community, the city of Shenzhen, and the Chinese government to ensure a successful meeting. The bar for international botanical meetings has been raised to a new level. The next Congress will be the first to meet in South America, so there is a lot to look forward to. See you in Rio!



Figure 5. *The upper floors of the convention center had two break areas for the morning and afternoon sessions. Beverages and snacks were served.*





What Does the Botanical Society of America Do for You and What Do You Do for the Society?

The compound question in the title needs to be asked of every member of our Society, emeritus members, distinguished fellows, BSA Officers, committee and section chairs and members, regular members, and students. A little over two years ago, I wrote an article for *PSB* titled “Where Goes the BSA Endowment: A Legacy Yet to be Written” (2015 61[2]: 62-63). As continuing chair of the Investment Committee whose task it is to co-manage, along with an outside investment firm, the endowment funds for growth and use for Society initiatives, I have become increasingly aware that the BSA membership, as a whole, needs to understand the importance of financially giving to the endowment, as it is able.

What does this actually mean? BSA has grown in stature and importance to the entire botanical community worldwide since its inception in 1893, about 124 years ago (<http://cms.botany.org/home/about/an-historical-overview-of-the-bsa.html>). During this entire period, botany has expanded into new fields, has given birth to new plant societies, and yet has retained its breadth as a basic plant biology

society. BSA has developed important publications, and programs in education, technology, and research and travel grants that serve a broad spectrum from young people to seasoned researchers. Together, these latter groups represent the heart of botany and inevitably its future.

In order to maintain BSA's vital role in the field of botany, and its nurturing and development of future botanists, we the members in all membership categories, must make a continued financial commitment, no matter how small or how large, to helping the BSA Endowment grow from its present \$5M to +\$10M, so it can become a beacon of financial support for all of the Society's initiatives and programs, well into the future.

Please consider giving \$5, \$10, \$50, \$100, \$500, \$1000 or more annually (*or right now*) as you are able, through a check or other means to: The BSA Endowment Fund, Business Office: 4475 Castleman Avenue, St. Louis, MO 63110-3201. Let this be your commitment to the Society and those who follow.

To paraphrase a past President of the United States who understood what commitment was all about, “It's not what the Society can do for you but what you can do for the Society.”



**By Harry T. (Jack)
Horner**
*Chair, BSA Investment
Committee*

Latest News on the PLANTS Grant Program

The PLANTS grant program (Preparing Leaders and Nurturing Tomorrow's Scientists: Increasing the diversity of plant scientists) has just finished its seventh year. Currently managed by co-PIs Ann Sakai (UC-Irvine), Anna Monfils (Central Michigan University), and BSA Staff Member Heather Cacanindin, the goal of the PLANTS program is to encourage students from under-represented populations to become part of the scientific botanical community and, in particular, to help them understand the opportunities possible with an advanced degree and to learn about careers in the plant sciences. The program, which is funded by the National Science Foundation with additional support from BSA, brings 10 to 14 students, who are chosen through an open application process, each year to the annual BOTANY conference. The review committee for the applications includes members of the BSA Human Diversity Committee and two former PLANTS Scholars.

PLANTS students attend scientific talks with mentors, a workshop on applying to graduate school, the Human Diversity Luncheon, and numerous social and networking events. With assistance from Dr. Sakai, Dr. Monfils, and Dr. Ann Hirsch, as well as all those who served on the PLANTS grant selection committee, 72 students were funded over the first six years of the PLANTS grant (2011-2016). In 2017, 13 students were selected to attend the Botany 2017 Conference in Fort Worth, Texas.

At the core of the program are the mentors who serve to guide the students through what to expect at a scientific conference of this mag-

nitude. Each student is assigned a peer and a senior mentor. Mentors were matched to students based on student requests for particular research areas. A new addition to the program this year was a pre-meeting webinar hosted by the PIs and BSA staff to acquaint students and mentors with meeting opportunities, logistics, and responsibilities.

Mentors contact students before the meeting, attend social activities and scientific talks with the students, help the students network with other students and faculty at the meeting, and in general, introduce students to the broader relevance and application of the discipline. Mentors pass on to the students the genuine intellectual excitement and involvement of the conference participants. In fact, many mentors maintain contact with their mentees after the conference is over, providing insight and guidance on their career path and assisting them with graduate school and grant applications.

Our mentors are committed to helping young scientists and increasing the diversity of plant scientists. Mentors hail from government positions, small colleges, large research institutions, and nonprofit organizations. They represent the variety of job opportunities in the botanical sciences. Almost 100 mentors have participated in the program since 2011. They enthusiastically share their personal experiences and expertise in the sciences and serve without compensation or reimbursement. The mentors are truly the backbone of the PLANTS program and provide impactful experiences for the PLANTS students. The networking and mentoring both proved to

be highlights for the students as they helped to create a “sense of community” and a place where the students felt supported. One 2017 PLANTS recipients recently stated, “I was so humbled by how kind, supportive, and helpful my mentors were.” Another reiterated the importance of the sense of community created by the PLANTS program: “The program has given me a community that I was lacking and has tremendously increased my confidence as a student.”

The PLANTS grant co-PIs keep in touch with the past PLANTS scholars and track their progress and careers. So how is the PLANTS II program impacting careers? For our 2016 PLANTS cohort of scholars, one student is currently in a PhD program and has received a Ford Foundation Fellowship, three students are in Masters programs, one student is studying at an Environmental Science Institute, and two students are working in the plant sciences at botanical gardens/herbaria and plan to apply to graduate school this fall. This means that 82% of the 2016 PLANTS scholars are still pursuing careers in the botanical sciences.

The success, enthusiasm, and contributions of the PLANTS participants have helped to make our botanical community more aware and proactive about encouraging the diversity of plant scientists within the Society and the plant sciences as a whole. We continue to have increased recognition and support of the program from members of the Society, as PLANTS I program alumni are active and are recognized within our scientific community. In fact, two past PLANTS scholars have been elected student representatives to the BSA Board (James McDaniel [UW-Madison] and Chelsea Pretz [UC-Boulder]), and several have been recognized with Best Student Paper awards by their sections as well as BSA research awards. Moreover, a transformation of the membership of the BSA has begun to occur as documented by the increase in the

diversity of our overall membership. From 2011 to 2017, representation of BSA members who were American Indian/Alaska natives, Pacific Islanders, and African American/Black together rose from <1% to 2.7%, and members who were Hispanic or Latino/a rose from 2.3% to 4.6% of the U.S. membership, for a total of 7.3% of U.S. members.

Science will not thrive unless it is equally accessible to students from all backgrounds, including those from groups that are currently underrepresented. Access involves knowledge about the discipline, understanding the culture of science, feeling welcome as a participant in scientific endeavors and as a member of the scientific community, and understanding job opportunities in the area. The PLANTS program continues to be successful in encouraging students from underrepresented backgrounds to become part of our scientific community. The PLANTS program is just one part of an overall growing effort by the Society to provide a range of professional development opportunities to our student members. Some of these efforts include hosting non-academic career panels, workshops and symposia about science communication and dissemination, broader impacts issues, and career speed-dating.

When the call for applications comes out in February for the PLANTS Award, please carefully consider those who you might encourage to apply for this opportunity. In May, we will again be seeking peer and senior mentors for the 2018 cohort of PLANTS Scholars. If you are planning to attend BOTANY 2018 in Rochester, this could be a fantastic way for you to make new connections and positively impact the life of an aspiring plant scientist. If you have any questions about the program, please feel free to contact the BSA Office or go to <https://cms.botany.org/home/awards/travel-awards-for-students/plants-grants.html>.

An “Exit Interview” with Retiring BSA Executive Director, Bill Dahl



After 15 years of serving as the BSA’s executive director, Bill Dahl retired from his position on October 1, 2017. He’s affected the lives of countless BSA members and leaves behind a spirit in the Society that will continue for many years. The PSB is pleased to present a final discussion with Dahl just before his departure. We wish all the best to Bill, his wife Janice, on future days filled with travel and photography!

What drew you to the position of Executive Director of the Botanical Society of America?

It’s actually a love story. I was having a wonderful life in New Zealand in a similar position with New Zealand’s largest community health provider. New Zealand has the “dreaded” national health system and they actually take care of people with mental health issues! We assisted the most severe in a transition from hospitalization back into community living. A

fantastic system focusing on health—but that gets away from the question!

I came to the USA in 2000 to visit a U.S. partner and ended up at the conference of the American Society of Association Executives. My boss Gerry was attending and he invited me along. He felt we’d have a week to talk strategy.

On the first morning I attended a session called a CEO Boot Camp. I walked into a room with about 600 people, started one way, stopped, turned around and found a seat right next to Janice Grauberger (now Dahl). From there we had some amazing discussions and a very nice few days. I did see Gerry a few times in passing (LOL).

Two years later, our kids (from previous marriages) had all graduated and left the nests, and we were in a race to find employment in each other’s countries. Jan’s connections put her onto the BSA’s search for an Executive Director. I applied and had the pleasure of meeting with Judy Jernstedt and Ed Schneider in the Los Angeles airport. Months later I came to the BSA meeting in Madison for another interview and had the pleasure of meeting with the Board. It was also my introduction to Johanne Stogran and her family, who were running the Botany conferences. By October I was in St. Louis working for you.

What were your first impressions of the BSA and/or botanists in general?

It was nice to see and feel how important the long-term health of the BSA was to most of the Board and Society members. In conjunction with that, how dedicated people were to

plants and everything about plants and making sure others had the opportunity to share in their discoveries. I've been extremely fortunate to be involved with this group and have learned so much about so many things.

What's the biggest challenge that you felt you faced as Executive Director of the BSA?

Hmm, there were so many exciting things. I guess the first was landing in St. Louis to the large space allocated to the BSA at the Missouri Botanical Garden. There was a desk and a phone—that was it. From there it was building a team and setting the foundation in an effort to focus on the BSA's mission. The Board provided me/us with the document titled "BSA Strategic Planning/Action Plan: Deep Thought," which set the foundation for the next six to seven years of work. It was a fantastic map forward.

The first thing I did was ask Wanda Lovan to join the team. Her ability to remember people, events, and everything else we were involved in has always been a tremendous asset for the Society. She's also the glue that pulls everything together.

What are you proudest of?

First would be the team that was pulled together to support the Society's mission. They have and will continue to make anything possible.

I'd love to be able to say my biggest achievement was the growth and development of the Botany Conference program—but that was Johanne Stogran working with various BSA/ASPT/ABLS and AFS meeting directors. Or that it was the development of our publications, the *American Journal of Botany*, *Applications in Plant Sciences*, and the *Plant Science Bulletin*, and the support given to their authors—but that was Amy McPherson, Beth



Bill Dahl in the early days of his time at the BSA, along with Administrations Officer Wanda Lovan.

Parada, and Richard Hund working with the editors and editorial boards. Or that it was our response to educational needs and the development of the PlantingScience program—but that was initially Claire Hemingway, followed by the amazing work Catrina Adams and Jodi Creasap-Gee are doing now along with various education directors and so many dedicated members and Society partners. And the growth in the membership, in particular younger members and building the platform for them to become involved in steering the future direction of the Society—but, again, that was someone else: Heather Cacanindin. Of course, all of this involved developing technologies and web-based support led by Rob Brandt.

And the Boards and Board members—what a treat! I've had the pleasure of working with a wide range of botanists. Just the Presidents alone—Judy Jernstedt, Scott Russell, Linda Graham, Allison Snow, Ed Schneider, Chris Haufler, Pam Soltis, Karl Niklas, Kent Holsinger, Judy Skog, Steve Weller, Elizabeth Kellogg, Pam Diggie, Tom Ranker, Dick Olmstead, Gordon Uno and Loren Rieseberg—wow! And that's just a small part of the entire group of Board members. And then there are folks like the current *PSB* editor, Mackenzie

Taylor, who was the first BSA student representative on the Board (and the 10 or so that have followed her). It makes me smile.

So you see, it's always been the team! We are botanical.

The PlantingScience program is a major highlight. In Mobile, in 2003 Dr. Bruce Alberts challenged us to get off our backsides to support science education in a meaningful way. I feel we continue to do so; there are very few ventures of this type bringing scientific societies together to support the understanding of science. In concert, we support middle- and high-school teachers while mentoring their students in the core principles of scientific investigation. Dollar for dollar, this program has more potential to get young people involved with plants, science, and scientists than anything else out there.

What changes, positive or negative, have you seen in the Society, or in scientific societies in general, during your time as Executive Director?

Slowly but surely, collaboration is becoming important across scientific societies. Biology is so diverse that it creates a real communications problem. AIBS made a good move in focusing on legislative issues because someone needs to speak for biology, and the mix of societies makes it very difficult. I hope this continues and that folks find new ways to work together.

I'd also like to stress how the efforts of a few make a huge, really huge, difference for the whole. Diversification is an important direction in science as our demographics shift. I remember back as far as 2003 when BSA members Karen Renzaglia and Jeff Osborn put together the Undergraduate Mentoring in Evolutionary Biology (UMEB) program to support under-represented peoples in coming

to our meetings. Later after the UMEB program expired, Ann Sakai and Ann Hersch, supported by then-BSA President Judy Skog and Heather Cacanindin, evolved this concept into the BSA PLANTS program. I smile with the knowledge that two of the current BSA Board members are past PLANTS recipients.

What do you think will be the biggest challenge for the Society in the next 10 years?

Filling the understanding gap as to why it is important to support scientific societies and society-based publishing. The BSA has done a very good job in supporting member-publishing options in the *American Journal of Botany*, *Applications in Plant Science*, and *Plant Science Bulletin*, yet we continue to hear young scientists looking to publish in other places without understanding why.

Do you have any parting words of wisdom?

Cherish the importance of plants, and what you and what your peers do as botanists! From ecosystem down to the tiny bits of DNA, plants are critical to all life as we know it.

What's Next Regarding the BSA Executive Director Position?

With Bill's retirement, Heather Cacanindin has been named as the Interim Executive Director. A search committee has been formed, and its members will be reviewing applications for the Executive Director position. The position should be filled in early 2018.

BSA Enters Publishing Partnership with John Wiley and Sons

After careful consideration and deliberation over the past year and a half regarding the future of its publishing program, the BSA has decided to enter a publishing partnership with John Wiley and Sons, beginning officially in January 2018. This agreement will affect the Society's two research journals, *American Journal of Botany* and *Applications in Plant Sciences*. Both titles will be hosted on Wiley Online Library, including back file content from *AJB* dating back to 1914.

"The Botanical Society of America looks forward to this partnership with Wiley," said BSA President, Dr. Loren Rieseberg. "Wiley's proven expertise in scientific publishing and marketing will not only expand the reach of BSA publications, but also provide enhanced tools and technologies to assist our authors and members with the publication process and the dissemination of their research."

"Wiley is proud to be selected as BSA's publishing partner," said Colette E. Bean, Vice President & Society Publishing Director for the US, Wiley. "The BSA is a leader in plant science research, and we are honored to partner with them to publish their prestigious journals. We very much look forward to working with the BSA to continue to publish high-quality content that supports their community of authors, readers, and members, and to further advance the knowledge and communication of botanical research."

What does this mean for readers and authors of the journals? First of all, editorial control of the journals remains with the editors-in-chief (Drs. Pamela Diggle for *AJB* and Theresa Culey for *APPS*). BSA staff members for each journal (Amy McPherson and Richard Hund for *AJB* and Beth Parada for *APPS*) will also remain to serve authors, reviewers, and editors throughout the publication process. The article submission system authors have used for years, Editorial Manager, will be retained.

The most visible change will be the online hosting of each journal via the Wiley Online Library. The new websites will offer an updated look for each journal and better author tools. With Wiley, the BSA is looking to expand the journals' reach; modernize the online presence; support our authors, reviewers, editors, members, and subscribers; and keep current with the demands and challenges of scientific publishing in the 21st century.

With changes to come, one thing above all will remain the same: the mission of the Society to promote botany. If you have any questions, please contact us at ajb@botany.org.



SPECIAL FEATURE

Plant Evolution in a Human-Altered World

Remarks from Botany 2017 by President Loren Rieseberg

In a poster designed by cartoonist Walt Kelley to publicize the first annual Earth Day in 1970, Pogo the Possum is shown picking up trash that humans have strewn across his home in Okefenokee Swamp, with the headline, “We have met the enemy and he is us.” This quote has even greater resonance today. Humans are the main threat to life on our planet and have emerged as its dominant selective force. While climate change receives the most publicity, it isn’t the only concern. Other threats include habitat destruction, urbanization, and the spread of pests and diseases. In a human-altered world, plants must adapt to these changes, migrate to a new environment, or die. I devoted my presidential address to discussing the importance of one of these responses to anthropogenic change: evolutionary adaptation. I specifically asked the following questions: How fast can plants evolve? How fast do they need to evolve to

cope with climate change? How can we aid or hinder adaptation? And, how can we convert this knowledge into action?

How fast can plants evolve?

Despite the focus of evolutionary biologists on adaptation for over 150 years, an answer to this question remains out of our reach. Nonetheless, theoretical and empirical studies allow us to draw some preliminary conclusions. In an influential theoretical study of rates of adaptive phenotypic evolution, Bürger and Lynch (1995) employed a simulation model in which selection acts on a quantitative trait that is correlated with fitness. They reported that in a large population, the sustainable rate of phenotypic evolution is “a few percent” of a phenotypic standard deviation (SD) per generation. In small populations, the sustainable rate of evolution was even lower: <1% of a phenotypic standard deviation per generation. Recent theoretical studies support these general conclusions (e.g., Kopp and Matuszewski, 2013).

Why is evolution so slow, at least according to theory? One potential impediment to adaptation is the depletion of beneficial



By Loren H. Rieseberg,
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genetic variation. The rate of adaptation is also limited by the number of selective deaths that have to occur to replace one allele with another. This is referred to as the “cost of selection” (Haldane, 1957) and can lead to population extinction if selection is too strong. Conversely, phenotypic plasticity and density-dependent or “soft” selection provide a buffer against extinction. That is, if the strength of selection is commonly reduced at low densities (e.g., due to a reduction in the intensity of competition or spread of a disease), extinction risk might be much lower than predicted by conventional “hard selection” models.

What can we learn from empirical studies? Evolutionary biologists typically quantify rates of contemporary phenotypic evolution in terms of Haldanes, where a Haldane is defined as a change of one phenotypic SD per generation. I searched the literature for

studies that had estimated rates of phenotypic evolution in plants, building on a review by Bone and Ferris (2001). I only included studies that reported on rates of phenotypic evolution in natural populations *and* verified through common garden or reciprocal transplant studies that the phenotypic changes were genetically based rather than plastic. Results indicate that while rates of evolution can be very fast over the short term, over longer time periods, phenotypic evolution slows and is roughly consistent with theoretical predictions (Figure 1). The decline in rates over time likely has multiple causes, including fluctuating selection pressures, the approach to a new phenotypic optimum, and the depletion of genetic diversity.

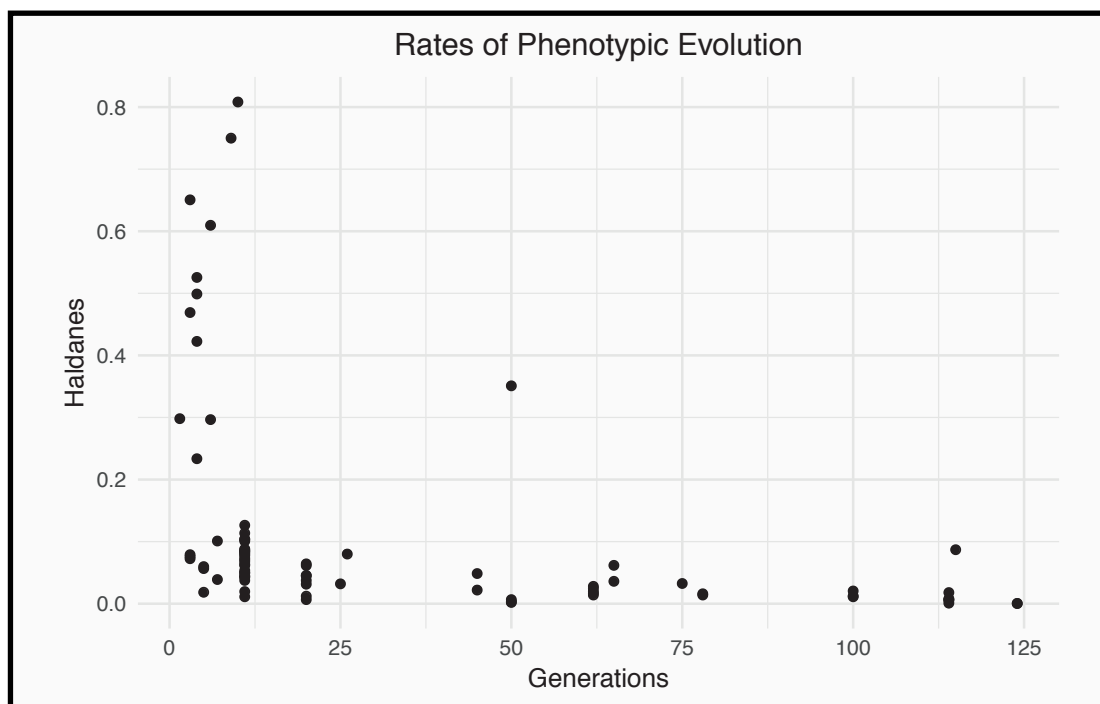


Figure 1. *Rates of phenotypic evolution in plants.*

How fast do plants need to evolve to cope with climate change?

To estimate the extent of phenotypic change required to cope with climate change, I surveyed the literature for studies that report on phenotypic differences along latitudinal or altitudinal clines. A rate of $0.45^{\circ}\text{C}/\text{degree}$ of latitude (Lindzen, 1994) and $0.5^{\circ}\text{C}/100\text{ m}$ of altitude (Marshall et al., 2007) was employed to estimate temperature differences between study sites unless more accurate values were provided by the study. As before, only studies that distinguished between genetic and plastic differences were included in the analysis. While there was considerable variation among traits, phenotype differentiation averaged ~ 0.3

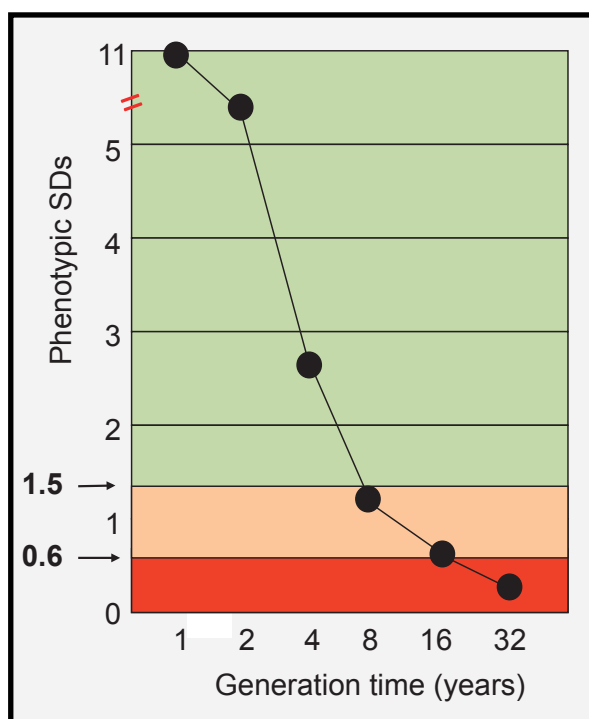


Figure 2. Maximum expected phenotypic adaptation over the next century compared to necessary adaptation predicted by climate models.

SD per degree of Celsius, which provides a crude estimate of the magnitude of phenotypic change necessary for adaptation to predicted climate change.

Climate projections suggest temperatures will rise between 2° and 5°C over the next century (Rafferty et al., 2017). Based on average phenotypic differences observed along altitudinal and latitudinal clines (above), we can extrapolate that, on average, phenotypic change of 0.6 to 1.5 phenotypic SDs per century will be required to adapt to predicted temperature changes, and in the absence of migration. Assuming an average rate of phenotypic evolution of 0.11 Haldanes, which seems reasonable at least in the short term, this implies that species with short to medium generation times (8 years or less) might be able to evolve rapidly enough to cope with climate change (Figure 2). Species with longer generation times must migrate.

Of course, this is a very rough approximation and does not take phenotypic plasticity into account. Also, there is likely to be considerable variation among traits, populations, and species in their response to selection. It might be, for example, that traits more closely associated with fitness will evolve more slowly due to reduced genetic variation or genetic and physiological constraints. In addition, populations facing climate change may be subject to other potential conflicting selection pressures such as competition from invasive species, new diseases, loss of pollinators, habitat disturbance, and so forth that will slow evolutionary responses to climate change. Thus, it is important to compare these results with other studies that examine threats to plant species.

First, it is important to keep in mind that presently climate factors are not a leading

threat to plant species. Kew Garden's *State of the World's Plants* (2016) quantifies the threatening processes for vascular plants on the IUCN Red List. Agriculture (31%), Biological Resource Use (21%), Urbanization (13%), Natural System Modifications (9%), and Invasives and New Pests and Diseases (8%) are the main threats. Climate change and severe weather are considered to be threatening factors in <4% of species, but this number is expected to grow in the future. A meta-analysis of 131 studies across a broader array of organismal groups (Urban, 2015) suggests that climate change is a somewhat greater threat (7.9% of species and accelerating) than implied by the Kew report, but currently still less than other major threatening processes.

On the other hand, a recent study of extinction at the population level across the geographic ranges of numerous plant and animal species reported that local population extinctions at the warm edge of species' ranges are frequent (Wiens, 2016). In plants, for example, roughly 40% of 260 plant species surveyed suffer from warm edge extinctions. This implies that, contrary to my calculations, populations of many species are unable to cope with climate change. Perhaps adaptation at range edges is frequently limited by maladaptive gene flow, insufficient genetic variation, or conflicting selection pressures.

Lastly, it is important to remember that evolutionary adaptation is only one of several biological processes that impact organismal responses to environmental change. Other key processes not considered here include migration, species interactions, demography, physiology, phenotypic plasticity, phylogenetic constraints, and characteristics of the environment. Ideally, models should include information about all of these processes to

predict climate change responses (e.g., Urban et al., 2016).

How can we aid or hinder adaptation?

Understanding the factors that limit adaptation is central to understanding how evolutionary change can be facilitated when desired (e.g., adapting to climate change) and hindered when necessary (e.g., slowing the evolution of pests and weeds). Population size is probably most critical, as a large population brings both genetic and demographic benefits (Figure 3). Probably less widely appreciated is the need to reduce conflicting selection pressures brought about by the wide array of threatening processes described above. Lastly, it is important to manage levels of gene flow. Gene flow can be beneficial by increasing the genetic variation available for selection. However, gene flow can be potentially maladaptive as well by reducing the efficiency of selection. The latter is most likely if levels of gene flow are high and/or the gene flow derives from genetically or ecologically divergent source populations.

In terms of specific actions, one of the most widely debated approaches is assisted migration or assisted colonization (Ricciardi and Simberloff, 2009; Aitken and Whitlock, 2013). As implied by the name, the method refers to the translocation of genotypes to a more suitable environment or one that is predicted to be more suitable in the future. Assisted migration includes assisted population migration, assisted range migration, and assisted species migration. Assisted population migration, in which genotypes are better matched with the environment within the current range of

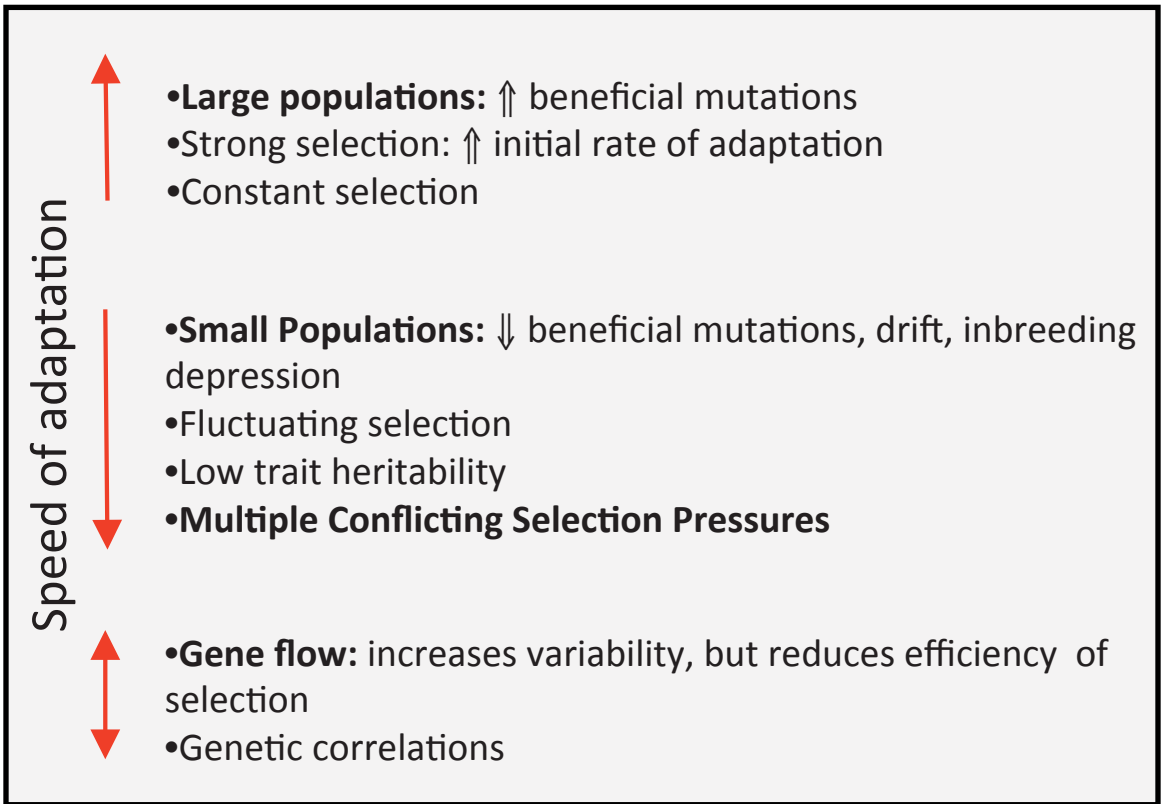


Figure 3. *Factors that affect rates of adaptation.*

a species, is least controversial and has the potential to rescue species that cannot migrate sufficiently fast or lack the capacity to adapt *in situ* (Vitt et al., 2009). Assisted range migration and assisted species migration are more controversial because populations are translocated beyond current range boundaries, leading to legitimate concerns about potential harm to recipient communities (Ricciardi and Simberloff, 2009). With that said, given ongoing and predicted anthropogenic impacts, inaction may result in greater damage to biodiversity than the careful integration of assisted migration (broadly defined) into conservation strategies (Schwartz et al., 2009).

In addition to adaptation of natural populations, more attention needs to be given to adaptation of managed populations, such as fiber, forage, and food crops. This is critical because agriculture and biological resource

use (e.g., logging) are currently the greatest threats to plant diversity. With an expanding human population, and dietary shifts due to increasing affluence, competition for land and water is expected to further intensify in the future. Thus, we must not only increase the productivity of our crop, forest, and rangelands (thereby sparing land for conservation), but also modify our agricultural practices to make them more biodiversity friendly (Kremen, 2015). Practices that enhance local adaptation of crops and trees can contribute to both goals. For example, Wang et al. (2006) has shown that implementation of a knowledge-based policy in which seeds are matched to future local climate can increase forest productivity by circa 35% relative to the status quo. Likewise, the breeding and deployment of locally adapted crops has the potential to both increase yields and reduce the need for external inputs such as water and fertilizer.

To accomplish this, we must tap the genetic diversity of environmentally resilient wild plants, which has been shaped by millions of years of natural selection. While in some cases (e.g., crop wild relatives) this can be accomplished via conventional breeding, given the urgency of reducing agriculture's footprint, we should embrace and utilize the full arsenal of agricultural biotechnology.

Modern plant breeding practices have developed crop varieties that perform exceptionally well in monoculture and soils enriched by synthetic mineral fertilizers (N-P-K). However, these varieties typically are less well-suited to more sustainable agro-ecological farming practices such as intercropping, perennial systems, organic matter inputs to soil, etc., which increase crop and non-crop diversity (Kremen et al., 2012). We need to re-orient breeding efforts toward the development of cultivars that are locally adapted, environmental resilient, and well suited to agro-ecological farming practices. Such well-adapted varieties will be required if sustainable and diversity-focused agriculture is to match the productivity of conventional farming.

Methods for hindering adaptation in pests or weeds are important as well and can be viewed as the flipside of encouraging adaptation. A general strategy therefore is to limit population sizes of the pest, as well as to reduce the consistency and strength of selection pressure from the focal control agent. For example, to reduce the evolution of herbicide resistance, standard management procedures (e.g., <http://hracglobal.com/prevention-management/best-management-practices>) include: (1) crop rotations, which permit the rotation of herbicides that vary in mode of action; (2) cultural control methods (e.g., plowing, delayed planting, mulching,

etc.) that release the weed population from herbicide pressures and reduce the soil seed bank; and (3) herbicide mixtures or sequential treatments of different herbicides. Unfortunately, except when enforced by strict regulatory regimes, the implementation of evolutionarily informed management strategies tends to be haphazard and resistance evolution is inevitable.

In the future, new biotechnology approaches may be employed to both aid and hinder adaptation of natural populations. One of the most promising of these is gene drive, in which inheritance is biased toward a particular copy of a gene. As a consequence, a "drive" allele will spread much more quickly through a population than a mutation governed by conventional rules of inheritance. New gene editing methods make it possible to build robust gene drive systems that could, for example, eliminate populations of invasive species, pests, and weeds by driving in sterility or sex ratio bias genes. Alternatively, it might be feasible to drive in genes that protect species at risk due to climate change or reduce pest damage. Of course, there are many risks associated with deployment of drive systems. For example, drive alleles might have unintended consequences due to pleiotropic or epistatic effects. They also may spread beyond the target species if it has sexually compatible relatives, potentially wreaking havoc in non-target species. Most likely, though, natural resistance will arise to the drive allele, so that it will be stopped long before it can move across the range of a system. The bottom line is that there is much more that we need to understand before drive alleles should be released into natural populations.

How can we convert this knowledge into action?

A popular cartoon shows a group of scientists sitting around a conference table with the caption, “The latest research shows that we really need to do something with all of this research.” Scientists have historically been strong proponents of curiosity-driven research, in which they choose both the question to be studied and the experimental program. Results contribute to our basic understanding of how the world works and typically do not have an obvious application. However, such research sometimes leads to serendipitous breakthroughs. It also is important to keep in mind that all applied research builds on this foundational research. The curiosity-driven research paradigm has been extraordinarily successful and is arguably mainly responsible for the extraordinary pace of scientific discovery and technological innovation seen over the past century. The one potential weakness is that the knowledge flow is unidirectional (from scientists to end-users). This has sometimes been likened to a loading dock. Scientists dump the information on the loading dock, but most of the time no one picks it up.

An alternative solution-driven paradigm has been building steam of late, driven by the desire of funders (mainly governments) to extract greater economic benefits from the science they fund. In this paradigm, research is focused on finding solutions for end-users, whether they are in government, industry, NGOs, or society, more generally. Knowledge is produced jointly and the flow of knowledge is bidirectional, with benefits to both researchers and end-users. Results tend to be more specific and applicable to end-user

concerns. The downside is that such research is less likely to contribute importantly to our broader understanding of the natural or physical world, and fundamental breakthroughs are less likely.

I spent my first two decades in academia focusing solely on curiosity-driven research (and loving every minute of it). However, given the severity of the challenges facing the globe, I believe that there is a need for both curiosity- and solution-driven research. Thus, I urge botanists to engage with end-users, such as land managers, farmers, plant breeders, policymakers, etc. to learn their concerns and co-design research programs that may contribute to solutions. My own lab’s efforts are now split approximately equally between these two endeavors. I do miss the heady days of doing whatever I wanted all of the time, but my lab’s research program over the past decade has been greatly enriched by engagement with end-users.

While conducting research is important, most of us will have a greater impact through education. My own accomplishments pale in comparison to those of my students. For example, my first two students, Dulcé Arias and Oscar Dorado, were both from the state of Morelos, Mexico. After leaving my lab, they returned to Morelos, where they established the world’s largest tropical deciduous forest preserve, the Huatla Sierra Biosphere Reserve (<http://www.unesco.org/new/en/natural-sciences/environment/ecological-sciences/biosphere-reserves/latin-america-and-the-caribbean/mexico/sierra-de-huatla/>). Tropical deciduous forest is one of the world’s most threatened habitats, and the Huatla Reserve protects one of the few large remnants of this unique ecosystem. A more recent student, Hannes Dempewolf, joined

my lab with the ambitious goal of feeding the world over the next century as population growth, changing diets, and climate change create a perfect storm. He currently is doing exactly that! After leaving my lab he joined the Global Crop Diversity Trust, where he is spearheading a \$60 million project to adapt crops to climate change.

By the time students reach our labs, though, their trajectories are largely set. I have no doubt, for example, that Dulcé, Oscar, and Hannes would have done great things for biodiversity and food security, respectively, even if they had never set foot in my lab. We arguably can have a greater influence on our undergraduate students and on our children by stimulating an interest in nature. I was late in having children and have struggled to engage them with nature while living in an urban environment. Yet we have to teach our children to love nature before asking them to save it! My wife and I serve as the zoologist and botanist, respectively, for a TV show called “Scout and the Gumboot Kids,” in which children (including our own) solve nature mysteries. The hope is that the five-minute show, which appears each morning on CBC Kids (<http://www.cbc.ca/parents/shows/view/scout-the-gumboot-kids>), will kindle children’s curiosity about nature and foster a more protective view of our natural environment.

Conclusions

The meta-analyses I performed offer some conclusions about the rates at which plants can evolve, as well as the rate at which they need to evolve to keep up with climate change. Evolutionary rates can be high in the short term, and potentially high enough to allow many plant species to cope with climate

change. However, observations of frequent population extinctions at the warm edge of species’ ranges contradict this conclusion. Possibly, adaptation at range edges is limited by other factors, such as conflicting selection pressures due to other anthropogenic impacts.

I also made a call for the development of strategies to aid adaptation when desired and hinder it when necessary. In addition to maintaining large and connected population systems, we must attempt to limit the conflicting selection pressures faced by populations. More options exist for assisting adaptation in managed populations, ranging from assisted population migration to selective breeding to gene editing. Equally important are approaches to limit adaptation in pests and weeds. Strategies utilized to slow pest adaptation typically attempt to limit population sizes, as well as to reduce the consistency and strength of selection pressure from a given control agent. More generally, our focus going forward should be on adaptation rather than preservation of the *status quo*.

To put this knowledge into action, I argued that botanists need to become more engaged with end-users, and that the botanical community should embrace both solution-based and curiosity-driven research. However, we likely will have our greatest impact through education rather than research, especially by inspiring the curiosity of our non-majors and children about the natural world. The latter hopefully will contribute to a needed cultural shift towards valuing and protecting nature.

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Cutting the Cord: Tips for Computer-Free Presentation Skills

This paper grew out of a skill-building workshop held at Botany 2017 in Fort Worth, Texas.

Giving a talk” or “preparing a lecture” has become synonymous with putting together slides in presentation software such as PowerPoint or Keynote. However, the power of these tools cannot replace good fundamental presentation skills and may even detract from your message. In addition, computer-less “chalk-talks” for seminars or interviews are gaining popularity. For people used to working with presentation software, going computer-free can be a challenge. Planning for pacing is important when you have to draw and write everything out while you talk, and visual components must be streamlined. However, understanding how to work with just a marker and whiteboard will help you refine your message to its most essential components. Here, we provide tips for effectively communicating information in a chalk-talk and give examples of what to do and what not to do. We share some of the feedback provided by participants of the skill-building workshop we held on this topic at Botany 2017.

1. Good fundamental presentation skills—don’t forget your KAYAK.

The weekend after we decided to host a workshop together on presentation skills, one of us (MLP) went on a whitewater kayaking adventure. For those readers without first-hand experience, know that kayaking on a fast-moving river is quite different from paddling on a lake or slow-moving river. If you don’t steer properly and get into the right part of the river where the water is flowing, your kayak gets hung up in the bends of the river with the flotsam and jetsam and you get tangled in all the overhanging vegetation—a situation that the River Guide called “the Jungle Tour.” While this sounds attractive to a botanist, the jungle tour isn’t really all that great!

The River Guide thankfully provided some instruction to successfully navigate the river: he said to “look” at where we wanted to go and “paddle accordingly—sometimes hard and fast.” He also cautioned us against looking at the places where we didn’t want to go—by shifting our eyes and focusing toward those areas, we would end up paddling right into them! For the sake of science, the River

Guide’s instruction was followed (result: paddling like a pro, with kayak moving through the sweet spot of the rapids) and, for comparison, ignored (result: tangled up on the Jungle Tour). Hypothesis testing works.

Readers may wonder why we’re sharing this story



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here. The River Guide's simple instruction is equally applicable to making good presentations: **Know where you want to go** and **Do what it takes to get there**. The word "KAY-AK" also makes a helpful acronym to remember the following tips for giving a good presentation.

"**K**now"

There are several things you need to know:

- Know your audience (who are they, why are they there, what do they already know, what questions will they want answered).
- Know your goal—your objectives—for the presentation. What are your major points? What information does your audience need in order to follow your presentation? What figures/diagrams are necessary for audience to follow and understand your message?

"**A**sks"

Ask questions!

- A good presentation is really about communication, and that communication should be two-way. Ask questions so you can better know your audience and engage them. Of course, sometimes when you engage the audience in this way, you can end up taking a bit of a Jungle Tour—but that is okay, because you **Know** what your goals are and how to reach them, so you will be able to get back on track and into the flow of your message.

"**Y**ou tell a story"

A good presentation tells a story.

- You aren't going to go into all the details—just focus on the parts that enable

you to tell an effective story, one that provides context and has a beginning, middle, and end. We are naturally drawn to a story and find it easier to connect to information shared as part of a story; a story gives us a way to connect with the material shared in a presentation—that material goes from being disparate pieces of information (or "facts") into forming a more cohesive whole.

- We are natural storytellers—we tell stories all the time—and we don't pull up the computer or presentation software to do it! Your most important tool is your voice, followed by your hands and your body. Use changes in volume, pitch, and speed of voice for emphasis. Use silence, too. You yourself are the most effective instrument for conveying meaning.

"**A**ssess understanding and **A**djust"

Remember, you are communicating with your audience, and communication needs to be two-way.

- **Assess** your audience's understanding and engagement by asking them questions and paying attention to their body language and facial expressions. Do they look lost? Ask questions to find the point at which you lost them. Do they seem disinterested? Do you need to change the pace, get them re-engaged?
- You must pay attention to the audience and **adjust** accordingly. Sometimes, your audience is stuck in the Jungle Tour and you need to go get them and bring them back into the flow again so you can reach your desired endpoint—together.

"**K**now you've reached your goal"

How will you know your presentation

achieved your goal?

- Because you followed KAYAK, you will **K**now that you conveyed all the key points you wanted to convey, you **A**sks questions so you could involve your audience, **Y**ou told a story, you **A**ssessed understanding and can see that your audience has the satisfied look and body language that communicates to you that communication was successful, allowing you to **K**now you've reached your goal.

2. Challenges and concerns of going computer-free—don't be afraid to get your feet wet.

After presenting the KAYAK of good, fundamental presentation skills at the Botany 2017 workshop, we asked participants to help us generate a list of challenges and concerns one may have about giving a computer-free presentation. Below is a summary of that, followed by our counterpoints and potential solutions.

Fear of forgetting something

- Presentation slides should be used because they support what you are saying—not the other way around (that is, you are not there to walk the audience through a set of slides). Slides should be created with the purpose of helping the audience understand your message; they should not be used as speaking notes, loaded with text you intend to say.
- Allay concerns about forgetting what you want to say by listing main points on an index card. If you need the comfort and assurance of more detailed speaking notes, you can create one (or more) cards per major topic, punch holes in the top corner, and secure the set together with a loose-leaf binder ring. The ring of cards

fits nicely in your non-dominant hand and you can easily flip through them as you complete a point. If scripting your presentation helps you feel prepared, then make a simplified, bulleted version to reference during your talk so you don't get lost in your text.

- Bring a hard copy of any diagram or illustration you plan to draw on board or show via a PowerPoint slide; make sure it is annotated with the things you intend to point out or discuss with your audience.

Fear of being vulnerable, or feeling naked without the computer and slides to hide behind

- We can spend a significant amount of time preparing a talk using presentation software. Looking for images, formatting the slides, and producing the accompanying text can take countless hours; after all that effort, we may think our presentation is “ready” because we have a digital file that will surely impress our audience with how prepared we are. However, we can choose to prepare differently. We can spend less time preparing PowerPoint slides and more time thinking through our presentation and how to connect the audience to our main objectives. We have more time to clarify our ideas and how best to share them.
- Going computer-free can be better because the audience gives *you* more attention, instead of focusing on your slides. If you use presentation software, you can use the “black screen” to remove the distraction of the slides when you want to direct attention at what you are saying or what you are drawing on a whiteboard.

Fear of not being in control

- Because we can spend so many hours preparing slides in presentation software, we become rather invested in them. We can feel compelled to “get through the slides” because of all that effort. Our audience can also become subdued, reluctant to ask questions they need answered, and inclined to watch passively. Everyone can feel locked into the presentation that exists. While it may be comforting to keep in lockstep with projected slides, it can prevent us from being attentive to our audience and engaging in the two-way communication that helps us successfully deliver our message.
- It’s okay to give up this kind of control because you know (**KAYAK**) what your objectives are and what you need to do to help audience reach those objectives with you.

Fear of trying a new presentation method

- If you are not sure you are ready to forego presentation software, you can at least minimize your dependence on it while delivering your presentation. Prepare presentation slides as usual (with as much text as your heart desires), print a version to use as your hardcopy speaking notes, then delete every slide except those containing figures or text that you consider essential for supporting your message. In this way, you can have the best of both!

Fear about running out of time

- Timing is important for any presentation. Establish signposts in your presentation with target times, so you end on schedule and allot sufficient time for critical content (for example, “I must be

discussing this point by 15 minutes into the presentation”).

- Keep main points in mind (know your goals, **KAYAK**) so you can get back on track when the audience or discussions pulls you off your planned course.

Fear that audience won’t follow your presentation or won’t understand your message

- You know what your goals are and what information the audience needs in order to follow your presentation (**KAYAK**), you ask questions so you have a sense for existing knowledge and are stimulating engagement (**KAYAK**), you are telling a story (**KAYAK**) so your presentation is a satisfying “whole” instead of disparate bits of information, and you are continually assessing your audience (**KAYAK**) so you can provide additional clarification when needed.
- You can use a whiteboard, chalkboard, or flip chart to provide the visuals you need, including text or outlines that will help organize your presentation. Don’t overlook the value of including other demonstration objects that you have determined can help convey your meaning.

3. How to make the most of the whiteboard—paddles in the water.

You can make a “chalk talk” as information-rich as a slide presentation. We use PowerPoint in our classrooms, but we spend much more time using the whiteboard than projecting PowerPoint slides because we’ve found them to be much more effective. The fastest way to lose a group of students or any audience is to project a slide showing a detailed diagram for which they are not properly prepared. Drawing and/or writing on the board is

superior because:

- You create the visuals you need right there, when you need them. The act of creation draws in the audience.
- Simplified diagrams that the audience watches you create will help them follow you as you walk them through the drawing, rather than getting lost in a very detailed projected illustration (these projected illustrations are much more effective after you've created simplified versions on the whiteboard).

Here are some tips for when you are planning your presentation, and for when you are in front of the board with a marker in hand!

Write it out

The simple act of writing key words and phrases will give your audience clear clues as to the most important parts of your message.

- **Keep it short**—Writing takes longer than talking, so don't expect to write out whole sentences all the time. Stick to single words or short phrases. You might even consider picking a few, longer words to abbreviate; just make sure it's as obvious as possible what the abbreviations stand for, and don't abbreviate similar words.
- **Keep it organized**—Use spatial placement of words as a clue to how they are related to each other. Bullet points are your friend here, but word clouds or flow charts can be useful for more complex relationships.
- **Keep it legible**—There's no way to avoid it: handwriting is important. You don't have to win any penmanship awards, but there is no point in writing something down if no one else can read it.

- Writing on a vertical surface is different than writing on a flat desk, so it's a good idea to practice.
- Think about where the audience is sitting; in a bigger room, you will need to make your writing larger.
- If you find yourself making illegible scribbles because you feel rushed, slow down and simplify what you are trying to write. Remember that note-takers will be writing, too, and will probably appreciate a little extra time.
- Make an effort to focus on what you are writing, as this will help you to be neater. It can be difficult to write and talk at the same time; it's okay to catch your breath while you write.

A picture is worth a thousand words

Illustrations, diagrams, charts, graphs—all of these are important tools, but they can seem daunting to produce in front of the audience.

- **Have a map**—Take the time to plan your illustration. Draw the complete image out on an index card or paper that you can bring with you up to the board; you can reference this to stay on track.
- **Simplify**—If it's not necessary, don't draw it; this will save you time and keep your message clear. Using a simplified style can also help you if you think you are artistically challenged—and if drawing isn't your strong suit, that's okay! You can use your maybe-oversimplified representations to add a little humor (“Believe it or not, this blob-shape is supposed to be a _____ ...”). Label elements of the image for clarity; if labels aren't key words for your message, then do you really need to draw that element at all?

- **Practice**—Before you present, practice drawing out the image while explaining what it is that you are drawing. You’ll feel more relaxed when you actually present, which means that you can concentrate a little more on making straight lines, neat circles, or whatever else it is you need to draw.
- **Break it into pieces**—It can help to make several passes for illustrating complex concepts. Start with the simplest diagram possible that can provide a broad overview (this establishes context), and then make additional components, each adding just a little more detail. In between passes, be sure to turn around and check in with the audience.
- **An animated experience**—You can’t draw an entire picture at once, so think of it as an opportunity to add a dimension of time to your image, or to indicate a series of actions.
- **Use tools**—Do you have to draw a lot of straight lines, but you can’t seem to keep your hand from wobbling? There is no reason you can’t bring a ruler to use when you’re up at the board. Your audience will appreciate having a neat and tidy image.

Build your board together

Pull your audience into the experience by asking for their input, and incorporate that into what gets written or drawn on the board. Word-clouds and flowcharts are great for this; their flexible formats allow you to take advantage of your audience’s creativity. Here’s how you can do it!

- **Make a plan.** Decide what you want to explain, and think about the best visual strategy to present the concept—this is your goal. Even though you can never know exactly what sort of journey you and your audience will explore, your job is to guide them toward the goal.
- **Start simple.** When you’re at the board, start by writing a single word or simple phrase. Putting it in the middle of the board allows for the most flexibility, but you can put it on the top or side of the board as a clue to your audience that you have a linear concept you want to explain. If it’s useful, block out zones of the board for certain types of ideas that you will be looking for (for example, if the core word is “Photosynthesis”, block out the left side of the board as “Inputs” and the right side as “Products”).
- **Ask a question.** You can start with a fairly general request for ideas related to your core topic, and ask about more specific concepts if the audience is veering away from the goal. Avoid yes-or-no questions.
- **Organize audience input.** If you get ideas that are relevant, but you don’t know how to incorporate them just yet, you can “put them off to the side for now” (start a word box on one side of the board, that you can grab terms from later). Even if you don’t end up using all of the terms, audience members will be encouraged by seeing their ideas written on the board.
- **Build on your core idea.** If you get useful ideas, add them to your diagram/flow-chart/word-cloud!
- **Evaluate your story.** This is an important step, to make sure that you stay on track. Did the last addition help you get to your goal? Is your audience showing special interest in a tangential topic that you can explore during this lesson, or as part of a future talk? As a review for the audience, take a moment to walk through the important parts of the image you have so

far, from start to finish. This can help you form your next question and will prime your audience to think about where you are going.

- **Repeat steps as needed!**

Tip: Grab an assistant from the audience.

Are you nervous about having your back to the audience while you write on the board, or worried about your hand writing? Choose an audience member to come up to the board with you and be your “note-taker” (just make sure your assistant gets a copy of the notes, or can take a picture of the board with their phone at the end).

4. Conclusions: Giving a talk is like taking your audience on a journey toward the goal of understanding a concept. How you guide

them is up to you and is influenced by how you decide to deliver your talk. PowerPoint slides are one tool you can use; your slides will certainly be informative, and it’s easy to “stick to the script.” A whiteboard is another tool—one that is just as effective at conveying information, and one that also facilitates interacting with the audience. If you are used to using only PowerPoint slides, going computer-free can seem challenging—but this challenge is nothing that can’t be solved by having a plan and practicing. In fact, planning out how best to use the whiteboard is a great opportunity to think about simplifying and streamlining your message, ultimately making it easier for the audience to follow along with you.

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Scientists Respond to Call: PlantingScience Mentor Pool Increases to Meet Need

In the last issue, we shared an urgent need for scientist mentors to work with small teams of students on plant science investigations through PlantingScience.org. BSA and partnering organization members responded to the call, and this summer we added over 200 new mentors to our scientist mentor pool. We are starting the fall session with 625 mentors. PlantingScience mentors come from all career stages with especially high numbers of graduate students ($n = 224$), post-docs ($n = 78$) and early career scientists ($n = 127$) volunteering. Our mentors include scientists from 25 countries and 48 U.S. states. Collectively, PlantingScience mentors are members from 150 different societies/professional organizations and have a diverse set of research interests (Figure 1).

Thanks to all of our mentors for making the program possible and for helping get more plant science into middle- and high-school classrooms. Thanks also for everyone's assistance in recruiting scientists to serve as mentors.

We will be recruiting teachers heavily in spring, so if you know of middle- or high-school biology teachers who may be interested in participating with their classrooms, please direct them to our website, <https://plantingscience.org/>.

Teachers and Early Career Scientists Participate in PlantingScience Digging Deeper Professional Development in Colorado Springs

This summer, 36 high-school teachers and 22 early-career scientists met at Biological Sciences Curriculum Study (BSCS) headquarters in Colorado Springs, CO to prepare to participate in PlantingScience this fall using the Power of Sunlight Photosynthesis and Respiration Investigation Theme. Enthusiasm was high as groups worked together to learn how to address student misconceptions, ask the right questions to move student learn-



**By Catrina Adams,
Education Director**

BSA Science Education News and Notes serves as an 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.

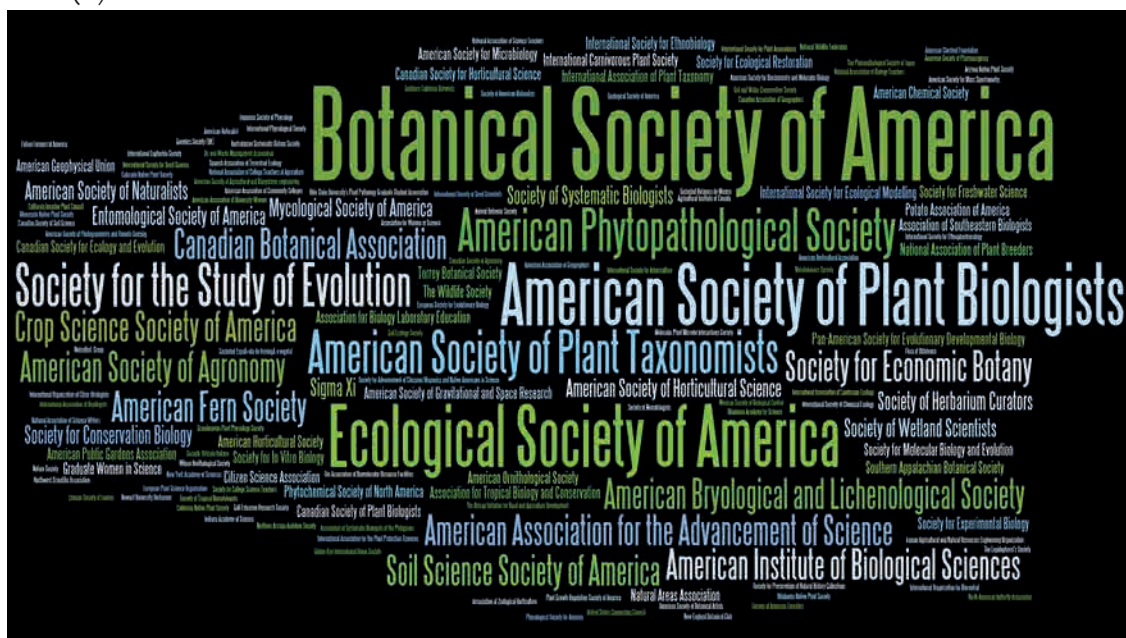


Figure 1. *PlantingScience* mentors collectively belong to 150 organizations. Societies with the most *PlantingScience* volunteers are largest in this wordle. Notice the diversity of scientific fields and interests represented!

ing forward, and practice using the website as they will in the fall. Early-career scientists discussed mentoring strategies and how to encourage student thinking in an asynchronous, online environment, as well as how to be good role models and encourage students'

long-term interest in science and confidence in their science ability. The workshops are part of the NSF-funded *PlantingScience: Digging Deeper Collaborative Teacher/Scientists Professional Development* research project (#1502892) (Figure 2).



Figure 2. *Early-career scientists and teacher participants from one of two PlantingScience: Digging Deeper professional development workshops held this summer. Photo taken during the field trip to Garden of the Gods park in Colorado Springs.*

Upcoming Science Education Conferences

Interested in creating environments and opportunities for your students to discover, investigate, and inform with data? Attend the 4th Life Discovery – Doing Science Biology Education Conference October 14-21 at the University of Oklahoma. Go to <http://www.esa.org/lcd> for more information.

Attending the National Association of Biology Teachers' (NABT) meeting (November 9-12) in St. Louis? Please stop by to see BSA staff at the PlantingScience booth. We'd love to have PlantingScience mentors or teachers stop by to share their experiences with the program. Also check out our Inquiring About Plants workshop with effective, tested ideas for bringing inquiry-based teaching about plants into your classroom. Attendees will get a free print copy of the book "Inquiring About Plants." Interested in the workshop but won't be attending NABT this year? You can purchase the e-book version (\$10.95) at <https://secure.mybookorders.com/Orderpage/1400>; all proceeds go to support the PlantingScience program.

PseudoScience Fair at the University of Central Arkansas is an Opportunity to Engage Students' Critical Thinking and Communication Skills

Increasing students' ability to think critically and distinguish between science and pseudo-science is a main goal for many science teachers. Why not approach that goal directly by

giving students opportunities to recognize and critique pseudoscientific concepts head on? That's what a team at the University of Central Arkansas aimed to do by organizing a well-attended, cross-disciplinary PseudoScience Fair through their STEM Residential College. BSA members Steven Karafit (University of Central Arkansas) and Faith Yarberr share their experience of facilitating their freshman-level biology students' participation in the fair and their plans for a second Pseudoscience Fair this fall.

Studying the nature of science by investigating pseudoscience

Students often view science as a hard and daunting subject that is little more than memorizing vast amounts of unrelated facts. It is no secret that there is growing evidence on the need for science faculty to not only teach their students about the nature of science, but also have students actively participate in the scientific process (e.g., Alberts, 2005; AAAS, 2011). Growing evidence suggests that students who accept pseudoscience as fact are likely to accept other invalidated claims, such as paranormal beliefs and conspiracy theories, as facts as well (Lobato et al., 2014). Students of the STEM Residential College at the University of Central Arkansas were given the chance not just to learn to recognize good science, but to research what bad science looks like. By researching a topic that may fall outside the sphere of science, students build skills by finding and reading primary, peer-reviewed literature, analyzing data and claims, working in groups, and explaining science to a broad audience. This project allowed students to research claims that may or may not be pseudoscientific and encouraged them to challenge their own previously held beliefs on

the subject.

The STEM Residential College in Arkansas Hall is a living and learning community consisting of approximately 200 freshman science students on the University of Central Arkansas (UCA) campus. In the fall of 2015, the STEM Residential College established a Pseudoscience Fair as part of its co-curricular activities across the scholastic disciplines of Biology, Chemistry, History, Philosophy, Psychology, and Exercise Science. The Fall 2015 and Fall 2016 Pseudoscience Fairs were held on the UCA campus, and approximately 400 individuals attended the event each year from the university community and the City of Conway.

The Resident Master of the STEM Residential College is tasked with organizing the event. Besides scheduling a date, time, and venue, the primary order of business is coordinating the faculty and students. Lists of enrolled students are obtained for the participating classes. Students taking multiple participating classes were placed into groups. This is an essential step in the process because it encourages students to view a topic through a variety of lenses. The participating faculty members are then brought together and topics are determined for those groups that span multiple disciplines. At the start of the fall term, the groups are given their topic choices and the research begins.

The STEM Residential College Resident master assembled a list of topics for Pseudoscience Fair participants. Topics were either generally considered to be pseudoscience by the scientific community or were at least perceived as such by the general public. The list of topics was deliberately broad in order to encourage students to focus on the process and interdisciplinary nature of science as recommended

by Vision and Change (AAAS, 2011).

Biology 1440

Biology 1440 (Principles of Biology 1) is a freshman-level cellular and molecular biology course for biology majors. It also is a required course for several other majors to obtain a B.S. degree. Biology 1440 is a typical lecture-based course with a weekly 3-hour lab component. Students were placed in groups of four to six students. After a lecture on the nature of science, they picked their topic of study (Table 1). In the following lecture, a librarian led the students through the process of finding relevant primary literature. Students were then tasked to do a review of literature on the topic. After completing their literature review, they met with their instructor to discuss their findings. Students were provided with feedback and then had a second meeting with their instructor where they presented a rough draft of their project and received additional feedback. Students were encouraged to think critically about the evidence that they found, and not judge the credibility of their subject until they had enough evidence to do so. Students were tasked with creating a presentation or poster that would contain the following information: background; claims made by the product, practitioners, or believer; evidence for or against these claims; and a group conclusion. Within the conclusion, students needed to determine if their topic was scientific or not, and they were asked to discuss what evidence would be needed in order for the topic to be considered as scientific.

Table 1. Topics covered by Biology 1440 student groups in the Fall 2017 Pseudoscience Fair.

Pseudoscience Fair Topics
Aromatherapy
Homeopathy
The Dangers of GMO Foods
The Health Benefits of Green Tea
Climate Change Denial
Lunar Effects on Human Behavior
Greenwashing
Vaccines and Autism
Subliminal Messaging
Electroshock Therapy

The pseudoscience fair/public outreach/student attitudes

Participants discussed their findings with fellow students, faculty, and the public at the Pseudoscience Fair. The three highest scoring groups in Biology 1440 were asked to participate in a science outreach event at a local junior high school.

While we have collected no formal data at this time, over 50% of students recommended that Biology 1440 participate in the fair in the future. Students displayed interest in their topics and were able to take what they had learned and apply it to other topics, including experimental design in the lab portion of the course.

Future work/data collection

The participating faculty met during the summer of 2017 to discuss the organization and evaluation of the Fall 2017 Pseudoscience Fair. The organizers plan to develop a common survey to analyze the student opinion of the process, along with a rubric to determine communication effectiveness both orally and in writing.

Literature Cited

Alberts, B. 2005. A Wakeup Call for Science Faculty. *Cell* 123: 739-741.

American Association for the Advancement of Science (AAAS). 2011. *Vision and Change in Undergraduate Biology Education: A Call to Action*. Washington D.C.

Lobato, E., J. Mendoza, V. Sims, and M. Chin. 2014. Examining the Relationships Between Conspiracy Theories, Paranormal Beliefs, and Pseudoscience Acceptance Among a University Population. *Applied Cognitive Psychology* 28: 617-625.



STUDENT SECTION

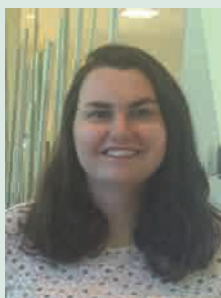
A Reflection on the Current State and Future Direction of Student Membership of the BSA

Throughout the last decade, many botany departments have become enveloped by larger biological science departments, resulting in fewer students pursuing botany degrees. In order to combat this issue, many different initiatives have taken root (e.g., using #IAMABotanist on social media); however, one of the most notable initiatives was BSA's foresight to invest in their student members. During a time when popularity and funding for botany related research was diminishing, former BSA Executive Director Bill Dahl approached the board of directors with the suggestion that students needed to play a more active role in the Society by having their voices

heard by the rest of the Society. In fact, here is a quote graciously provided by Dahl himself:

“There are so many passionate, talented, and energetic young botanists/scientists looking to make a positive contribution to science and [the] Society in general. We needed the ideas and energy from this group, and we needed to provide a means for this to come directly into the governance structure. Creating positions on the board just made sense. This has also allowed the BSA to expose a younger group to governance (with a window into scientific society operations). Part of the vision was to prepare tomorrow's leaders by giving people hands-on experience. I feel this has worked well. I think all of the past student reps would share a similar story in terms of increased confidence and growth. Remember, they represent the Society as well as being responsible for bringing forward new ideas and concerns of the students to the board for action. Having seats at the table is important for everyone.”

Thus, more than a decade ago, the BSA realized that there was a need to build a support



By James McDaniel and Chelsea Pretz,
BSA Student Representatives



system for the student membership in order for the Society to continue prospering. As a result, two student representative positions were established on the BSA executive committee.

More recently, at BOTANY 2016, the society recognized a decade of service provided to the BSA by student representatives, and we wanted to take time to recognize this monumental feat by reflecting on some of the accomplishments that have occurred over the past ten years. For example, there has been a push to establish additional resources geared toward the student members of the BSA. Previous student representatives saw a need for more student-oriented content at the conferences, which resulted in Sunday workshops aimed at students being added to the conference schedule. Over the past few years, student representatives have led workshops such as “Crafting an Effective Elevator Speech and Communicating Broader Impacts” and “Cutting the Cord: a Workshop for Computer-Free Presentation Skills” in an effort to convey the importance of utilizing effective science communication skills when networking and/or interviewing for jobs. Furthermore, the very first Undergraduate Student Mixer occurred at BOTANY 2017, which will continue to help

integrate undergraduates into the Society as well as encourage them to attend future conferences.

Another notable accomplishment within the last ten years is the fact that the Society has doubled the number of grants available each year to student members. Specifically, the Society added five new awards in 2012 and again in 2013, which brought the total up to 19 annual grants specifically targeted toward student membership. We are even more proud to announce that the student awards were renamed to honor Bill Dahl’s tremendous contributions to the Society over the years, specifically those that were critical in the growth of the student membership within BSA. The awards are now titled the “Bill Dahl Graduate Student Research Awards” and the “Bill Dahl Undergraduate Student Research Awards.”

The Society has also been integral in increasing diversity among the student population by creating the NSF-funded PLANTS (Preparing Leaders and Nurturing Tomorrow’s Scientists) grant. The PLANTS program, which was established in 2012, annually funds ten different students from underrepresented groups to attend the BOTANY conference. These students are supported by a cohort of their peers as well

as two different mentors as they navigate their first botany-related conference. Additionally, PLANTS has been a large component when it comes to engaging students in botany and establishing them as active members in the Society.

Unfortunately, one of our very own PLANTS grant recipients, Samuel Torpey, tragically passed away in May of 2017. As an undergraduate at the University of Idaho, Samuel attended his first Botany Conference in 2014 after receiving the prestigious PLANTS grant. From there, he finished his undergraduate degree at the University of Idaho and became a dedicated student member of the BSA by serving as a mentor for future PLANTS grant recipients. Furthermore, Samuel was a member of the Coeur d'Alene Tribe and enjoyed studying his family's native cultures while also working as a part-time environmentalist for his tribe. Ultimately, Samuel was a charismatic individual who had a knack for making friends and a passion for the environment and its floral diversity. As a result, the BSA is seeking donations to help fund a new PLANTS recipient at BOTANY 2018 in the honor of Samuel. If you would like to donate or to learn more, please visit <https://crm.botany.org/civicrm/contribute/transact?reset=1&id=13>.

As your current student representatives and past recipients of the PLANTS grant, we are excited to keep the momentum going as student membership continues to increase throughout the Society, but we are also excited to focus on building an inclusive and supportive community for students that will last for decades to come.

Quick Notes on the BOTANY 2017 Conference

We would like to extend a thank you to everyone who attended BOTANY 2017 in Fort Worth, Texas! From our perspective, the conference was filled with great workshops and mixers geared toward the student membership of the Society as well as great talks given by students, faculty, and alumni. More importantly, approximately 30% of the conference attendees were students—a number that has gradually increased throughout BSA's history. During our "Careers in Botany" Student Luncheon, we were reminded by Ned Friedman to take time to enjoy what we do and not spend time worrying about what needs to get done (to an extent). Friedman was also gracious enough to show us high-speed videos of Rhododendron flowers releasing pollen, which was followed up by a nice discussion that saw students interacting with panelists from a broad range of botanically oriented careers.

We also had a wonderfully executed workshop on "chalk talks," which introduced students to skills that are vital for giving a successful computer-free presentation. After watching Melanie Link-Perez present her take on a successful chalk talk (very successful, indeed), we all had the opportunity to practice and receive feedback in a friendly environment. Overall, our student-oriented events were a success and we loved having the opportunity to meet everyone at the student mixer, which was hosted at the T&P Tavern in downtown Fort Worth, Texas.

We look forward to seeing all of you again, or getting to know you for the first time, at BOTANY 2018, July 21-25, in Rochester, Minnesota!

Getting to Know your New Student Representative: Chelsea Pretz



Chelsea Pretz is a PhD student at the University of Colorado-Boulder, Ecology & Evolution Department, and has just started her two-year term.

When did you join BSA and what motivated you to do so?

I first heard about the Botany Conference during an REU (Research Experience for Undergraduates) internship at Missouri Botanical Garden. This was my first experience being around so many botanists, and I came to realize that research was a reachable career choice. So many of the researchers had very fond memories of Botany and would talk about the conference. The next year, I was lucky enough

to be a recipient of the PLANTS (Preparing Leaders and Nurturing Tomorrow's Scientists) grant where I was able to attend Botany and create my own fond memories in Edmonton, Canada. Furthermore, PLANTS included a four-year membership to the BSA, which motivated me to stay involved.

What motivated you to run for the position of Student Representative to the Board of Directors?

I was motivated to run for Student Representative after having such a positive experience in the PLANTS program. During this program, I met many different students who were at the same place in their career and who were excited to talk about plants. Throughout this process I realized how lucky I was to have a cohort of peers to experience the conference with; however, I know that there were other students who were isolated without a supportive community of people. This realization made me want to help connect students with resources and help students network to meet other really great researchers at the conference.

What is your research about?

I am studying the evolution of the genus *Physalis* (Solanaceae), which contains the important crop tomatillo. In particular, I am investigating interspecific gene flow, pollination ecology, and reproductive isolation with a focus on the domesticated species and their relatives.

What sorts of hobbies do you have?

Like most botanists, I enjoy hiking, camping, gardening, and traveling. Other things that fill my time include sewing, listening to podcasts (Planet Money, Code Switch, and Reveal), cooking, and playing board games with friends.

Building an Intentionally Inclusive Community

One of our main goals moving forward is to focus on building an intentionally inclusive community for student members of the BSA. If you have any questions, concerns, suggestions, or comments about how we can make a more inclusive community, please reach out to either James McDaniel (jlmcdaniel@wisc.edu) or Chelsea Pretz (chelsea.pretz@colorado.edu).

You did a good deed!

This year at the Botany Conference we collected your unused toiletries from the Omni hotel. Together with the Professional Convention Management Association (PCMA), we were able to put together and donate over 400 packets of shampoo, conditioner, bath wash, and body lotions. These will be given to families at Nationwide Children's Hospital in Columbus.



PCMA POWER Chapter members Johanne Stogran and Dianne Killian collecting supplies.



Thank You!!



ANNOUNCEMENTS

Harvard University Bullard Fellowships in Forest Research

Annually, Harvard University awards a limited number of Bullard Fellowships to individuals in biological, social, physical, and political sciences and the arts to promote advanced study or the integration of subjects pertaining to forested ecosystems. The program seeks to allow mid-career individuals to develop their own scientific and professional growth by utilizing the resources and interacting with personnel in any department within Harvard University.

In recent years Bullard Fellows have been associated with the Harvard Forest, Department of Organismic and Evolutionary Biology, and the J. F. Kennedy School of Government and have worked in areas of ecology, forest management, policy, and conservation. Stipends up to \$60,000 are available for periods ranging from six months to one year and are not intended for travel, graduate students, or recent post-doctoral candidates. Applications from international scientists, women, and minorities are encouraged. Additional information is available on the Harvard Forest website (<http://harvardforest.fas.harvard.edu>). Annual deadline for applications is January 15.

Tenure-Track Positions Open at Iowa State University

The Department of Genetics, Development and Cell Biology (GDCB) at Iowa State University invites applications for two tenure-track faculty positions at the rank of Assistant Professor. The department seeks to enhance and build upon existing strengths at ISU, with an emphasis on: (i) cellular or developmental processes integral to animal health or disease, especially in genetic model organisms; or (ii) cellular or developmental mechanisms that underpin plant responses to environmental signals and stresses.

Responsibilities include building nationally recognized research programs that compete successfully for extramural funding, advancing the discipline through high-quality publications, mentoring students, and effective teaching of undergraduate and graduate courses.

The successful candidate will possess excellent communication and leadership skills and will share the university's commitment to an inclusive environment that supports world-class diversity.

For more information, go to <https://www.iastatejobs.com/postings/28431>.



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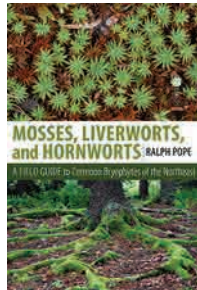
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BRYOLOGY

Mosses, Liverworts, and Hornworts: Field Guide to Common Bryophytes of the Northeast

Ralph Pope
 2016. ISBN-13: 978-1-5017-0078-1
 Paper, US\$24.95. 384 pp.
 Cornell University Press



As a field botanist, I am often drawn to and fascinated by nonvascular plants, but like so many other botanists and plant enthusiasts, I've not had much training in identifying them and am challenged when I try to do so. This summer, I was excited to add to my library Ralph Pope's new field guide to mosses, liverworts, and hornworts, a resource made for people just like me who want to be more versed in these diminutive plants but need help getting there.

Pope's guide to northeastern bryophytes is a valuable resource for anyone who wants to learn to identify common mosses and other nonvascular plants in the eastern U.S. [Note: the author acknowledges that although *bryophytes* may not be a "proper" taxonomic term based on contemporary understanding of plant systematics, it is still a term often used to refer to nonvascular land plants, and for the sake of convenience he uses it in this way in the book. For simplicity, I will do the same in this review.]

The target audience for this handy and information-rich guide is amateur naturalists and non-bryologist botanists, and the book is well-constructed for use by this audience—one does not need to be highly trained in nonvascular plants to use it. It is created with the intention that readers can identify the plants with only a hand lens (although some characteristics would be more easily seen with a dissecting microscope). He describes

a handy trick of putting phyllids (leafy parts of some bryophytes) between two slides and then holding up to the light with a hand lens to see characters such as costa and differentiated alar cells, which could be very useful in field identification.

Included in the book's introductory material are: information about illustrations/photographs, geographical and taxonomic coverage, species names and ranges, basic bryophyte biology, taxonomy, and ecology. The introductory chapter also includes helpful information about collecting and studying bryophytes.

The section on bryophyte taxonomy presents one current taxonomic delineation (stated as one of several in use today), but unfortunately with no citation/reference for its source or author. The author does call out main important points in the taxonomy of these plants, and this is useful in understanding current knowledge of bryophyte taxonomy, but the systematics of nonvascular plants is still uncertain and he notes this.

Following the introductory material, there is a master key used to divide bryophytes into six major groups: hornworts, thalloid and leafy liverworts, Sphagnaceae, acrocarpous mosses, and pleurocarpous mosses. The three moss groups each have a section of the book with a key to genera. In some cases (especially with common or diverse groups), keys to species within genera are also included. Hornworts and the two groups of liverworts are placed together in the final section.

The master key is very well crafted and useful. It only gives names of major groups to lead the reader to the next stage of the book; it would have been more useful to also include page numbers to lead the reader to the relevant section. It is helpful that the keys in the

book rely as little as possible on sporophyte characteristics as these are not always available (although in places it was understandably unavoidable).

At the beginning of each section on the major groups, there is a nice, organized list of species included. Each species description includes specific description of its characteristics, comparison with similar species, range and habitat, and information about the name etymology. Each entry is abundantly illustrated with high-quality photos. Drawings and photos focused on key characteristics of each species are particularly useful. Many include scale bars, which are incredibly helpful. Some do not, which diminishes their usefulness, but only slightly. Moss species entries also include distribution maps for northeastern U.S. south to South Carolina and Georgia and east into Michigan (maps are not included for liverwort and hornwort species).

An illustrated glossary is included in the back. This glossary could use even more illustrations of the terminology included, but it will still be very helpful to those new to the vocabulary of bryophyte structures. The author also includes a list of annotated references in the back, in five sections: those not needing a microscope; those more technical where a microscope is required; textbooks; miscellaneous printed references; and websites. Readers will find this list of resources useful for learning more about nonvascular plants beyond what is available in this guide.

In general, the book is very well organized and user-friendly. The colored "tabs" indicating the four main sections of the guide will be very helpful in efficient use of the guide in the field or laboratory.

Nonvascular plants can be very tricky to identify in the field for anyone not already

well versed in their characteristics, and there has been a lack of easy-to-use resources for field identification of this group. This book helps to fill that gap. I highly recommend it for anyone in the eastern U.S. who wants to become more familiar with this fascinating group of plants that are so often overlooked. Their identification will still take careful study and focused investigation even with this tool in hand, but this guide will serve as a good entry point for those new to the challenge.

-Amy Boyd, Warren Wilson College

DEVELOPMENT AND STRUCTURE

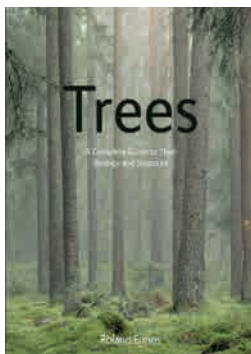
Trees: A Complete Guide to their Biology and Structure

Roland Ennos

2016. ISBN-13: 978-1-5017-0493-2

Paper \$19.95, 128 pp.

Cornell University Press,
Ithaca, New York.



For the lay public, this is indeed a concise, but complete, guide to the biology of trees. For professional botanists, it is a source of interesting connections and observations. For instance, the first chapter is an abbreviated history of the evolution of vascular plants highlighting *Rhynia*, *Lepidodendron*, *Calamites*, tree ferns, cycads, conifers, and angiosperms (including monocot “trees”). Ennos notes the rapid growth of fossil fern allies during the carboniferous with *Lepidodendron* reaching full height (about 40 m) in only 10 years. This growth was so successful at sequestering carbon that atmospheric CO₂ decreased from 20× the current levels at the beginning of the

period to levels lower than our current 400 ppm.

The second chapter provides an integration of the physiology of water transport with the “hydrodynamic design of wood.” An interesting note is that hydraulic tension within the xylem can “shrink” a 20-m-tall, 30-cm-wide tree during the day by 1 cm in height and 1 mm in width. Among the structural features described in Chapter 3 is a comparison of fiberglass to wood cell walls. However, instead of just a structural comparison of glass fiber and cellulose microfibrils surrounded by a matrix, Ennos notes that embedding glass fibers in a matrix increases the combined strength 1000× tougher than either component alone. The analogous composite of cellulose and lignin is about 100× tougher than fiberglass. Some interesting notes on “Limits to Height” are that stomata at the tops of tall trees close earlier in the day than those at lower levels, and that photosynthesis and new growth are reduced in the upper canopy, despite greater access to light. Chapters 5-8 focus on specialized groups of trees: survival strategies; trees in different climates; specialist trees; and trees of the southern hemisphere. My favorite “tid-bit” from these chapters is that the “drip tip” of rainforest trees not only help the leaf shed water, but actually helps minimize soil erosion. The final chapter touches on all aspects of the economic botany of trees. My favorite example is the physics of why the English longbow was constructed from the joint between sapwood and heartwood of the Yew tree. As a result, arrows could be shot more than 100 m and penetrate body armor.

At the end of the book is a one-page glossary, about two dozen selected references equally divided between books and websites, and a useful index.

My only concerns were the lack of a geological timeline of periods and the place of families in the hierarchy of classification, both of which would provide a better perspective of the fossil groups covered in the first chapter.

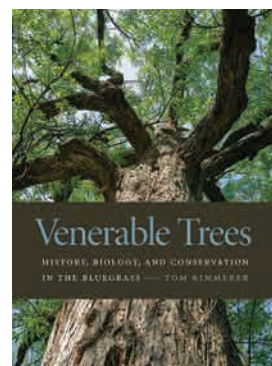
“Trees” is not quite a coffee table book, with a 7.5- × 10-inch trim size, but it contains numerous high-quality, full-color images, including full-page images facing each chapter title page. The format is much like a modern textbook with a single wide column of text and marginal figure captions. Size and placement of text figures varies throughout in an attractive way. I found the book to be a pleasant read and will include it on my undergrad reading list. I especially encourage middle- and high-school teachers to request a copy for their libraries. I suspect that it could provide an effective antidote for treating plant blindness.

-Marshall D. Sundberg, Emporia State University

ECOLOGY

Venerable Trees: History, Biology, and Conservation in the Bluegrass

Tom Kimmerer
2015. ISBN-13: 978-0-
8131-6566-0
Hardcover, US\$39.95. 288
pp.
University Press of Ken-
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With *Venerable Trees: History, Biology, and Conservation in the Bluegrass*, Tom Kimmerer takes us on a remarkable journey that is at once cultural and personal, wide-ranging and intimate, challenging and inspirational. We travel across the landscape of the Bluegrass and Nashville Basin ecoregions, easily traversing the years between first settlement and today, and learn about a legacy ecosystem from a masterful guide. Kimmerer is an ecological detective. He pieces together physical evidence and historical accounts of the region to reveal the origin of the woodland pasture, “an anomalous vegetation area” still evident in the oldest trees alive today. Yet Kimmerer’s account is much more than an historical or ecological report. It is also a call to awareness, an invitation to view the disappearance of woodland pastures as the result of collective choices, as well as a prescription for improved management of our inheritance.

Our tour begins with a visit to a massive bur oak surrounded by a parking structure in Lexington, the sole survivor of what was once, not too long ago, a woodland pasture shaded by this oak and representatives of the other four venerable tree species: kingnut, chinkapin oak, blue ash, and Shumard oak.

Kimmerer dubs the burly giant the “St. Joe Oak” and, by naming the tree, acknowledges the importance of its long life as a member of a larger community that eventually included the humans who demanded its preservation. The St. Joe Oak, and the other named trees and groves that grace the pages of *Venerable Trees*, reminds us of a landscape that predates human settlement and our present-day structures, a landscape that we now glimpse with the help of our able guide.

Large portions of the Bluegrass and Nashville Basin, we learn, were once mosaics of woodland pastures, forest, and meadows of cane and grasses. The botanist E. Lucy Braun, studying the region in the 1950s, was uncertain of its origin, believing that the environmental conditions there should have produced a continuous forest. Kimmerer deftly disputes the hypothesis that early settlers thinned the once-dense forests and instead investigates the interaction of several key factors over a longer time period that encompasses the settlement era. He weaves together natural history and memoir, biogeography, and dendrochronology to demonstrate that “today’s landscape is the direct descendant of the mosaic created by karst, drought, and bison.” The effect of clearing, fire, and Native American activities were not as relevant here as in other regions of the eastern United States.

Kimmerer’s ecological analysis is the heart of *Venerable Trees*. His interpretation of the origin of woodland pastures is accompanied by a comparison with the analogous “wood pastures” of England. This comparison serves to not only strengthen his analysis, but also fuels the subsequent discussion of how best to conserve the ancient giants and remnant pastures that exist today. We continue touring the landscape with visits to several locations that exemplify good management and several in which management was an afterthought

or development was prioritized. We see that woodland pastures can be maintained in agricultural areas with key changes to animal management, and in urbanizing areas, awareness and care can extend the lives of isolated trees. Kimmerer uses living examples such as the Old Schoolhouse Oak and the Elmwood Trees to suggest several “general rules of management” that reflect our current state of knowledge about tree reproduction and establishment and their susceptibility to root damage caused by construction and suburban lawn care.

For those of us encountering the Bluegrass and Nashville Basin for the first time, perhaps not having an investment of familiarity and connection in these particular trees, we meet with the challenge of considering how well we know our own regional landscape. Kimmerer indirectly asks us to consider the way in which natural landscape elements are gradually but permanently altered by human actions. His words are a subtle call for an integrated human-nature landscape and for understanding the needs of that which we value. Many venerable trees remain because people learned to value the park-like atmosphere that they created in cemeteries and preserved estates. Others were the focus of active campaigns to protect them during construction or to care for them after lightning strikes or disease.

This impressive synthesis of several fields of study is clearly the result of many decades of research and exploration. Readers new to these topics will find food for thought in Kimmerer’s technical detail about mast fruiting, dendrochronology, the effect of lightning strikes, and range shifts in response to climate change. The more experienced reader may find inspiration in the author’s thoughtful discussion of ecological management and restoration planting. All who appreciate trees will enjoy the dozens of

color photographs and the species list with habitat notes. Just as venerable trees increase as we move away from city centers, our view enlarges as we move away from “what is” and consider “what might be.”

The promise of this book’s title is fulfilled. A venerable being, Webster’s dictionary tells us, is one that “calls forth respect through age, character, and attainments.” The story of the woodland pasture trees not only evokes a respectful awareness, but also suggests the profound relationships we are capable of having with long-lived species able to shelter many generations of our own.

-By *Andrea Kornbluh, Rowan University*

ECONOMIC BOTANY

The Botany of Empire in the Long Eighteenth Century

Yota Batsaki, Sarah Burke Cahalan and Anatole Tchikine, Eds.

2016. ISBN-13: 978-0-8840-2416-3

Hardcover, US\$90.00, £66.95, €81.00. 406 pp.

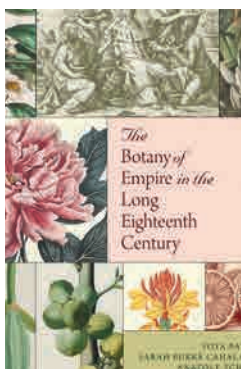
Dumbarton Oaks Symposia and Colloquia, Dumbarton Oaks Research Library and Collection, Washington, DC.

The *Botany of Empire* is a lavishly illustrated and carefully documented volume, extending presentations from a symposium marking the fiftieth anniversary of the Rare Book Room at the Dumbarton Oaks Research Center. The editors are long-time affiliates of Dumbarton Oaks: Yota Batsaki is Executive Director; Sarah Burke Cahalan is Director of the Marian Library, University of Dayton, formerly special projects and reference librarian at Dumbarton Oaks; Anatole Tchikine is Assistant Director

of Garden and Landscape Studies, Dumbarton Oaks. Nearly all images reproduced are from volumes held in the Dumbarton Oaks Rare Book Collection; if from elsewhere, they are for purposes of comparison.

This endeavor spearheads strengthening connections to the history of science. It documents widespread exploration worldwide, and derives from the massive increase in collection of botanical specimens, taxonomic breakthroughs, and horticultural experimentation during the 18th century. Contributors to this volume compare the impact of those new developments and discoveries as several regions broadened their geographical possessions beyond the better-branded British, Dutch, French, and Spanish empires. These studies examine the botanical ambitions of 18th-century empires; some notable botanical explorers; links between imperial ambition and the impulse to survey, map, and collect botanical specimens in “new” territories; and the relationships among botanical knowledge, personal motivations, and material culture. Organizationally, the contributions are divided into four parts that follow the Editors’ Introduction. Chapter titles are provided here.

Part I: Botanical Ambitions, features “Botanical Conquistadors: The Promises and Challenges of Imperial Botany in the Hispanic Enlightenment,” establishing that botanical exploration was a global enterprise with high economic stakes that relied on institutional networks and received strong state support in the quest for new raw materials; “The Geography of Ginseng and the Strange Alchemy of Needs,” wherein a Jesuit account of Chinese ginseng published in Paris, read by a missionary in Quebec, led to the unlikely discovery of the plant in North America; “Weeping Willows and Dwarfed Trees: Plants in Chinese Gardens



under Western Eyes,” communicates Jesuit accounts showing the Chinese garden as the product of an enlightened empire, worthy of imitation due to its informal aesthetic and low cost, although that view was subsequently reversed, considering it perhaps as perverse manipulation of nature; “Echoes of Empire: Redefining the Botanical Garden in Eighteenth-Century Tuscany,” offers a concise trajectory of the botanical garden.

Part II: Agents of Empire? scrutinizes the notion of botanist as agent of empire through several case studies. “The Politics of Secular Pilgrimage: Paul-Émile Botta’s Red Sea Expedition, 1836–39,” indicates that Botta’s success rested on his knowledge of area languages and geopolitics, and his ability to establish local connections and navigate local conflicts, then highlights the extent to which botanical practices were enmeshed in other areas of expertise (e.g., in this example, archaeology and diplomacy); “François Le Vaillant: Resistant Botanist?” reveals his criticism of botanical illustration for its two-dimensionality, and its deplorable neglect of indigenous knowledge of indigenous ecosystems; “Thomas McDonnell’s Opium: Circulating Plants, Patronage, and Power in Britain, China, and New Zealand, 1830s–50s,” displays how metropolitan centers connected activities on the periphery.

Part III: Botanical Itineraries, conveys “On Diplomacy and Botanical Gifts: France, Mysore, and Mauritius in 1788,” tracing some interpersonal trajectories of 18th-century colonial botany featuring nutmeg, cloves, and cinnamon, spices not native to France; “From Local to Global: Balsa Rafts and a Bountiful Harvest from Ecuador,” advances an appreciation of river transport; “In Imperio Rutheno’: Johann Amman’s *Stirpium rariorum* (1739) and the Foundation of Russia’s Botanical Empire,” assesses Russian

imperialist aspirations especially where they came in conflict with Ottoman and Safavid neighbors.

Part IV: Cultivating Identities, includes “Ornamental Exotica: Transplanting the Aesthetics of Tea Consumption and the Birth of a British Exotic,” explores the cultural effects of tea as commodity by focusing on how tea consumption in England penetrated its commerce and sensory experiences; “Allegories of Alterity: Flora’s Children as the Four Continents,” examines Robert Thornton’s Temple of Flora that personifies each plant, assigning to each racial and cultural characteristics associated with its territory in a hierarchical scheme that privileges Europe as the locus of culture and power, but tainted ideological associations with plants from Africa, America, and Asia; “Ottoman Horticulture after the Tulip Era: Botanizing Consuls, Garden Diplomacy, and the First Foreign Head Gardener,” brings to learned European audiences a more sophisticated picture of Ottoman culture than those found in conventional “Orientalist” accounts; “Making ‘Mongolian’ Nature: Medicinal Plants and Qing Empire in the Long Eighteenth Century,” contrasts Linnaean taxonomy with its multiethnic and multilingual form; “William Bartram’s Drawing of a New Species of *Arethusa* (1796): Portrait of a Life,” interprets Bartram’s drawing as “a historical reflection reminding those who might choose to interpret the young nation—or the course of their own lives—as the product of a revolutionary break with the past that the present and future are, in fact, embedded in historical relationships that are continuous and ever-binding,” or as sculptor Richard Berger (1997) more succinctly stated: “History Never Lets Go.”

As with other books in this scholarly series, the volume unearths substantial historical

artworks from Dumbarton Oaks' rare book collections: 174 exquisite color illustrations, 6 halftones, 1 line drawing, 1 map, 1 table; each article is thoroughly researched, evident from the abundant endnotes; the writing is precise and the arguments are well-defined; and it closes with a 14-page author and subject Index and Contributors' biographies. Readers who enjoy botanical chronicles, as well as contemporary plant explorers, will appreciate these diverse approaches that enrich our knowledge about the historic pursuit of green treasures.

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—By Dorothea Bedigian, *Missouri Botanical Garden, St. Louis, Missouri*

Sound and Scent in the Garden

D. Fairchild Ruggles, Ed.
2017. ISBN-13: 978-0-8840-2422-4
Hardcover, US\$65.00, £51.95, €58.50. 362 pp.
Dumbarton Oaks Symposia and Colloquia, Dumbarton Oaks Research Library and Collection, Washington, DC.



The 2014 Dumbarton Oaks symposium in Garden and Landscape Studies was based on the theme of sensory perception. Presentations explored the ways that historical encounters with sound and scent can be reclaimed, and explained the implication of those essences for landscape design. In what ways are plants, gardens, and landscapes shaped to stimulate the senses and to promote healing? The Editor's Introduction closes with the proposal

that the volume's lasting contribution may be to show the wide variety of approaches that we can apply to the study of sensory history, signifying that audition and olfaction have always been important dimensions in the experience of gardens.

Although visitors may generally consider gardens as places for visual experiences, *Sound and Scent in the Garden* explores selected, more elusive encounters of sound and smell, that stimulate the sensations of humans mightily. Sounds of fountains, footsteps, raindrops, wind, bells, and birdsongs mingle with scents of fragrant flowers, sunbaked soil, bitter medicinal herbs, earthy leaf litter, humus, or mushrooms to become soothing or stimulating, while their sources are subtle and distant with low visibility.

Strikingly, the titles of several contributions are evocative and poetic, e.g., "Perfuming the Heart: A Study of a Seventeenth-Century Perfumery Treatise from Islamic India"; "The Scent of Power: Flowers, Fragrance, and Ephemerality in the Gardens of Louis XIV"; "Sounds and Scents of Monsoon in the Late Medieval Gardens of Rajasthan"; "Lilac and Nightingale: A Heritage of Scent and Sound at Horace Walpole's Strawberry Hill."

Imagery to delight the imagination abounds in this volume: Visitors to an ancient Chinese garden found zither music; the recipe for preparation of aloeswood incense (ūd) instructs the reader to break up 1 kg of the best quality aloeswood into small pieces, and soak these pieces for three days and three nights in rose water strengthened with petals of *Rosa damascena*. The chips of aloeswood are to be dried in the shade and later crushed very fine. Sugar syrup, in which ambergris soaked in rose water, and the crushed aloeswood are combined, and the whole is set aside to cool. Finally, small balls, each the size of a grape,

are formed from this paste, dried in the shade in a china dish, and burned when required, to scent a space or perfume one's apparel. The writer observed in 1996 that this is a ritual still practiced in Saudi Arabia and Bahrain.

The architectural element of the pavilion features prominently in the monsoon gardens of Rajasthan. The moonlight garden was an essential part of all Rajput palaces, as the gardens would mostly be enjoyed at night in the summers and during the monsoons. Water features were abundant: canals, tanks, cascades, and water under pressure that would pass with considerable force through pipes embedded in hollow pillars of the structure, helping to rotate iron balls to create the artificial sound of thunder.

Water structures of the Italian Garden are conspicuous as well, described in itineraries from the 16th century as "murmuring," "whispering," "pattering," and "humming" streams, in "The Expulsion of the Senses," which includes lavish photographs by author Anatole Tchikine. His Appendix translates a 1931 cultural manifesto that remains a foundational statement of the Fascist "garden of reason," a product of the artistic subjugation of nature constructed on purely rational lines.

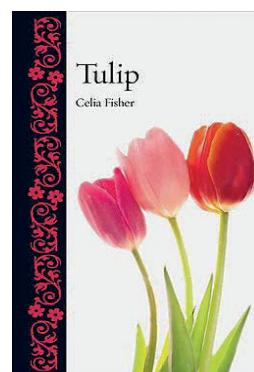
This admirable tome was edited by D. Fairchild Ruggles, Professor in the Department of Landscape Architecture at the University of Illinois, Urbana-Champaign. As with other books in this scholarly series, the endeavor unearths substantial historical artworks from rare books, including the Dumbarton Oaks collection, delivering 13 color illustrations, 113 halftone and color photos, and 4 line drawings. Each article is well-researched, evident from the abundant endnotes; the writing is clear and the arguments are well-presented; and the book closes with a 14-page author and subject Index and Contributor

biographies. Historians who admire garden architecture, connoisseurs of scented and aesthetic gardens, innovative professional landscape installers, as well as contemporary perfumers will appreciate these diverse approaches that deepen our learning about the world's botanical and cultural heritage.

—By Dorothea Bedigian, Missouri Botanical Garden, St. Louis, Missouri

Tulip

Celia Fisher
2017. ISBN-13: 978-1-7802-3759-6
Hardcover, £16.00. 224 pp.
Reaktion Books, London.



Celia Fisher's *Tulip* presents a concisely written account of various wild tulips, from their origins in the mountains of Central Asia, to their cultivation in the gardens of Mughal, Persian and Ottoman rulers, and their transfer along the silk route. *Tulip* is an appropriately illustrated botanical and cultural history of this beloved bulb. It depicts tulip representations on a trove of art treasures across diverse formats, including charming patterns on tiles from Iznik, Turkey, lacquer book bindings, bedsheets, fabric designs, manuscripts, paintings, and the august painting from Thornton's Temple of Flora, a grand scale reproduction of it adorning the reading room of the Missouri Botanical Garden's Peter H. Raven Library.

Fisher is a freelance art historian and plant specialist who has written several stylistically popular books on natural history, plants, and gardens in art, including "Flowers and Fruit: National Gallery Pocket Guide (2000)," "The

Medieval Flower Book (2007),” “Flowers of the Renaissance (2011),” “Flower: Paintings by 40 Great Artists (2012),” “The Golden Age of Flowers: Botanical Illustration in the Age of Discovery 1600-1800 (2013),” and “The Magic of Birds (2014).”

Fisher’s Acknowledgements reveal that she relied heavily on Diana Everett’s salient 2013 volume, reviewed in these pages (Bedigian 2014), from which she acquired 11 illustrations of tulips in their natural habitats, as well as substantial scientific details. The contents include wild tulips; Turkish tulips; the economics of “Tulipomania,” during which the frenzy that rare tulips inspired among ostentatious collectors caused an economic bubble; links with artists’ tulips, and literature that tulips have roused, from Dutch Masters to Alexandre Dumas’ novel, “The Black Tulip.” Botanists, florists, plant hunters, and nurserymen are all are counted in brief.

Fisher’s book joins the ranks of numerous other writings about tulips aimed at amateurs; a subject search of non-fiction titles in WorldCat® related to tulips uncovers 781 books, 85 serials, and 7 articles. Fisher’s *Tulip* contains 107 illustrations, 104 in color, reproduced on high-quality paper stock, printed and nicely bound in China; it closes with a short Timeline beginning with the year 1070 AD when Seljuk Turks began to conquer eastern Anatolia, creating the first ceramic tiles that feature tulips, simultaneously with the Persian poet Omar Khayyam’s compositions of verses in his *Rubaiyat*, the first literature to mention tulips. Fisher’s *Tulip* can appeal to weekend gardeners, horticulturalists, and history buffs who admire or grow this fashionable flower.

–By Dorothea Bedigian, *Missouri Botanical Garden, St. Louis, Missouri*

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Bedigian, D. 2014. *Plant Science Bulletin* 60(3): 170-172. The Genus *Tulipa*. Tulips of the World. Diana Everett. 2013. Kew Publishing, Royal Botanic Gardens, Kew.

SYSTEMATICS

The Botany of Mangroves, Second Edition

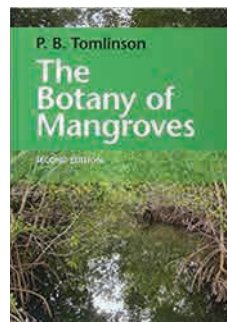
P. B. Tomlinson

2016. ISBN-13: 978-1-107-08067-6

Hardcover, US\$84.99. 418

pp.

Cambridge University Press, Cambridge, U.K.



Thirty years ago, I wrote my first grant proposal to study mangroves and began an odyssey through mangrove ecology that continues to this day. Six months earlier, P. B. Tomlinson had published *The Botany of Mangroves*, which, despite scant reviews (I can only locate two: one written by Ong Jin-Eong [1987] for *Trends in Ecology & Evolution*, and the other by Alwyn Gentry [1987] for *Annals of the Missouri Botanical Garden*), was welcomed worldwide as the go-to reference for floristics, biogeography, and especially its unified treatment of, and identification guide to, “true” mangroves and mangrove “associates.” Although not a formal taxonomic monograph, the first edition of *The Botany of Mangroves* more than fulfilled its intended goal of introducing mangroves and mangrove ecosystems (“mangal”) to a much broader audience of scientists, foresters, conservation biologists, and restorationists. I relied heavily on *The Botany of Mangroves* to ground my fanciful proposals in the reality of working in dense Belizean forests of “walking trees.”

The first edition of *The Botany of Mangroves* was re-issued in a paperback edition (1994) with minor updates in a seven-page Appendix. Now, nearly a quarter-century later, the second edition provides more comprehensive updates to chapters in the first section (“General Account”) on biogeography, shoot and leaf systems, structural biology, and interactions with people. Most notably, this first section includes a new first chapter—“Historical Prelude”—reviewing Georg Everhard Rumphius’s (a.k.a. Rumphius; 1627–1702) early description of 19 species of true mangroves (“*Mangium legitimum*”) from the Dutch colony of Amboina (now Ambon Island in Indonesia). The material in this chapter is based on Beekman’s (2011) six-volume translation of Rumphius’ *Herbarium Amboinense* and is a most welcome introduction to the long history of botanical explorations of mangroves (summarized in Kathiresan and Bingham, 2001). Rumphius, Tomlinson, and all other students of mangroves recognize that “mangrove” is not a taxonomic grouping, but an ecological one that provides seemingly endless opportunities for studying convergent evolution.

In terms of literature review and synthesis, however, the other 10 chapters in the first section leave much to be desired. As in the first edition, and reflecting the author’s expertise in anatomy, physiology, and functional morphology, ecology and conservation are given short shrift. A thorough review of mangrove ecology and conservation—of which >10,000 articles have been published since 1987 alone—deserves its own book, which remains to be written (excellent reviews of that literature, uncited in *The Botany of Mangroves*, include Kathiresan and Bingham, 2001; Walters et al., 2008; Feller et al., 2010; Sandilyan and Kathiresan, 2012; and Lopez-Angarita et al., 2016). At the same time, the still-burgeoning literature on other

aspects mangrove “plant science”—more than 1000 articles published 1987–2015—is only cursorily reviewed; for his updates of new but basic information, Tomlinson apologetically (p. xii) relies on only a few dozen primary articles or reviews published in the last 15 years.

The second section, occupying nearly 60% of the book, is a detailed description of the 36 families that include true mangroves (trees characteristically found growing in tidal swamps that have anatomical, physiological, and morphological specialization for living in salt water) and mangrove associates (trees and shrubs, and a few herbs, that grow in mangal but are not restricted to it). These botanical descriptions reflect systematic and nomenclatural changes that have occurred since 1987. The most notable are in the Rhizophoraceae and *Avicennia* (Avicenniaceae) and reflect Duke’s (2006) treatment of Australian mangroves. A handful of hybrids, some of which were hypothesized in the first edition of *The Botany of Mangroves*, have been confirmed by molecular methods and are fully treated in the second edition. Unlike in the first edition, the treatment of each family begins on its own page, making it much easier to read. This section easily supplants that of the first edition as the standard reference for students, researchers, and practitioners working with mangroves in the field.

The Botany of Mangroves is copiously illustrated, but the numerous photographs and line drawings, so crucial to identifying, understanding, and appreciating mangroves, are a mixed bag. On the very positive side, the second edition includes an expansive section of 24 color photographic plates illustrating many aspects of mangrove flora and fauna. (Full disclosure: I took 9 of the 177 individual photographs.) Mangroves are enlivened by the stunning photographs of bark and roots; fruits, flowers, and leaves; the unusual vivipa-

rous seedlings; microscopic details of leaf and wood anatomy; and the forests and the people living and working in them. On the downside, however, the line drawings and most of the black-and-white photographs that are placed throughout the text appear simply to have been scanned at low resolution from the first edition, and then enlarged to the somewhat larger format of the second edition. The result is a substantial fuzziness and loss of details crucial for accurate identification of species. Some of the enchanting humor has been lost, too. In the first edition, but not the second, Tomlinson quoted Watson's (1928) description of *Avicennia alba* fruits as "resembling a gorged leech" that "as spent swimmers, that do cling together and choke their art."

From Nearchus and Theophrastus, through Plutarch, Abou'l Abass, and Rumphius, and down to the present day, mangroves have fascinated scholars, authors, and travelers (Kathiresan and Bingham, 2001). Rumphius (*vide* Beekman, 2011) admired the "mangi-mangi" for their ability to live in salt water and their novel anatomy and morphology, whereas Steinbeck (1951) referred to them as places of "stalking, quiet murder." Tomlinson's *The Botany of Mangroves* is a must-read for anyone starting out in studying mangroves and mangal, and a key reference for all of us actively working on these amazing plants and the ecosystems that they build.

—Aaron M. Ellison, Harvard University, Harvard Forest, Petersham, Massachusetts, USA;
aellison@fas.harvard.edu

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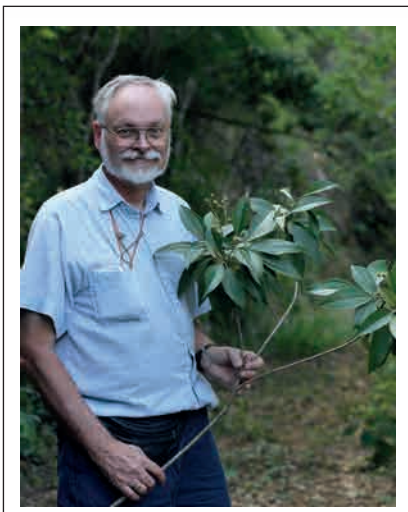
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