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Behind the Scenes of Botany Conferences!

The Challenges of Planning & Pulling Off a Scientifically & Financially Successful Scientific Conference

By Heather Cacanindin
BSA Executive Director

Grant Promotes Student Leadership in Testing Manmade Chemicals on Weedy Plants in the Mississippi Delta
By Nina Baghai-Riding et al.

Blue Carbon Through Green Plants in Yellow Deserts
By Shiran Ben-Zeev & Anitra Thorhaug

FROM the EDITOR

Greetings, botanists!

You may notice we are a bit late with this Fall issue, it feels like a lot longer passed since I caught up with our membership at Botany 2025. If you attended the conference, I hope you had a good time and enjoyed this chance to meet new people, network, and get new ideas for your research. I also hope you enjoyed the beautiful desert and mountains around Palm Springs! Still riding on the Botany wave, we have a very special article in this issue by Heather Cacanindin, BSA's Executive Director, about the work behind planning and running our conferences. We are also offering two articles: one on experimental work on a classroom setting in a small state university and another on the possibility of creating man-made mangroves as a carbon sink. As always, our book reviewers have been busy; we have 15 book reviews in this issue! I want to highlight Dorothea Bedigian's extensive review on plant toxins, highlighting the effects of urushiol and the interesting ways species of Anacardiaceae cause cross-reactivity issues.

I hope you enjoy reading this issue as much as I enjoyed it, and that the end of the year goes smoothly for all! See you soon!

Carolina

TABLE OF CONTENTS

SOCIETY NEWS

Botany 2025: Behind the Scenes 138
Botanical Society of America's Award Winners (Part 2) 143

SPECIAL FEATURES

Blue Carbon Through Green Plants in Yellow Deserts 149
INBRE Grant Promotes Student Leadership in Testing Manmade Chemicals on Weedy Plants in the Mississippi Delta 156

MEMBERSHIP NEWS

Together We Did It! Thank You for Making the Second Annual "A Day for BSA" a Success! 164
Celebrating 50 BSA Spotlights! 164
Membership Dues Updates for 2026 165
Here are the latest Spotlights 165
Your BSA Benefits in Action! 166
Support Graduate Students with Year-End Donations to the GSRA Fund – Donate today! 168
Help Us Reach Our Goal of 100 Gift Memberships by December 31st! 168
3-Year Memberships Stay connected at a discount! 168

SCIENCE EDUCATION

Nominations for 2025 Bessey Award 170
Impacts of PlantingScience on Students' Motivation to Study Plants 170
PlantingScience Session Update - Fall 2025 171
ROOT&SHOOT Updates: New article in eLife 172

STUDENT SECTION

Botany 2025 Recap 174

ANNOUNCEMENTS

Plant Science Scholarships for 2026-2027 Announced by Cleveland's Western Reserve Herb Society 176

BOOK REVIEWS 177

https://2026.botanyconference.org

Botany 2025: Behind the Scenes

The challenges of planning and pulling off a scientifically and financially successful scientific conference

PULLING OFF BOTANY 2025 IN A YEAR OF CHANGES

After 25 years as Botany Conference Manager, Johanne Stogran retired following Botany 2024. We knew that this transition would be an important one for the conference because Johanne had so much historical knowledge from years of meeting improvements and innovations. Johanne was devoted to the BSA and Botany conference and we knew she would be hard to replace. BSA conducted a search for a new meeting planner and ultimately contracted with Burk & Associates Inc. (an Association Management Company with strong references from other scientific societies), with Lori Strong serving as our new Director of Conferences. With over 25 years of experience handling meetings, Lori transitioned into the role in October 2024. Outsourcing to an experienced firm has the benefit of having a "team" behind the Director of Conferences and it also saves the conference on personnel expense.

By Heather Cacanindin

BSA Executive Director

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Orienting a new Conference Director to a meeting of six scientific societies with all their nuances is no quick or simple task. Add to that situation a last-minute change in venue for Botany 2025 that was necessitated by the renovation of our contracted conference property in Tucson, Arizona. Finding a new space for a conference of our size can be quite challenging due to the number of meeting rooms required for concurrent sessions in addition to enough space to hold exhibitor booths and posters. In addition, we strive to keep the meeting space accessible and all under "one roof" if possible to aid those with mobility issues. (This is one of the reasons why meeting at a university campus has become less desirable.) Over the span of just a couple weeks in November 2024, a new venue was identified, favorable contracts with Tucson for 2026 were finalized, new contracts for 2025 were signed, and our membership was apprised of the changes (meeting to be in Palm Springs, California).

Due to the above circumstances, normal meeting challenges were amplified for the planning committee, which consists of the program managers and presidents of all six scientific societies represented at Botany conferences. One of the most pressing challenges for 2025 was a fiscal one. The rising costs of audio-visual (AV), food and beverage, and hotel room rates have made

it quite challenging to run a financially successful medium-sized meeting (800–1200 attendees). A report by Global DMC Partners released the results of a 2024 survey of 165 event professionals, the majority of whom are based in the US and Canada. "The majority of planners report that costs have increased by 10 to 30 percent on average across various categories compared to two years ago. Specifically, significant cost hikes were noted in hotels/venues, food and beverage, airfare and ground transportation" (Banerji, 2024). Our Botany conference has indeed seen major increases in expense areas like AV, food and beverage, and venue rental since the pandemic.

After incurring financial losses from each of the past three Botany conferences, it was imperative that Botany 2025 break even or potentially make a slight profit. It was clear to the planning committee that difficult decisions would need to be made. A financially viable budget was developed in consultation with leadership from all participating societies; it included cutting out some expenses while pursuing additional revenue, all while centering BSA's commitment to its mission and its strategic priorities. Some changes included:

- New Exhibitor Prospectus & Sponsorship Guide
- Sponsored Academic Displays for Colleges/Universities/Department Programs
- Eliminating continental breakfasts Monday through Wednesday and snacks with coffee breaks
- Information about food and beverages at the Botany conference were included in registration materials, and focused "food-centric" messages went out in the weeks before the conference so attendees would know all their options. Options include cash-and-carry stations, on-site eateries, local eateries, and nearby grocers
- Charging fees for all workshops to defray (but not completely cover) the costs associated with them (these costs, which include AV, room charges, and coffee breaks, have previously been subsidized entirely by the conference; by charging fees, we are making these costs visible to attendees and exercising fiscal responsibility to all partnering societies, which share in profits or losses from the conference)
- Making the Closing Reception a ticketed item, while allowing donations from attendees to defer the cost for students to this event.
- Implementing "Botany Eats" as a new program. During registration, students could indicate that they had concerns about food insecurity and would welcome support. Botany conference purchased $50 gift cards for the grocery store down the street from the conference and provided those cards to 53 students who requested the assistance
- Bringing in our own AV company to save on meeting WiFi and AV charges

Just to give some perspective, some of the largest expenses for our conference in 2025 included:

- Food & Beverage: $180,000
- AV/WiFi: $90,000

- Exhibit Hall Expenses (poster boards, booth set up, clean up, electrical): $28,000
- Room/Space Rental in Hotel and Convention Center: $24,000

In the end, we held a meeting with over 1050 attendees and proved that even in the post-pandemic world we could hold a scientifically successful and financially responsible conference. Botany 2025 made a small profit that will be shared among the society partners, with half the profit remaining in the conference bank account to offset the years with financial losses. Meeting attendance over 1000 helped to boost conference revenue overall, as did exhibitor and sponsor participation where revenue was 44% more than budgeted. (If there are companies you would like to see in the Exhibit Hall at Botany 2026 and beyond, please send that information to Lori Strong at lstrong@burkinc.com.)

There were some new and notable adjustments to the conference in 2025, especially with a mind toward accessibility and inclusion issues:

- Availability of a PDF of the conference program
- Poster number labels that are larger, with wider spacing between poster rows
- Quiet room/low sensory input room
- Maps with accessibility features highlighted (including gender-neutral toilets, quiet room, medical/nursing room, etc.), available on website, app, and wayfaring signage on-site
- Fridge in the registration office for medicine (or milk or formula)
- Wheelchair seating area marked and blocked out in each session room; these were in the rear of the rooms to make it easier to maneuver (we were unable to get those in the front of the rooms this year)
- Use of closed captioning in Power-Point

The Conference website (https://www.botanyconference.org/) was also reorganized and revised for a cleaner look, and the conference logo received a revamp.

SURVEY REVEALS INSIGHTS

In August of 2025, 30% of attendees took the post-conference survey with 86% rating the meeting in Palm Springs as "Excellent" or "Good." From the comments, it appears that there were many positives. Attendees noted the excellence of some of the organized sessions and the diversity within the botanical sciences that is present at this joint meeting as well as the general respectfulness and friendliness of attendees. In the post-conference survey, one attendee expressed, "It was amazing! The community of people at the Botany meeting are some of the most caring, dedicated, positive scientists I have ever interacted with. There is a reason I have been coming to Botany conferences for the last fifteen years!" Several respondents also mentioned a visible effort by organizers to prioritize accessibility with the use of microphones, live captioning (despite its accuracy issues), inclusive bathrooms, etc.

There were also many comments to encourage improvements in future years. For example, the advertising pop-ups in the app were a pain. We hear you! While sponsor funding is critical to the success of the conference, adjustments

are being made to ensure sponsor advertising does not impede the usability and efficiency of the conference app. Also, no more jingly, noisy lanyards next year. Those were fun sometimes, but rather distracting. Based on feedback from the last few conferences, we are also planning to add a Speaker Ready Room back to the reserved space for Botany 2026. This will be a place to check the slides that you have uploaded to ensure everything looks as it should and/or consult with a technician for help, if needed.

INFO ON BOTANY 2026

As we begin planning the details for our return to Tucson in 2026, we want to share a few bits of information. First, we signed a contract in 2019 to return to the Tucson property because we had received overwhelmingly positive feedback about the conference there and because we were able to lock in very reasonable hotel rates: $108/night for students and $138/night for others. We are keenly aware of the concerns about hosting a conference at resort property that is a distance from the town center. To help alleviate this concern, we are bringing back food trucks for lunches (while looking to negotiate more of them this time to avoid long lines), exploring cash-and-carry food carts, as well as negotiating a daily shuttle to take attendees into town. We plan to make it easier to get off property and explore Tucson. We will also look carefully at the food and beverage we can offer as part of registration. If we can bring back continental breakfasts within the conference budget, we will do so.

VIRTUAL MEETINGS

Looking toward future meeting locations, we have probed our members about the possibility of a virtual conference as part of the meeting rotation. Our survey results show that most attendees prefer face-to-face meetings rather than a virtual conference. Our attendees noted the networking, social interactions, and informal conversations at meals and breaks are irreplaceable. They also noted engagement challenges with virtual meetings. Respondents reported difficulties staying focused in virtual meetings with "Zoom fatigue" and lower levels of interaction and community-building possibilities. Many said they would likely not attend or would not find a virtual meeting "worth it."

A smaller group of respondents supported virtual meeting options, highlighting reduced travel costs, broader inclusion (especially for international and underfunded participants), and environmental benefits. Clearly a virtual conference would be highly accessible and more affordable for attendees. Since there did not appear to be enough enthusiasm for a virtual conference, some possible alternatives are being discussed. We are looking at hybrid models of meetings where some talks are livestreamed or certain virtual sessions are handled a few weeks prior to the in-person conference. We could consider holding more frequent, shorter, topic-focused virtual symposia to complement the main in-person conference. There is also the option of recording talks and posting them for later access. While participants see some advantages to virtual conferences, the overwhelming feedback was that a fully virtual Botany meeting would be less engaging, less valuable, and less aligned with the conference's

core strengths. Hybrid or complementary virtual options were seen as more promising than replacing in-person meetings altogether. Supplementary virtual events look like something we should explore.

EXPLORING MEETING LOCATIONS BEYOND 2026

As we consider meeting locations for 2027 and beyond, we have engaged with cities on the East Coast and Midwest with an eye on the food and beverage costs, space rental, AV, and service charges. If coffee prices are $96 per gallon, that location is likely out of the running! Comparing food and beverage prices can be quite eye opening. This means looking at smaller cities and getting creative. Even some of the smaller venues have increased their rates and meeting room rental charges to levels that are not acceptable to us. Some cities under current consideration for the future are Buffalo, NY; Franklin, TN; Halifax, Nova Scotia; Hartford, CT; Madison, WI; St. Paul, MN; St. Louis, MO; and Cincinnati, OH. We are trying to avoid walking long distances between venues and rooms for increased accessibility as well as ensuring that food options will be plentiful, nearby, and economical.

Planning and running a conference is not for the faint of heart. Each year is a challenge, and every location brings its own nuances and idiosyncrasies. One year, our venue did not have enough poster boards, and we ended up paying extra to secure them after searching all over the state to find more! Sometimes there are unforeseen expenses for electricians, security personnel, or specific cancellation insurance needed. With average costs per attendee increasing approximately 4.5% in 2024 (Global Business Travel Association, 2025), we are planning meetings with tighter budgets. At the same time, we are determined to produce quality conferences that are valuable and affordable for our members. This is a challenging time for meeting planners and scientific societies as we continue to navigate the highs and lows of planning a successful conference. Tucson, here we come!

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

BSA Emerging Leader Award

FAY-WEI LI

CORNELL UNIVERSITY

Dr. Fay-Wei Li is a trailblazing plant biologist whose innovative research and collaborative spirit have quickly established him as a rising star in the field. As an Assistant Professor at the Boyce Thompson Institute and adjunct faculty at Cornell University, Dr. Li has made remarkable contributions to our understanding of fern biology, symbioses, and plant evolution, pushing the boundaries of genomics and evolutionary biology. His pioneering work on hornworts and nitrogen-fixing cyanobacteria has opened up entirely new avenues of research, shedding light on ancient plant-microbe interactions, CO_2-concentrating mechanisms, and the evolution of key plant traits. As one of Dr. Li's recommenders wrote, "His groundbreaking research has redefined what is possible in plant evolutionary biology." Another colleague described Dr. Li as "brilliant, fearless, and highly original," praising his intellectual generosity and his dedication to scientific community-building.

Beyond his scientific excellence, Dr. Li is a sought-after mentor, conference organizer, and speaker, known for uplifting students, postdocs, and collaborators alike. His nominators noted that his lab is a hub of international partnerships and interdisciplinary work where Dr. Li mentors young scientists and freely shares tools, data, and insight. As one recommender aptly summarized, "Fay-Wei is the epitome of the Emerging Leader: a scientist who is not only transforming our understanding of the plant world but also setting the standard for leadership, mentorship, and scientific integrity."

BSA Corresponding Members Award

Corresponding members are distinguished senior scientists who have made outstanding contributions to plant science and who live and work outside of the United States of America. Corresponding members are nominated by the Council, which reviews recommendations and credentials submitted by members, and elected by the membership at the annual BSA business meeting. Corresponding members have all the privileges of life-time members.

Dr. Natalia Pabón Mora, Universidad de Antioquia, Medellin, Colombia

AWARDS FOR ESTABLISHED SCIENTISTS GIVEN BY THE SECTIONS

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,

James Brock, University of Auckland, for the Presentation: Effective long-distance dispersal of ferns between isolated habitats

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.

Grace Burgin, Harvard University, For the Presentation: The genetic basis of a novel self-pollen recognition system in *Phlox drummondii* (Polemoniaceae)

Michael Cichan Paleobotanical Research Grant (Paleobotanical Section)

The Award is to provide funds for those who have completed a PhD and are currently in a post-doctoral position or non-tenure track position.

Alexander Lowe, National Museum of Natural History, Smithsonian Institution For the Paper: Plant community and climatic response across the onset of the Miocene Climatic Optimum in the Pacific Northwest (USA) within a refined taxonomic and chronologic framework

Giovanni Nunes, Museo Egidio Feruglio, Argentina. For the Paper: Early Cretaceous flowers from Patagonia: new insights into the evolution of angiosperms in Gondwana

AWARDS FOR STUDENTS - GIVEN BY THE SECTIONS

Student Presentation and Poster Awards

A. J. Sharp Award

(ABLS/Bryological and Lichenological Section)

This award is given for the best student paper presented in the Bryological and Lichenological sessions.

Kristen Hillegass, University of Kentucky, For the Presentation: Variation in plant-fungal interactions in a tropical liverwort between streamside and roadside populations. Co-author: David Nicholas McLetchie

Developmental & Structural Poster Award

Best Student Poster

Elissa Sorojsrisom, Columbia University, For the Poster: Across the Bryophyte-Angiosperm Divide: an 8-stage homologous framework for the evolution and patterning of the land plant gametangia. Co-authors: Dennis Wm. Stevenson, Barbara Ambrose

Isabel Cookson Award (Paleobotanical Section)

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

Tengxiang Wang, Penn State University, For the Presentation: Fossil leaves of Sindora (Fabaceae, Detarioideae, Detarieae) from the Plio-Pleistocene of central Vietnam. Co-authors: Peter Wilf, Truong Van Do, Tao Su

Li-COR Prize (Physiological and Ecophysiological Section)

Each year, the Physiological Section presents the Li-COR prize to acknowledge the best presentation made by any student, regardless of subdiscipline, at the annual meeting. The Li-COR prize is presented annually at the BSA Banquet.

Best Student Oral Presentations

Daniel Mok, Michigan State University, For the Presentation: CAM photosynthesis in the carnivorous plant genus Pinguicula (Lentibulariaceae). Co-authors: Robert VanBuren, Kadeem Gilbert

Best Student Poster

Amelie LeTierce, University of Minnesota-Duluth, For the Poster: Beauty is Skin Deep: Obscured Chlorophyll is Photosynthetic in *Zinnia elegans* Flowers. Co-authors: Monica Ruuska, Jessica Savage

Ecological Section Presentation and Poster Awards

Best Graduate Student Oral Presentation

Brooklyn Richards, Oregon State University, For the Presentation: Floral frenemies: How pollinators and seed predators shape female advantage in a gynodioecious plant. Co-authors: Thomas Kaye, Susan Waters, Andy Jones

Best Graduate Student Poster

Alex Arena, Christopher Newport University, For the Poster: Heavy metal accumulation and tolerance in soils and plants across an urban-rural mosaic. Co-Author: Janet Steven

Best Undergraduate Poster Awards

Bjoyrn Domst, Willamette University, For the Poster: Differences in mortality across the Mojave Desert reveal the effects of climate change on Influence of climate on growth and survival of Joshua trees (*Yucca* spp.). Co-author: Christopher Irwin Smith

Sarah Jones, Willamette University, For the Poster: Identification of Arbuscular Mycorrhizal Fungi in the Roots of Joshua Tree (*Yucca* spp). Co-author: Christopher Irwin Smith

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, 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. (PSB, Spring, 2003). 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.

Keana Tang, University of Kansas, For the Presentation: Flower of Monimiaceae from the Late Cretaceous of Antarctica. Co-authors: Selena Smith, Ari Iglesias, Kelly Matsunaga, Brian Atkinson

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.

Austin T. Nguyen, University of Kansas, For the Presentation: Duplication and subfunctionalization of AGAMOUS genes in the cypress family (Cupressaceae). Co-author: Kelly Matsunaga

Phytochemical Section Presentation Awards

Best Presentation:

Melanie Madrigal, Louisiana State University, For the Presentation: A Breath of Fresh Control: Dissecting the Resistance Pathways of *Botrytis cinera* to Linalool. Co-author: Jordan Dowell

Honorable Mention:

Chase Hearn, Purdue University, For the Presentation: Root-derived phenylpropanoids are necessary for normal growth of *Arabidopsis*. Co-authors: Fabiola Muro-Villanueva, Clint Chapple, Josh Widhalm

Best Poster:

Karen Campos Secenas, University of California-Irvine, For the Presentation: Anthocyanins in *Viola sororia* identified by LC-MS-MS. Co-authors: Devin L. Hemmans, Aakrish Mittal, Zane G. Long, Rachel W. Martin

Honorable Mention:

Abbigale Baum, Utah Valley University, For the Presentation: Concentration of Phenolic Compounds in Populus (Salicaceae). Co-author: Michael Rotter

Physiological and Ecophysiological Section Student Presentation and Poster Awards

Best Student Oral Presentation

Malinda Barberio, University of Wisconsin-Madison, For the Presentation: Exploring Foliar Water Uptake in Neotropical Epiphytes. Co-authors: Katherine McCulloh, Duncan Smith

Best Student Poster

Osedipo Adegbeyeni, University of Utah, For the Poster: A comparative study of isohydric and anisohydric strategies in leaves and photosynthetic stems in two desert Utah sites. Co-authors: Oranys Marin, Eleinis Avila-Lovera

Blue Carbon Through Green Plants in Yellow Deserts

ABSTRACT

Carbon sequestration is a cornerstone of climate change mitigation, capturing and storing atmospheric carbon dioxide and dissolved carbonate in oceanic waters partitioned from the atmosphere to reduce greenhouse gas concentrations and promote ecosystem stability. This multifaceted approach includes natural methods such as afforestation, soil carbon sequestration, and the restoration of "blue carbon" ecosystems like seagrasses, mangroves, and saltwater marshes, as well as technological innovations like direct air capture and bioenergy with carbon storage. Blue carbon ecosystems are particularly effective, sequestering carbon at rates far exceeding terrestrial tropical forests while providing multiple additional benefits, such as biodiversity support, fisheries nurseries, and coastal resilience. Arid regions, including deserts, represent an untapped opportunity for carbon sequestration. Although the deserts may be lacking in water, there are frequently large bodies of water immediately adjacent to the desert. This salt water or estuarine lower salinity water may function to increase the biodiversity greatly. Engineered solutions, such as creating man-made, fjord-like inlets in coastal deserts, can harness the potential of salt-tolerant shoreline and terrestrial vegetation and blue carbon ecosystems to transform barren landscapes into carbon sinks with collateral benefits. These inlets, stabilized with mangroves, salt marshes, and seagrass meadows, could capture significant amounts of carbon while fostering marine biodiversity, enhancing fisheries productivity, and protecting coastlines from erosion. This approach highlights the ecological and economic potential of integrating carbon sequestration practices into underutilized especially dry landscapes. By leveraging the unique capabilities of these ecosystems, we can address climate change while supporting environmental sustainability and human livelihoods. Deserts, often dismissed as barren, hold the key to scalable

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and sustainable carbon solutions, making their transformation an urgent and necessary step toward a resilient future. While these proposals aim to create new carbon sinks, it is important to acknowledge that deserts are not ecological voids. Although relatively sparse, desert ecosystems often support specialized species adapted to harsh environments, including insects, reptiles, mammals, and ephemeral plant communities. Introducing engineered water systems could lead to displacement of native biota, disruption of existing soil microbiomes, and alteration of fog-dependent microclimates that sustain some desert-adapted species. The tradeoffs between carbon sequestration potential and ecological disturbance must be carefully evaluated.

INTRODUCTION

Carbon sequestration plays a pivotal role in mitigating climate change and ensuring environmental sustainability (Sierra et al., 2021; Don et al., 2023). As the process of capturing and storing atmospheric carbon dioxide, it helps to reduce the overall concentration of greenhouse gases in the atmosphere (Sierra et al., 2021). This mechanism is essential not only for slowing the progression of global warming, but also for maintaining the balance of natural ecosystems. By integrating carbon sequestration practices into agricultural, forestry, and industrial strategies, society can work toward a more resilient and sustainable future (Raihan, 2023). Various methods are currently being used to sequester carbon effectively (Lal, 2008, 2009; Wang et al., 2019). Afforestation and reforestation are popular natural approaches involving the planting of trees to absorb carbon dioxide from the atmosphere (Lackner, 2003; Nayak et al., 2019). Soil carbon sequestration, achieved through practices such as no-till farming and crop rotation, enhances the organic carbon content in soils (Reicosky, 2008). Technological solutions, like direct air capture and storage (DACCS) and bioenergy with carbon capture and storage (BECCS), are also gaining traction for their ability to capture carbon from industrial processes and store it underground (Sanna et al., 2014; Wang et al., 2024). These methods, both natural and technological, form a multifaceted approach to tackling climate change by reducing atmospheric carbon levels.

Plants play a crucial role in carbon capture through sequestration due to their ability to scrub CO_2 from the air or dissolved CO_2 from water and store the CO_2 through the excess of the photosynthesis process of root exudates into the sediment (De Deyn et al., 2008; Chen et al., 2018). Trees, in particular, are highly effective because they store carbon in their biomass, such as trunks, branches, and roots, as well as in the deep layers of soil below their roots (Peichl et al., 2006; Gross et al., 2022). Grasses and perennial plants also contribute significantly, especially in agricultural systems where practices like cover cropping and agroforestry enhance their sequestration potential (Freibauer et al., 2004). Wetlands, which include peatlands and marshes, are especially notable for their ability to sequester large amounts of carbon in the dense root systems of plants growing in them and in waterlogged soils (Chmura et al., 2003; Temmink et al., 2022). If thought of as a resource, leveraging the natural abilities of plants, these ecosystems can act as powerful carbon sinks, providing a sustainable and cost-effective way to combat climate change.

Seagrasses, mangroves, and saltwater marshes are among the most efficient natural ecosystems for carbon sequestration (Schile et

al., 2017; Thorhaug et al., 2017). Often referred to as "blue carbon" ecosystems, these habitats sequester carbon at rates five to ten times more than terrestrial forests (Thorhaug et al., 2017). Seagrasses, found in shallow coastal waters, not only capture carbon from dissolved carbon in the seawater, incorporating approximately 12% of it into their biomass, but also store it through rapidly growing blade detritus and root exudates into the sediment below, where it can remain trapped for millennia (Thorhaug et al., 2017). Seagrass ecosystems can sequester 40–250 mg C ha^{-1} yr^{-1} in sediment, with an additional 15–30 g C m^{-2} stored in aboveground biomass. Similarly, mangroves, with their extensive root systems, capture and store carbon both above ground (about 20% in the slower-growing tree structure) and in submerged soils through leaf litter and root exudates (Thorhaug et al., 2020). Total carbon stocks in mature mangrove ecosystems can range from 350 to 1000 mg C ha^{-1}, with annual sequestration rates of 100–200 g C m^{-2} yr^{-1}. These ecosystems also provide environmental benefits such as coastal protection, fish nursery habitat, biodiversity support, and improved water clarity (Wolanski et al., 2000; Hutchison et al., 2014). Their extraordinary efficiency and multifunctionality make them critical targets for conservation and restoration in climate change mitigation. Indeed, this is how fossil fuels were originally formed. These ecosystems also provide additional environmental benefits, such as protecting coastlines from erosion, supporting biodiversity, especially fish nurseries and endangered species such as sea turtles (Hutchison et al., 2014), and enhancing water quality, like water clarity (Wolanski et al., 2000). The extraordinary efficiency and multi-functional benefits of seagrasses and mangroves make them critical targets for conservation and restoration efforts in the fight against climate change.

Desert soils can sequester atmospheric CO_2 through microbial processes that form carbonaceous minerals like calcite. This microbial activity is significant in drylands with sparse vegetation, demonstrating a natural mechanism for carbon capture in desert environments (Liu et al., 2020). However, the vast desert areas of the world present a largely untapped opportunity for carbon sequestration, and changes to rainfall even lead to carbon emissions (Yang et al., 2023). These lands, often considered unusable for traditional agriculture or habitation, hold the potential for innovative carbon capture strategies (Schile et al., 2017). Several deserts located near oceans—such as deserts in Senegal, Western Sahara, Morocco, Eritrea, Djibuti, Libya, Oman, Saudi Arabia, Mexican Sonora, Peru, Northern Chile and perhaps, the Sinai Peninsula (near the Red and Mediterranean Seas), and coastal portions of the Atacama Desert (near the Pacific Ocean)—illustrate that some arid regions exist in proximity to saline water sources. Although these locations differ in elevation, political context, and feasibility, they exemplify the type of coastal desert where, under appropriate conditions, engineered carbon sequestration ecosystems could be explored (Gu et al., 2018). Coastal deserts, in particular, provide opportunities for implementing engineered ecosystems or introducing salt-tolerant plants to capture CO_2 effectively. By rethinking how we use these arid landscapes, we can transform them into valuable assets in the global effort to mitigate climate change.

We propose creating man-made, fjord-like ocean inlets in coastal deserts to promote carbon sequestration. Natural inlets have been restored using mangroves in Oman (Figure 1), such as those in the Musandam Peninsula. (See the FAO's [2024] work on mangrove

Figure 1. *Before and after mangrove restoration at Bandar, Oman. The left image shows the coastal landscape at Bandar, Oman, prior to mangrove restoration, characterized by bare rocky shores and minimal vegetation. The right image, taken from a similar vantage point, shows the same inlet after successful mangrove planting, with mature mangroves established along the shoreline. Restoration efforts included planting not only along fjord edges but also on nearby sandy beaches across the Omani coast. (Photo credit: Edward D. Manning.)*

restoration and blue carbon in the Gulf region for inspiration and current initiatives.) Our proposal refers to engineered analogs, that would mimic the hydrological features of fjords but be intentionally designed for ecological stabilization and carbon drawdown.

These engineered ecosystems will allow water to flow into and out of the inlets and feature gently sloping banks reinforced by diverse mangroves (tropical and subtropical areas) and salt marshes (temperate areas), with extensive root systems to stabilize the soil and capture atmospheric carbon (Figure 2). The sediments within light zones of seagrass of these inlets would be restored with seagrass, leveraging its remarkable ability to sequester carbon in both biomass and sediment. By combining these three highly efficient blue carbon ecosystems, these artificial inlets could serve as powerful carbon sinks throughout the deserts. Furthermore, their design would integrate coastal resilience benefits, protect nearby areas from erosion, foster biodiversity of marine and endangered species, and create opportunities for fisheries. Shoreline birds may be drawn to these new habitats, depending on regional species compositions and whether restored ecosystems replicate their nesting or foraging conditions. However, given that many desert-ocean ecotone birds are adapted to sparse, low-disturbance environments, careful habitat design is essential to avoid negative impacts. This innovative approach maximizes the sequestration potential of coastal areas and provides a scalable solution to address global carbon emissions. If the shoreline is rocky, special niches for mangroves can be placed on the constructed shoreline for secure placement of mangrove saplings.

The ecological engineering of fjord-like inlets would require significant excavation, sediment displacement, and infrastructure to manage water inflows and shoreline stabilization. These construction activities are likely to emit greenhouse gases, particularly through heavy machinery and material use. A rigorous cost-

Figure 2. *An AI-made illustration of what the suggested inlets could look like in a desert, created by Chat GPT 4.0.*

benefit analysis is necessary to determine the net carbon impact—i.e., how much carbon would be sequestered over a 50-100–year horizon compared to emissions produced during implementation. Initial modeling could draw from seagrass and mangrove restoration efforts documented in Thorhaug et al. (2020) to estimate sequestration rates under comparable conditions.

The man-made inlets would also deliver significant ecosystem services, particularly through the presence of seagrass meadows. Seagrass plays a crucial role in enhancing fishing by providing a vital nursery habitat for juvenile fish and shellfish, offering them food and shelter, ultimately leading to increased fish populations and improved fishing grounds for small-scale and large-scale fisheries. Some juveniles migrate to the open ocean in adult stages, then return to spawn in the near-shore area. Globally, healthy seagrass meadows are considered essential for near-shore fisheries productivity. Seagrass beds act as protected areas for young fish to grow and develop before moving to open waters, helping to maintain fish stocks. Additionally, seagrass provides food for various marine invertebrates, which serve as a food source for fish and birds and act as fishery stock in themselves (e.g., lobster, crabs, shrimp, oysters, clams, and mussels). The complex structure of seagrass meadows supports a diverse range of fish species, which in turn attract a wide array of shorebirds, many of which in the tropics are endangered or threatened (e.g., whooping cranes, great blue herons, Louisiana blue herons, tricolored herons, and piping plovers [Barber, 2016]). Additionally, the blades of the seagrass, as water flows through them, slow the current speed to help filter water by particles dropping out and being stabilized into bottom sediment by seagrass rhizomes and roots, leading to better water quality, which further benefits fish populations. These interconnected benefits underscore the ecological and economic importance of integrating seagrass into the design of these inle.

The urgency of addressing climate change demands bold, innovative solutions. Visions of the future that prioritize the unique potential of underutilized landscapes like deserts are key to conceiving important transformations of once-more-fertile systems. By leveraging salt-tolerant vegetation, blue carbon ecosystems such as seagrasses and mangroves, and sustainable engineering practices, we can transform arid regions into powerful carbon sinks. These strategies not only enhance carbon sequestration, but also deliver vital co-benefits—such as improved biodiversity, fisheries productivity, and coastal resilience—that support both ecosystems and human livelihoods.

Deserts, often overlooked as barren and unproductive, hold untapped potential to become integral to the global climate solution. By focusing on scalable and sustainable interventions tailored to these landscapes, we can drive impactful progress in combating climate change while fostering ecological and economic resilience. The time to act is now—creating visions for deserts as allies in our fight against carbon emissions is no longer just an option, but a necessity for a sustainable future.

ACKNOWLEDGMENTS

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INBRE Grant Promotes Student Leadership in Testing Manmade Chemicals on Weedy Plants in the Mississippi Delta

ABSTRACT

Delta State University (DSU), a small teaching university in the Mississippi Delta, incorporates hands-on exercises in both the laboratory and the field into undergraduate Environmental Science and Biology courses. These procedures strengthen core concepts, provide an academic foundation in understanding scientific methodology, and increase the competitiveness of future graduates. In Fall 2024, a Mississippi iDeA Network of Biomedical Research Excellence (INBRE) Research Initiation Grant titled "Testing for Manmade Chemicals from Mississippi Delta Plants," awarded to DSU, linked botanical and environmental science concepts to biomedical and molecular biology. Students collected flowers from weedy plants that grew around the borders of farm fields and unsprayed areas, made extracts for atrazine and glyphosate enzyme-linked immunosorbent assays tests, prepared microscope slides of flowers, analyzed cell morphological features, and compiled data. Students discovered how herbicides may influence the health of food chains, cell structure of flowers, and the local biodiversity.

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KEYWORDS

Atrazine, enzyme-linked immunosorbent assay ELISA, glyphosate, Johnson grass, tall late boneset, tall goldenrod, undergraduate student research

INTRODUCTION

The Mississippi Delta is an agricultural center of cotton, soybean, and rice production and contains over 31,290 total farms consisting of 10.3 million acres of farmland (Mississippi Department of Agriculture and Commerce; https://www.mdac.ms.gov/agency-info/mississippi-agriculture-snapshot/). Crop dusters are a common sight during the summer months, aerially applying pesticides to protect crops from weeds and insect pests and to improve agricultural yields. Although management strategies such as transgenic crops have helped to reduce budworms, flea hoppers, aphids, and noxious weeds (Grossman, 2014), farmers continue to apply herbicides copiously to this region. Pesticide

applicators also locally apply herbicides to golf courses and lawns to reduce weeds and pests. Two herbicides sprayed throughout the spring and summer months in the Mississippi Delta are atrazine and glyphosate. Atrazine, the second-most used pesticide in the United States (Center for Food Safety, 2025), is water soluble up to 30 mg/L and is an endocrine-disrupting compound (Galbiati et al., 2021). The Center for Food and Safety (2025) identifies atrazine as a contributing factor to birth defects, breast and prostate cancer, and non-Hodgkin lymphoma. Atrazine is a chlorinated triazine systemic herbicide that reduces broadleaf weeds and annual grasses before they emerge (U.S. EPA, 2025); licensed pesticide applicators apply atrazine to agricultural plots for field corn, sweetcorn, sugarcane, and sorghum. Gardeners use glyphosate (trade name RoundUp) to kill grasses and weeds; farmers also use this chemical widely in large-scale agriculture (U.S. EPA, 2025).

Delta State University is a small public regional university located in the Mississippi Delta that welcomes many first-generation students. Faculty in DSU's Division of Mathematics and Sciences are involved in a wide range of scientific research and discovery. They are committed to helping their undergraduate students with various research activities. In June 2024, Dr. Nina Baghai-Riding, Professor of Biology and Environmental Sciences at DSU applied for a Mississippi IDeA Network of Biomedical Research Excellence (INBRE) Research Initiation Grant. Her project titled "Testing for Manmade Chemicals from Mississippi Delta Plants" was funded with co-principal investigators including Drs. Severine Groh, Associate Professor of Biology; William Katembe, Associate Professor of Biology; and Charles Smithhart, Associate Professor of Chemistry. This project links botany to biomedical research using biochemical and molecular approaches. The major objectives of this study were for Environmental Science and General Biology majors to learn scientific methodology in conducting research. Two major aims were proposed to answer the following questions. First, do differences exist in floral morphology, cell shape, and the quantity of pollen per flower for weedy species that border sprayed areas? Second, does the quantity of pesticides retained on flowers differ among species? Students incorporated herbarium, geospatial, data collection, statistical, plant anatomy, plant microscopy, biochemical, and environmental skills throughout the study.

METHODS

Two core students, Ms. Olivia Pharr and Mr. Donald Coleman, Environmental Science and Biology majors, assisted with this study. In addition, students in Economic Botany – BIO 404, Dendrology – BIO 312, Environmental Chemistry – CHE 434, and Materials and Methods in Environmental Science – BIO 415 contributed to this study. In Fall 2024, Baghai-Riding, the two core students, and the BIO 404 class collected fresh flowers of weedy plants that border sprayed agricultural fields and unsprayed areas that are within a 10-mile radius of DSU in Cleveland, MS. Areas included the former DSU Golf Course, Shumate Park, Bear Pen Park, and along roadsides in Cleveland, Bolivar County, MS. They collected from weedy angiosperm species that produced large numbers of flowers and were more than 5 ft. tall: goldenrod (*Solidago canadensis* L.), late boneset (*Eupatorium serotinum* Michx.), and Johnson grass (*Sorghum halepense* (L.) Pers.). During the late winter and early

spring months, students and faculty collected flowers from spiderwort (*Tradescantia virginiana* L.), white clover (*Trifolium repens* L.), common dandelion (*Taraxacum officinale* F.H. Wigg.), and blue violet (*Viola sororia* Willd.). During summer 2025, other flowers collected included Johnson grass, tall ironweed (*Vernonia gigantea* (Walter) Trel.), lanceleaf coreopsis (*Coreopsis lanceolata* L.), and more around Cleveland, MS, as well as from Washington County. Participants placed flowers from each locality into resealable, transparent plastic bags; each bag possessed the date of collection, name of collector, and place of collection. The samples were kept in a –20°C freezer until there was time for further investigation. Students composed an Excel spreadsheet of the plant sample data; plant specimen location sites were plotted onto Google and ArcGIS maps. Students also mounted voucher specimens for the Delta State University herbarium (DSC) to serve as reference materials.

Pharr, Coleman, and students in BIO 312 and CHE 434 also became familiar with preparing plant extracts for the enzyme-linked immunosorbent assays (ELISA). They used weight boats, scales, vortex mixers, centrifuges, and hot plates set at 50°C inside fume hoods throughout the procedure. Extracts for atrazine quantification tests consisted of weighing 1 g from each flower sample and adding a solution of acetone and distilled water into test tubes for centrifugation. Extracts for glyphosate quantification tests included weighing 1 g of flowers and adding distilled water. Each extract was slowly heated over a hot plate until the quantity was approximately 15 ml. Students poured each extract into a labeled screw capped test tube and refrigerated them prior to doing an ELISA.

Under the guidance of Groh and Katembe, Pharr and Coleman conducted more than 50 atrazine and glyphosate ELISA quantifications using Gold Standard products (Figure 1). Each ELISA incorporated standards, positive control, and negative control to ensure the accuracy of the assays. A Thermoscientific Varioskan Lux microplate reader was used to determine the concentrations of atrazine and glyphosate. The test results were recorded in Microsoft Excel file format. Pharr, Coleman, and Katembe also showed Baghai-Riding's BIO 415 class how to prepare an ELISA and use the computer and microplate reading equipment.

During the summer of 2025, Pharr and Coleman learned how to prepare thin microsections of goldenrod, late boneset, and Johnson grass flowers. Groh taught both students how to process the plant specimens

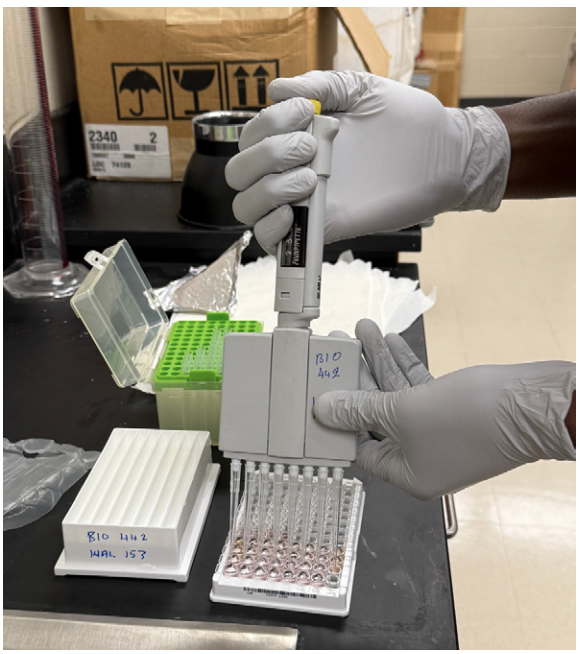

Figure 1. *Donald Coleman is placing prepared solutions into wells of an ELISA microplate.*

for paraffin embedding, use the Leica RM 2135 microtome to cut longitudinal and transverse 10 µm-thin flower sections, and conduct double-staining techniques to differentiate cell wall components. Safranin O dye stains lignified tissue red whereas fast green stains cellulose-based tissues green (Figure 2). The students were able to distinguish cell types: epidermal, ground tissue, and conductive tissue (Figure 3). Digital microphotographs were taken under 40, 100x, and 400x magnifications with an Olympus Q-Color 3 camera attached to an Olympus BX43 compound light microscope. A phase contrast condenser was used in some situations to enhance cellular features. General morphological observations were made on the three floral species (Figure 4). Measurements included the length and width of ground tissue and xylem cells associated with the style, anthers, ovary, and pollen grains. Thirty-five measurements for specified anatomical features were captured for statistical purposes. To reduce bias, three to six microscope slides from different individual plant specimens were scanned. Students entered the data in an Excel spreadsheet for descriptive statistical studies: mean, range, median, and standard deviation.

Figure 2. *Olivia Pharr is cutting 10-mm sections of paraffin-embedded plant material with a microtome.*

Figure 3. *Olivia Pharr is deparaffinizing a tissue section with xylene prior to staining it with safranin O and fast green.*

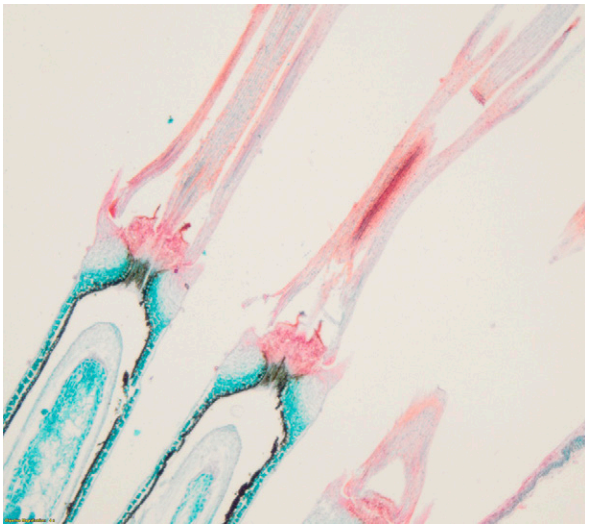

Figure 4. *Stained longitudinal sections of late boneset styles and ovaries.*

RESULTS

Students acquired data that indicated that atrazine and glyphosate accumulate at variable levels in the flowers of distinct species. Most of the data were between the positive and negative control readings and designated in the safe levels. Late boneset had elevated levels of both pesticides at the sprayed Bear Pen Park site as well as at the DSU Golf Course even though this later area has not been in operation for eight years. Students also observed that white clover and dandelion flowers collected in April and May on residential lawns along Terrace Road, which borders a farm field in Cleveland, MS, possessed high atrazine levels; the spraying of pesticides did not commence in this area until June 2025. Vervain had high pesticide levels from a site in Greenville, MS, as well. In contrast, Johnson grass, a prolific invasive weed, possessed low concentration of both pesticides.

The microtome flower sections of tall goldenrod and late boneset produced discernable cells. Students noted species variations in the longitudinal shapes of ground tissue cells and xylem cells in the style of flowers of tall goldenrod and late boneset. For late goldenrod, the length of ground tissue parenchyma cells from Bear Pen Park ranged from 15 to 56 µm (mean 32 µm) in length and 7–22 µm (mean 12 µm) in width compared to 10–90 µm (mean 48 µm) in length and 4–14 µm (mean 9 µm) in width for late boneset. Additionally, the styles of late boneset flowers from Bear Pen Park were rectangular and linear whereas the styles from unsprayed areas possessed more irregular shapes and size variation. In contrast, Johnson grass flowers were difficult to section because of the palea and lemma bracts that enclose individual flowers within the spikelets, and the poor penetration of the paraffin wax into the flowers.

DISCUSSION

The mission of Delta State University is to "offer exceptional programs and opportunities that are current, innovative, and responsive to the diverse needs of those it serves. The University provides experiences that cultivate intellectual growth and individual enrichment to develop productive members of local, regional, and global communities" (DSU, 2025-2026). This INBRE Research Initiation Grant incorporated plant science with biomedical research within a rural agricultural area of the southeastern United States. Forty-three students were exposed to current scientific techniques that industry and governmental agencies use. Students gained an understanding as to how the quantity of pesticides can negatively impact food chains and negatively impact human health. They learned that wind drift, water erosion, and animal pollination may be partly responsible for the spread of herbicides in controlled unsprayed areas and that pesticides can linger in soil after spraying had ceased for years. Investigating the effects of pollutants on flowers is important for food security and environmental sustainability. This research strengthened the understanding of these biotic and abiotic concepts that are part of the DSU environmental sciences curriculum.

Students learned that experimental results take time to acquire. Many factors went into obtaining accurate and useful data. During experiments, several disappointments arose. For example, students had to redo ELISA quantifications when the positive and negative controls did not vary in value. Other difficulties included extracts drying out in beakers when hot plates were left unattended, melting paraffin wax for tissue embedding, acquiring accurate microtome sections, plant

material falling off the slides throughout the staining process, plant tissues not staining well, and air bubbles in microscope slides. Additionally, measuring the length of xylem cells sometimes was difficult because annular and helical secondary wall thickenings often would obscure the structural boundaries of cell partitions.

The two core students conducted leadership roles throughout the project. Both students were supported by funds from the grant and worked independently even when the Principal Investigator and Co-principal investigator faculty were absent for several days. They routinely explained to their peers and new incoming students how floral morphology and herbicides can affect biomedical and molecular biological studies. They instructed students in BIO 312, BIO 415, and CHE 434; used sophisticated scientific equipment; and mastered advanced concepts in the botanical and environmental sciences. The two core students also co-authored two abstracts and poster presentations that were given at the Mississippi IDeA/EPSCOR Conference 2025 in Oxford, MS as well as at Botany 2025 in Palm Springs, CA. Students in BIO 312, BIO 415, and CHE 434 were impressed with how DSU possessed sophisticated testing procedures that were useful in addressing environmental questions. Understanding morphology, anatomy, and physiology of flowers; exploring and identifying differences regarding cell structure of flowers; relating atmospheric factors to biodiversity; understanding how pesticides are tied to the health of food chains; and communicating research also fulfill objectives in botany outlined in the 2018 Mississippi College and Career Readiness Standards for Science (Mississippi Department of Education, 2018). The purchasing of new equipment, including a plant chamber, made possible with this INBRE grant will continue to enhance student success in the plant and environmental sciences at DSU.

Olivia Pharr provided a quote about her experience associated with this project. She said, “Working on this project has provided skills and knowledge that are used to investigate problems and threats to human, animal, and plant health. This includes researching the impact of pesticide exposure within local agricultural communities in the Mississippi Delta and the state of Mississippi. I am blessed to have good mentors who have taught and trusted me to perform complicated procedures and use expensive equipment that I wouldn’t have otherwise learned or used until graduate school or within a government or corporate lab setting." In addition, Donald Coleman, said “This project has been a satisfying experience that has given me an opportunity to improve my ability to work with others and gain hands-on experience in both the field and the laboratory.”

ACKNOWLEDGMENTS

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reviewing the manuscript prior to publication and for guidance throughout the project. We also extend special appreciation to Ms. Jessica Hardy for reviewing and critiquing the manuscript prior to publication. We also want to recognize Ms. Olivia Pharr and Mr. Donald Coleman, two core undergraduate students, who participated in this project.

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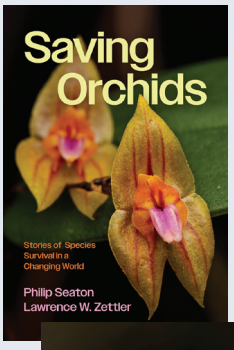
CHICAGO



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Philip Seaton and Lawrence W. Zettler

"*Saving Orchids* is a remarkable and extremely timely book. Seaton and Zettler outline the many mistakes made over the last few centuries that landed us in rather dire straits as well as some of the modern solutions that could be employed by diverse stakeholders."—Tom Mirenda, coauthor of *The Book of Orchids*

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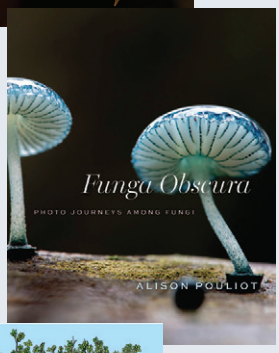

Funga Obscura

Photo Journeys Among Fungi

Alison Pouliot

"Ecologist and environmental photographer Alison Pouliot has a focus on fungi and her pictures take us across continents and hemispheres. . . . She reminds us that fungus is a vital component of life on Earth."—*Canberra Times*

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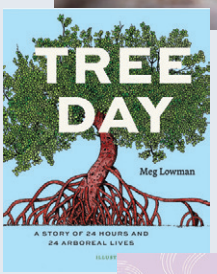

Tree Day

A Story of 24 Hours and 24 Arboreal Lives

Meg Lowman

Illustrated by Thibaud Hérem

"*Tree Day* reveals Lowman's love (which I share) of trees as living beings. It will help all who read it understand the important role trees play in our lives and the life of our planet. Congratulations, CanopyMeg."—Jane Goodall

Earth Day

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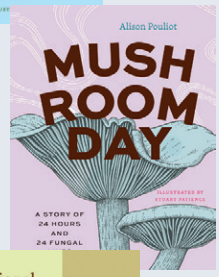

Mushroom Day

A Story of 24 Hours and 24 Fungal Lives

Alison Pouliot

Illustrated by Stuart Patience

"*Mushroom Day* is popular science at its very best—knowledge spiced with passion for the fungal kingdom. The combination of evocative and diverse stories of fungal wonders is captivating."—Anders Dahlberg, Swedish University of Agricultural Sciences

Earth Day

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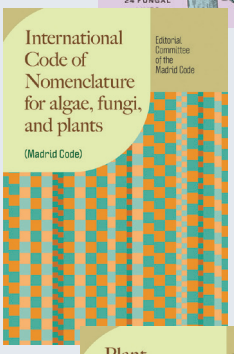


International Code of Nomenclature for algae, fungi, and plants (Madrid Code)

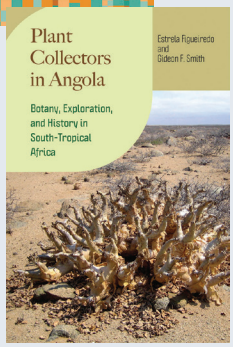
Editorial Committee of the Madrid Code

Contributions by Nicholas J. Turland, et al.

The latest, updated edition of the essential, authoritative reference for botanical, mycological, and phycological names.

Regnum Vegetabile

Paper $45.00



Plant Collectors in Angola

Botany, Exploration, and History in South-Tropical Africa

Estrela Figueiredo and Gideon F. Smith

"An essential reference tool for everyone studying African plant specimens."—Laurence J. Dorr, US National Herbarium, Smithsonian Institution

Regnum Vegetabile

Paper $45.00

The University of Chicago Press www.press.uchicago.edu

MEMBERSHIP NEWS

Together We Did It! Thank You for Making the Second Annual "A Day for BSA" a Success!

Thank you for making our second annual "A Day for BSA" an incredible success! Together, we raised $17,250 for the BSA Endowment, surpassing our $15,000 goal and strengthening the future of the botanical sciences.

Your generosity ensures that BSA can continue to provide resources, support students, and sustain vital programs even as budgets tighten and funding becomes less certain. Science thrives when we stand together, and this community has shown what is possible.

If you didn't have a chance to give this August, Endowment donations are welcome year-round and can be made easily when you renew your membership, or anytime by visiting https://crm.botany.org/makeadonation

By Amelia Neely

BSA Membership & Communications Manager
E-mail: ANeely@botany.org

Once again, thank you for your continued commitment to the future of the Botanical Society of America and your global botanical science community.

CELEBRATING 50 BSA SPOTLIGHTS!

This year we are celebrating our 50th BSA Spotlight! The spotlight series highlights both early-career and professional BSA members including their scientific goals and achievements, personal interests, and their advice for the next generation of botanical scientists. Spotlight profiles are shared on all BSA social media platforms, *Membership Matters, the* BSA eNewsletter, on the BSA Spotlight webpage, and here in the *PSB*.

We celebrated the 50th Spotlight this year at Botany 2025, sharing all 50 spotlights' advice on take-away bookmarks at the BSA booth, inspiring people to both read about their fellow members, but to also sign up and become a Spotlight themselves.

If you would you like to nominate yourself or another BSA member to be in the Spotlight Series, please fill out this form: https://forms.gle/vivajCaCaqQrDL648.

SPOTLIGHT ADVICE

Stay curious and always observe. Try knowing your plants, even beyond your scope of study. Get good friends as nice and honest sounding boards and be ready to reciprocate. – **Adam Abdullah**

I would say... **Plant biodiversity can be overwhelming**, however **don't let that stop you**. At the end of the day it is amazing to grasp patterns in order to understand a little bit more every day of the complexity we have in front of us. – **Natalia Contreras**

Get involved in a lab and don't be afraid to ask for help! – **Shawn K. Thomas**

Enthusiasm and friendliness will get you very far! – **Nina House**

Reach out to the people doing something similar to whatever it is you're interested in and **be open minded to the opportunities that may be presented**. – **Nicholas J. Engle-Wrye**

HERE ARE THE LATEST SPOTLIGHTS





Kiona A. Leeman, University of Wisconsin - La Crosse
Victoria Martinez Mercado, Northwestern University /Chicago Botanic Garden
Sarita Munoz-Gomez, Clemson University
Whitney Murchison-Kastner, Tulane University
Rachel L. Benway, Syracuse University

MEMBERSHIP DUES UPDATES FOR 2026

Membership revenue is vital to the Botanical Society of America's ability to fulfill our mission of supporting research, education, and outreach in the botanical sciences. Your membership contributions directly fund student awards, Society publications, programs at the annual Botany Conference, and much more.

Like many organizations, we review our membership rates annually to ensure we can keep pace with rising operational costs and maintain rates that are comparable to similar institutions. After careful consideration, it has been decided to adjust the rates for the **Professional** membership level and the **Developing Nations** membership level.

For our Developing Nations members, this is the **first rate increase ever**. We understand that funding can be limited in many regions, and we want to ensure all members continue to have access to BSA programs and benefits. To help, the BSA gift membership program allows members to purchase donated gift memberships that can be used as financial aid for any Developing Nations member who requests support. To request a discount code to help cover your membership dues, email Amelia Neely (aneely@botany.org).

2026 Rate Changes (effective October 1, 2025, the start of the 2026 renewal season):

- **Professional Membership Base Rate** has increased from **$75 to $80** ($205 to $220 for three-year memberships).
- **Professional Memberships with an Opt-In for the Grad Student Research Award donation will stay the same at $100,** but instead of $25 going toward the GSRA fund, $20 will be donated (it will stay at $280 for three-year memberships as well and $60 will be donated to the GSRA fund instead of $75).
- **Developing Nations membership** rate has increased from **$15 to $20** ($30 to $45 for three-year memberships).
- Finally, the **print subscription for the *PSB* will increase from $10 per year to $20 starting October 1, 2025**. This increase will help defray printing and postage expense for print copies of the *Plant Science Bulletin*. BSA will cover remaining costs to produce the publication. If you already have a print subscription via a multi-year membership, your subscription will not change until you renew.

YOUR BSA BENEFITS IN ACTION!

This year, the Botanical Society of America has continued to strengthen our community **by investing in our members and your work**.

This year BSA has:

- **Awarded 167 research and travel awards** to students and professionals—worth over **$140,000**—and celebrated member award winners with a week-long **Awards Blitz** on social media and via email.

- Brought together over **1,060 participants from 30 countries** at the annual **Botany Conference**, featuring more than **700 oral and poster presentations** and countless opportunities for networking and collaboration. A **new Hardship Award** helped cover costs such as travel, lodging, conference registration, and dependent care to support members affected by recent funding and grant cuts that resulted from decisions made by the current U.S. Administration.

- Continued to **deliver internationally recognized, peer-reviewed journals** (*American Journal of Botany* and *Applications in Plant Sciences*), while **ensuring access** through member publishing discounts, transitional agreements, and new pricing models that keep our journals accessible worldwide.

- Provided **leadership and volunteer opportunities** for members at every stage of their careers, including serving on the Board, as section leaders, committee members, student chapter leaders and advisors, Early Career Advisory Board members, and as Reviewing Editors for *Applications in Plant Sciences*.

- **Supported students** through discounted membership rates and access to membership financial aid. Enhanced conference participation with student-centered programming, discounted registration, travel awards, and the opportunitys for free registration through volunteering. Provided research funding and recognition through student-specific awards and grants. Strengthened community with a dedicated Student Hub webpage, provided leadership opportunities that connect students with professionals and give them a voice in decision-making, and ensured that student perspectives are represented through active Student Representatives on the Board.

- **Launched "A Botanical Podcast!"** to highlight the voices of our members and share the importance of botanical science with a broader audience.

- **Advocated on behalf of the botanical sciences** by signing on to several high-level advocacy letters that emphasize the importance of research and education in our field.

Every one of these efforts reflects our commitment to you: to provide resources, recognition, community, and advocacy so that your work in botany can thrive—today and for generations to come.

SUPPORT GRADUATE STUDENTS WITH YEAR-END DONATIONS TO THE GSRA FUND – DONATE TODAY!

Each year, BSA is proud to support graduatestudents with $1,500 awards to advance their research through the Graduate Student Research Awards (GSRA). These awards are funded by membership dues revenue and by the generous donations of BSA members. Professional members can "opt in" to add an additional $20 GSRA support fee during their membership renewal, and all members are welcome to give to the GSRA fund during their renewal, or anytime, by visiting https://crm.botany.org/makeadonation.

In 2025, we awarded 27 Graduate Student Research Awards, including the prestigious J.S. Karling Award. **As you plan your year-end giving, please consider a donation to the GSRA fund** to help us nurture the next generation of botanical scientists through these vital awards.

HELP US REACH OUR GOAL OF 100 GIFT MEMBERSHIPS BY DECEMBER 31ST!

With the year drawing to a close, we are working toward our goal of 100 gift memberships, but we have a long way to go and need your support to help us get as close as possible! Every $20 one-year gift membership or $55 three-year gift membership makes a real difference, helping us bring more students and more colleagues from developing nations into the BSA community. Please consider giving the gift of membership today—visit https://crm.botany.org/giftmemberships to get started!

You can also donate gift memberships by placing an "X" in the recipient fields. Donated gift memberships allow us to offer financial assistance to students and to colleagues from developing nations who request financial aid throughout the year. The level of support we can provide depends directly on the number of donated gift memberships purchased, so every donation makes a meaningful impact. Please consider donating gift memberships today!

Need help? Email aneely@botany.org.

3-YEAR MEMBERSHIPS STAY CONNECTED AT A DISCOUNT!

Have you considered a 3-year membership with the Botanical Society of America? A multi-year membership provides both savings and convenience: enjoy discounted rates and

skip the annual renewal reminders. You can also purchase the *PSB* print copy subscription and join sections both for three years when you renew. Plus, memberships that start now will be valid through December 31, 2028!

The following memberships are available for the 3-year option:

- Professional Memberships (save $20)
- Professional Family Memberships (save $50)
- Post-Doctoral Memberships (save $15)
- Student Memberships (save $15)
- Developing Nations Memberships (save $15)

For students and post-docs, there's even more flexibility—keep your 3-year membership at your current rate even if you graduate or your position ends.

Do you know a student or a colleague from a developing nation who could benefit from extended access to BSA membership benefits and the BSA community? Three-year memberships can also be gifted or donated, providing a valuable way to keep students and international members connected and supported for a full three years.

Visit here: https://crm.botany.org/ to renew at the 3-year level or to purchase gift memberships. Questions? Email aneely@botany.org.

Nominations for 2025 Bessey Award

Consider nominating an excellent BSA educator for the 2026 Charles Edwin Bessey Award. This annual award recognizes outstanding contributions made to botanical instruction. Ideal candidates are BSA members who are enthusiastic about teaching botany, are innovative in increasing student and/or public interest in botany, and teach in a way that increases the quality of botanical education. More information about the award and a list of past winners can be found on the BSA website: https://botany.org/home/awards/awards-for-established-scientists/charlesebesseyaward.html.

Official nominations are accepted starting in early 2026, but students and early career members who would like help putting in a complete nomination packet can fill in an online form (due by March 14, 2026) for assistance in putting a packet together: https://docs.google.com/forms/d/e/1FAIpQLSdwTrje8sk-aHrcANCTDOVgebFydyCuziS9teWMe97blZNU9Q/viewform?usp=sf_link

By Dr. Catrina Adams, *Education Director*

Jennifer Hartley, *Education Programs Supervisor*

IMPACTS OF PLANTINGSCIENCE ON STUDENTS' MOTIVATION TO STUDY PLANTS

The PlantingScience Team shared some preliminary results from our NSF-funded PlantingScience F2 research study at the recent Society for the Advancement of Biology Education Research (SABER) Midwest Conference, held alongside the National Association of Biology Teachers (NABT) Conference in St. Louis, MO on October 30 – November 1. Slides from our short talk are available here: https://tinyurl.com/ps-saber

Preliminary results show that PlantingScience has a positive impact on high school students' motivation to learn about plants, and in particular a positive impact on students' expectancy that they can be successful in learning about plants when compared to "Business-as-Usual" ways of teaching. A recent analysis of students' open-ended responses adds context to the quantitative data and, in the students' own words, how they feel working with a mentor impacted their motivation to learn about plant science (Figure 1).

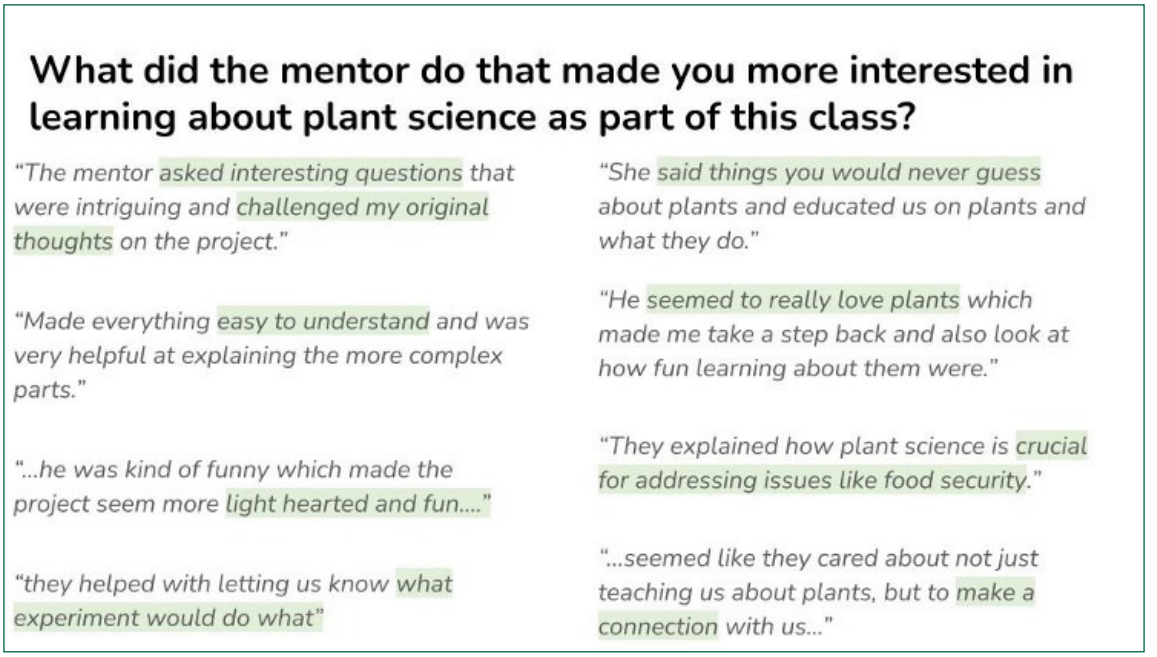


Figure 1. *Some examples of student responses to the prompt "What did the mentor do that made you more interested in learning about plant science as part of this class?"*

PLANTINGSCIENCE SESSION UPDATE - FALL 2025

The Fall 2025 PlantingScience session has wrapped up! Thirty high school and middle school classes participated, taught by 17 teachers. While most teachers were returning veterans, we were excited to welcome four new teachers and schools to the program this year.

Students dug into our most popular inquiry themes: seed germination and photosynthesis. We had one middle school group exploring C-fern life cycles. Two teachers also piloted the updated TreeMendous Benefits of Trees module, developed with help from Dr. Monica Lewandowski and other APS members. One Florida team even created a multimedia presentation on their chosen tree species; scan the QR code to see their work!

As always, PlantingScience thrives on the enthusiasm of our dedicated scientist mentors who guide students through authentic inquiry experiences. Their support continues to cultivate the next generation's curiosity about plants and the scientific process. If you have mentored for PlantingScience, thank you! Your contribution makes a big difference to our students. If you haven't signed up, consider doing so! Visit www.plantingscience.org to learn more!

ROOT&SHOOT UPDATES: NEW ARTICLE IN ELIFE

The ROOT&SHOOT NSF-funded research coordination network aims to make plant science more welcoming to all. One of the first projects developed by the RCN was a community-based effort to identify recommendations for making conferences in the plant sciences more inclusive. Many BSA members were involved in all stages of this project: contributing to working groups who created initial lists of suggestions, reviewing and refining these suggestions, and writing an article to report on the model and results. The RCN is excited to share the first publication to come from this initiative: "Equity, Diversity and Inclusion: Making conferences in the plant sciences more inclusive through community recommendations" (Puig-Lluch et al., 2025). Read the eLife article here: https://elifesciences.org/articles/106877.

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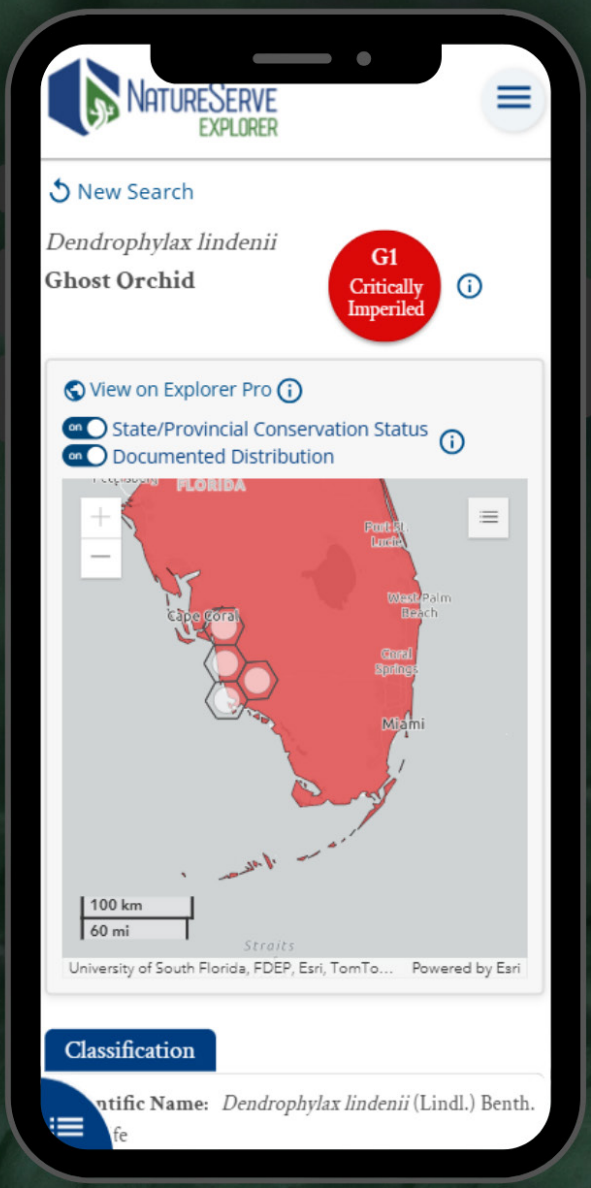

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NatureServe Explorer

Botany 2025 Recap

It's hard to believe that the Botany Conference at Palm Springs, California, was held 5 months ago! We're so grateful to everyone who took the time to complete the post-conference survey—your feedback has been incredibly valuable and is already helping us shape Botany 2026.

Botany 2025 in Palm Springs, California, was not only a great conference but, as always, an exciting opportunity for our community to reconnect. From the outstanding presentations showcasing the research happening within our society to the informal interactions during coffee breaks, every moment at the conference was an opportunity to engage and strengthen our sense of community.

Honoring this year's conference theme, the BSA Diversity, Equity and Inclusion Committee hosted a panel to highlight successful experiences of immigrants navigating academic life in the United States. Several international members, including students in our community, shared personal narratives describing the challenges of cultural adjustment, such as adapting to a new academic system, language nuances, classroom dynamics, and unspoken expectations. Many of the panelists recounted how routines as simple as food, social interactions, and daily schedules required adaptation, and how these early challenges sometimes made the vibrant opportunities of U.S. academia feel isolating. Despite these hurdles, they also shared strategies that helped them build a sense of belonging. By engaging with botanical societies, volunteering in outreach programs, and seeking mentors who understood both their scientific and cultural perspectives, they gradually built supportive networks within and beyond their labs.

By Benjamin Aderemi Ajayi and Sara Pedraza
BSA Student Representatives

These stories underscore a central lesson: "Integration does not mean sacrificing one's identity, but rather cultivating growth in a new environment." Through perseverance and community support, these BSA members found a balance for making their research in plant evolution and biodiversity flourish. Their experiences serve as a powerful reminder of resilience, adaptation, and the importance of creating inclusive spaces for all members in our botanical community, but also highlight the role that as a community we have to support each other to make "Botany without barriers"!

At this year's conference, we also hosted activities focused on supporting students in exploring careers in the field of Botany. The **Careers in Botany Luncheon** featured 10 panelists representing a wide range of sectors, including academia, government, non-governmental organizations, consulting firms, herbaria, botanical gardens, and museums (Figure 1). The panelists, who were at various career stages, shared their experiences and insights as plant biology researchers, offering students a broad perspective on potential professional pathways in Botany. A total of 96 students attended the luncheon, making it one of the best-attended yet! Join us next year for the Careers in Botany Luncheon at Botany 2026 in Tucson, Arizona.

Another fun and interactive student event at Botany 2025 was the **Student Social** (Figure 2)! This happy hour brought together students from diverse institutions, backgrounds, and fields of study to celebrate how *Botany unites us all!* Thanks to everyone who joined us! We had a wonderful time connecting and getting to know one another in Palm Springs. We look forward to seeing you all again at the next Student Social in Tucson, Arizona!

Figure 1. *Careers in Botany Luncheon at Botany 2025 in Palm Springs, California.*

Figure 2. *Student Social at Botany 2025 in Palm Springs, California.*

If you have ideas for future student-focused events at the Botany conference or are interested in gaining experience organizing events, we'd love to hear from you! Feel free to reach out to Benjamin (baa23a@fsu.edu) or Sara (sarapedraza@ucla.edu)

GRANT OPPORTUNITIES

As the semester gains momentum, it's a great time to explore funding opportunities and support for your research! We have updated acomprehensive list of opportunities, organized into categories to make your search for funding easier Roundup of Funding Opportunities (https://tinyurl.com/mutbfbyk).

Don't forget—BSA continues to share society grant and award announcements through our social media channels. Follow us to stay up to date: Facebook (Botanical Society of America), BlueSky (@botsocamerica.bsky.social), and Instagram (@botanicalsocietyofamerica).

PLANT SCIENCE SCHOLARSHIPS FOR 2026-2027 ANNOUNCED BY CLEVELAND'S WESTERN RESERVE HERB SOCIETY

Two scholarship programs open to students who have completed the second/sophomore year of undergraduate study and are enrolled in a bachelor's degree related to the study of plants were announced by the Western Reserve Herb Society in Cleveland, Ohio.

Applications are now being accepted for the 2026-2027 academic year. Eligible applicants must be attending an accredited college or university in the United States and have achieved a grade point average of 3.2 or above.

The two scholarship programs include:

The Western Reserve Herb Society Scholarship covers all accredited colleges and universities in the United States. For 2026-2027, there will be two awards of $4000 each.

The Frances Sylvia Zverina Scholarship is restricted to students studying at an accredited institution within the state of Ohio. For 2026-2027, there will be two awards of $4500 each.

Preference will be given to applicants who demonstrate coursework in rigorous sciences, exceptional dedication through outside experiences, and whose career goals may involve work in areas such as the public or nonprofit sector, education, sustainability, and research.

For an interactive application and additional information, visit http://www.westernreserveherbsociety.org/scholarships/.

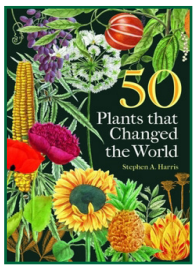
The Western Reserve Herb Society (WRHS) is a non-profit organization dedicated to promoting the knowledge, use and delight of herbs through educational programs, research and public outreach. A unit of The Herb Society of America, WRHS is based in Cleveland, Ohio. For more information, visit http://www.westernreserveherbsociety.org.

BOOK REVIEWS

50 Plants that Changed the World
Catesby's Natural History
Disabled Ecologies: Lessons from a Wounded Desert
The Ecology of Herbal Medicine: A Guide to Plants and Living Landscapes of the American Southwest
Flower Day: A Story of 24 Hours and 24 Floral Lives
Frustrating Flowers & Puzzling Plants: Identifying the Difficult Species of Britain and Ireland
The Heart of the Wild: Essays on Nature, Conservation, and the Human Future
Nature's Greatest Success: How Plants Evolved to Exploit Humanity
Plant Breeding Technology: Future Trends and Challenges
The Lignan Handbook
Natural Poisons and Venoms: Plant Toxins: Alkaloids and Lectins
Natural Poisons and Venoms: Plant Toxins: Polyketides, Phenylpropanoids and Further Compounds
Radical by Nature: The Revolutionary Life of Alfred Russel Wallace
Science with Impact: How to Engage People, Change Practice, and Influence Policy
Tree Day: A Story of 24 Hours and 24 Arboreal Lives

50 Plants that Changed the World

Stephen A. Harris
2025. ISBN: 9781851246526.
US$40.00 (hardcover); 314 pp.
Bodleian Library Publishing, Oxford, UK



The book *50 Plants…* is actually a new title for the second edition of Harris' 2015 book, *What Have Plants Ever Done for Us?* Both are a collection of 50 essays, each about a particular plant species of significance to Western Civilization. The essays are roughly in chronological order of their impact on the west, from Barley (*Hordeum vulgare* L.) through Thale Cress (*Arabidopsis thaliana* (L.) Heynh.). Essays begin with an illustration of the plant; a brief social history, including political, environmental, and cultural circumstances impacted by the plant; evidence of where and when it was domesticated; a brief biological description; major economic uses; and its spread around the world. The author includes nuggets of interest to suit a variety of tastes. For instance, in the first chapter (Barley), we are introduced to the traditional English ballad and folk tale of John Barleycorn, connecting the Roman Robigalia with later Christian planting festivals and the 1973 cult film *The Wicker Man*. With alcohol production a major economic use, the author briefly diverges to beer and whisky production. For a scientific twist at the end, we are introduced to the cereal grain as the basic unit of mass for the apothecary, troy, and avoirdupois systems. A penny sterling should weigh 32 grains (gr.) of round, dry wheat "taken from the midst of the ear"; 1 lb. = 16 oz. = 7000 gr.

As with most revisions, the text is virtually the same except for editorial corrections and updated data. Overall, the new edition is about 1 in. larger in both length and width (9.5 x 6.5 in.) with a half-point larger font (12 vs. 11.5). This allows for a footer of book title on even pages and chapter title on odd pages, along with the page number. Both changes result in a book that's easier to read and follow. The most dramatic change, however, are the illustrations. The black-and-white line drawings, inset on the first page of each chapter of the first edition, are replaced in the new edition by full-page color (except black and white for Papyrus, Coconut, Rubber, and Soy) copies of historic prints, mostly from the Bodleian Library or the Sherardian Library of Plant Taxonomy at Oxford. These are usually set on the first facing page of the chapter. Even the dust jacket is a colorful collage of images from the chapters. These plates are a wonderful historic addition to the volume. However, there is one problem. The plate used for Olive is from Elizabeth Blackwell's, *A Curious Herbal* (1760) but shows the plant with alternate leaves—olive has opposite leaves!

Not surprisingly, both the chapters for *Brassica* sp. and *Citrus* sp. require three plates to illustrate the variety of common fruits and vegetables within those genera. But Banana also has three plates. The author seems to have a particular fascination with Linnaeus' treatment of banana, including his support for the belief that it was the tree of knowledge in the Garden of Eden. Following one of Harris' endnotes, I consulted the original (Freer, 2007). Inserted into one of Linnaeus' personal copies of his book, facing p. 44 where there is a listing of nine reasons supporting the tree of knowledge view, is a hand-written note: "…it is the fruit with which Eve committed sin…. the fruit resembles…and Eve was aroused to such unbridled lust by its appearance." Harris also notes that Linnaeus was proud that he was the first person to coax banana to flower and fruit under cultivation in Europe. However, in two places in his text, Linnaeus specifically mentions three others who preceded him in this accomplishment: at Vienna, 1731; Karlsruhe, 1732; Leipzig, 1733; then himself at Hartenkamp, near Leiden, 1736 (Freer, 2007). This is a minor, but horticulturally important point for a future revision.

Most of the changes in the text are to update production information for the several crop species described. Not surprisingly, production numbers usually increased during the 10 years between editions. For instance: broad bean production increased 25% to 8 million tons; garlic, 7% to 29 million; onion, 8% to 115 million; coffee, 21% to 10.8 million; banana, 26% to 135 million; soybean, 28% to 348 million; and sunflower, 31% to 54 million. The single largest increase was 41% for oil palm fruit. Unfortunately, "there appears to be no straightforward way to phase out palm oil without incurring potentially more significant environmental and social impacts elsewhere" (p. 259). Perhaps not surprising, in some cases the numbers have gone down. For instance, although total citrus production increased, orange production decreased, particularly in the US where it is less than half that of a decade ago. Similarly, silk production, dependent on White Mulberry, decreased by nearly half; tobacco production decreased 17%, and cotton was down 18%.

Both editions have 491 sequential endnotes, but aside from updated international reports, mostly for production numbers, only two new endnotes were added and two replaced. I would have preferred having the notes divided by chapters. On the other hand, the

Further Reading section has been significantly expanded with 23 new entries. There is a useful table of picture credits; the index is adequate.

Overall, the book is of general interest and useful for introducing readers to 50 plants foundational to the rise of western civilization. A few, such as mandrake, papyrus, and woad, have minor importance today relative to earlier times. Four may be surprising to most readers. Ragwort and corncockle, two invasive weeds, have had significant negative impact on agriculture since ancient times and still require significant control efforts. Lycopods are mostly unknown by the public, but fossil lycopods are the source of coal, a major fossil fuel that powered the industrial revolution but is also responsible for associated environmental problems today. The second, *Arabidopsis*, is an inconspicuous weedy herb that has become the model organism of plant development and one of a handful of organisms at the foundation of modern molecular biology. This book is an attractive introduction to plants that should have a place in the stacks of your public library, school libraries, and college and university libraries.

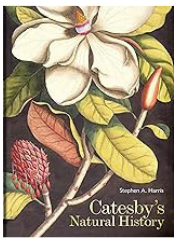
REFERENCES

Freer, S. 2007. *Musa cliffortiana: Clifford's banana plant.* Reprint and translation of Linnaeus' original edition (Leiden, 1736). A. R. G. Gantner Verlag, Ruggell, Liechtenstein.

Harris, S. A. 2015. *What Have Plants Ever Done for Us?* Western Civilization in Fifty Plants. Bodleian Library, Oxford, UK.

—Marshall D. Sundberg. Kansas University Affiliate and Roe R. Cross Distinguished Professor of Biology – Emeritus, Emporia State University.

Catesby's Natural History



Stephen A. Harris
2024. ISBN: 978-185124-639-7
US$75.00 (hard cover); 304 pp.
Bodleian Library Publishing, Oxford, UK

"I do not recall ever having heard the name Mark Catesby until almost ten years ago" (Neal, 2015). Indeed, although recognized by some of his immediate successors, such as Humboldt and Audubon, as one of the premier natural historians of the early 18th century, he was quickly overshadowed by them and was only rediscovered in the mid- 20th century and re-appreciated during the past two decades. Harris' book provides a succinct introduction to Catesby the man, a well-organized synthesis of his written observations that accompanied his illustrations, and a glorious reproduction of the 220 plates in the second edition of Catesby's *magnum opus*, *The Natural History of Carolina, Florida, and the Bahama Islands, Volumes 1 and 2* (1754) housed in the Bodleian Library at Oxford.

This is not a facsimile of Catesby's "*Natural History…*"; indeed, from the chapter "On Publishing the Natural History," it is clear that a single facsimile is not possible. To begin with, at 13 in. long x 9.5 inches wide, the pages are less than half the size of the original "Imperial Size" (Elephant Folio) plates. Catesby realized the accuracy of the images was of utmost importance and took personal responsibility for ensuring this. Not only did he produce sketches (sometimes colored) and notes in the field that could guide production of finished plates, but upon returning to England he learned to

etch copper plates and hand-color prints so he could control the entire production process. He personally etched each plate and individually colored, or at least oversaw and "touched up," each printed sheet (McBurney, 2021). With 155 subscribers, Catesby decided to divide publication into 20 fascicles of 20 pages each, to be sent to subscribers—one fascicle at a time—as each was completed. Thus, publication of the first edition spanned 18 years.

As a result, there is individual variation not only in the finished volumes, from plate to plate, but even in compiling fascicles into bound volumes. For instance, I had the opportunity to compare two third-edition sets from the Kansas University Special Collections. The first Volume 1 began with the title page, followed by the map, the Preface, 100 sequential pages of captions, a Catalog of plates, and finally the plates themselves. The second Volume 1 opened with the map before the title page, the Catalog before the Preface, and then text descriptions and corresponding prints on sequentially facing pages. Coloring and backgrounds of corresponding plates occasionally varied from each other and from the reproductions in Harris's book.

The first two chapters describe the state of natural history in the British Colonies, from European discovery through Catesby, and what little we know about Catesby's life. Much of the information Harris presents is distilled from several recent works, especially Nelson and Elliott (2015) and McBurney (2021). For Chapter 3, on the Habitats and Uses, Harris mines and organizes information Catesby provided in figure captions. Catesby recognized five major habitats in the southern colonies: Freshwater wetlands and swamps transitioning to oak, catalpa, and pine on the sandier soils of the coastal plain, mixed forests of hardwoods and pines in the Piedmont and into the foothills of the Appalachians. He noted that differences were related to soils and elevation. By visiting similar locations in different seasons, he could document seasonal changes in plants and animal activities, including bird migrations. He noted that by cutting wood from the swamps, they would more rapidly evaporate, providing better conditions for rice cultivation (the major export of the colony at the time). He described the natives burning land periodically to encourage grass growth and improve habitat for buffalo. Of the passenger pigeons, he wrote "some places where they roost…they often break down the limbs of Oaks with their weight and leave their dung some inches think under the tree" (p. 33). He noted and sketched the frequent association between specific bird and tree species, and he described how specific seeds or fruits were spread by the birds and were used by natives for food and medicine.

Harris uses the same approach in Chapter 4, compiling information from Catesby's figure notes to describe the indigenous and enslaved peoples in the colonies. Catesby thought the indigenous people "remarkably healthy" compared to Europeans, but "not as able to endure hard labor." Maize was the only grain they cultivated, and Catesby describes the many indigenous medicinal uses of plants. I was particularly struck with the uses of *Ilex vomitoria*, which was included to "restore appetite, strengthen stomach, and provide agility and courage in war." Although according to Catesby it was "not at all tasty," it was not considered to be harmful. (As a Scout leader in Louisiana, we were counseled to avoid even burning the branches because some may be allergic to the smoke!) He hired Native Americans as guides, interpreters,

and porters to assist his inland collecting, and he recorded native names and uses for food, shelter, construction, and medicinal uses. An interesting note was that the bills of ivory-billed woodpeckers, now considered extinct, were used as currency between tribes. Catesby was opposed to the practice of slavery and recognized that the enslaved Africans working in the rice fields of Carolina actually introduced cultural practices from Africa that improved production. Maize was the most important food for the enslaved, followed by sweet potato, and both were also used by "common white people." Catesby also noted that like Native Americans, enslaved people also ate pawpaw fruits, but white people did not.

In Chapter 5, Harris focuses on Catesby's collecting and cultivation of seeds and living plants to send back to his sponsors in England. He focused on forest trees and shrubs that had horticultural potential for transplanting in England and Europe, making notes on growth, flowering time, and properties of woods. *Catalpa bignonioides* and *Magnolia grandiflora* are two of the species he is credited with introducing to England. He bundled plant samples into "botanical books" (plant presses) that could be sent to sponsors to embellish their curiosity cabinets. In cases where large parts could not be adequately flattened, he made accurate sketches (flowers, fruits, large leaves, etc.) on the specimen sheets. Many of these still exist in British herbaria, particularly in the Natural History Museum. He used a numbering system to keep track of specimens and included information such as their appearance in life, habitat, when and where collected, uses, and common names. Upon returning to England, most of his time was spent producing his "Natural History," but he continued correspondence and trade with American naturalists to foster the introduction of new horticultural materials to England. Notably he had a long-term relationship with John Bartram (Sundberg, 2020) to provide new seeds and plants in exchange for sponsorship for a copy of the completed volumes of the book.

For 35 years, from the time Catesby first left for Virginia until he completed the Appendix of the first edition, his primary focus was on producing life-like images of organisms from the New World. Ultimately this included 403 specimens on 220 plates including 180 plants, 118 birds, and a variety of other animals. These are primarily based on first-hand observation, sketches, and field notes of living organisms taken from nature. During this process Catesby "invented" biological illustration, especially with the plants, taking the liberty in many instances of showing various stages of development (bud, flower, fruit, seed) on the same specimen and usually with both sides of leaves being shown. He explains in the introduction that he is not an artist and that his illustrations appear flat, but he focused primarily on the correctness of details and coloring, so much so that 131 of his plants were cited by Linnaeus and given scientific names and 40 illustrations serve as type specimens for their species (McBurney, 2021)! The final plate of Volume 2 contains the Lily thorn, *Catesbaea spinosa*, a genus named by Linnaeus to honor Catesby.

For Catesby, the images had precedence over the written word; Harris does an excellent job of exemplifying this philosophy in his book. Even in the text chapters he includes close-up reproductions from appropriate plates to illustrate examples of what he is describing as well as citations of numerous other plates that

serve as examples. The text is an appetizer of a mere 70 pages; the main course consists of beautifully produced full-page reproductions of Catesby's 220 plates. This is one of those books that bridges C. P. Snow's *Two Cultures*. Biologists will appreciate Catesby's observant eye and attention to detail in the illustrations. They will also recognize his ecological thinking, innovations in collecting, and contributions to horticulture. Historians will appreciate his descriptions of colonial America and particularly of the complex interactions between Native Americans, colonists, and enslaved Africans. And, of course, this is an art book. The remarkable thing is that Catesby was self-trained in all these endeavors. My biggest concern is whether I should prominently display my copy in our living room or in our library? I recommend that you get a copy and take up the challenge of where best to place it in your home to consult and admire.

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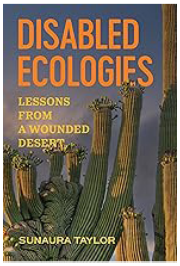
—Marshall D. Sundberg. Kansas University Affiliate and Roe R. Cross Distinguished Professor of Biology – Emeritus, Emporia State University.

Disabled Ecologies: Lessons from a Wounded Desert



Sunaura Taylor
2024. ISBN: 978-0-520-42469-2
US$22.95 (paper); 368 pp.
University of California Press,
Oakland, CA

The next time you fly into Tucson (e.g., the 2026 BSA conference), be aware that the international airport is situated on one of the first EPA Superfund Sites in the U.S. and that remediation is ongoing. A superficial description of the book is that it is a brief history of this particular segment of the Sonoran Desert, beginning with its formation 9000 BCE and extending to the present. The desert, and its underlying aquifer only 100 feet below, began forming at the end of the last glaciation, and by 300 BCE it was home to First Peoples. The Tohono O'odham's first contact with Spanish colonizers was in 1540, and the Mission San Xavier del Bac was established in 1692. The 1854 Gadsden Purchase brought the area into the United States and Western settlers to the land. In 1942 three huge aircraft hangars were built at the airport site and, for the first time, the portion of the Santa Cruz River running through the Tohono O'odham Reservation dried up as groundwater levels dropped: the first visible sign of disabled ecology in the area.

At the start of the Korean War, Hughes Aircraft (now Raytheon) built a manufacturing plant south of the airport and began dumping waste, including trichloroethylene (TCE), on site. TCE, first synthesized in 1864 and recognized as a toxic substance by World War I, was not classified as posing an "unreasonable risk of injury" by the EPA until 2023. Homeowners west of the three-hangars area, shortly after they were built, filed a lawsuit claiming contamination of their land and wells—the first of many suits.

To remediate the problem, Hughes excavated three large unlined pits in 1961 to trap and store runoff. Yet, in the early 1970s reservation cattle that drank from the river died, as did plants along the banks. Local residents noticed that plants died when watered and animals and people became ill from drinking tap water. The EPA, established in 1970, and the Safe Drinking Water Act of 1974 stimulated drilling of testing wells for TCE around the hangars and Hughes site, which confirmed high concentrations in the aquifer. Of course, TCE is not the only chemical contaminant affecting the land and aquifer. Chromium was detected in 1978, cadmium and lead in 1995, 1,4 dioxane in 2002 and PFAS (forever chemicals) in 2016.

These environmental degradations by themselves would be a topic for a book, especially for someone like me, trained in traditional biology and history from, as the author would say, an ableist perspective. But this is only one of the topics addressed by the author, and a minor one at that. In her nearly 30-page introduction, "Age of Disability," Taylor defines and connects several different ways of knowing and studying disabled ecologies, beginning from her perspective as a disabled person who was conceived and born in the study area.

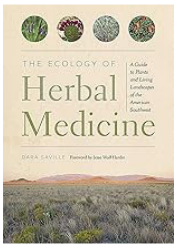
Both environmentalism and the environmental justice movement arose in the 1970s, and both grew out of the social justice movements (civil rights, women's rights) of the 1960s. But they grew in separate silos. Environmentalism focused on the physical environment and sought to minimize ecological damage to natural systems and remediate damages done. Environmental justice focused on the communities most negatively affected by the harmful effects of racial capitalism and colonization. That is, capitalist industries and infrastructure that tends to be constructed adjacent to poor, minority, immigrant, or native communities. Yet missing from both environmental and environmental justice perspectives are those immediately affected; individuals who often present physical disabilities and have individual needs. But individuals are not the focus of either perspective. In fact, establishment of the EPA specifically removed consideration of individuals, moving them to Health and Human Services. Disability Studies arose as a response of disabled persons to the ableist perception that all that they needed was some kind of physical accommodation for their particular disability. For environmental justice it was a matter of modifying community access; for disability studies it was a matter of minimizing personal injury to individuals and to their environment. The disability perspective recognizes the interconnectedness of the environment, both biotic and abiotic, society, and individuals—and that all become disabled when they are harmed. The author integrates all three movements into her telling of the area's history. She suggests that the solutions for disabled ecologies, at each level, begins with recognizing the current state of disability and its causes. This becomes the new normal, and further degradation can more easily be minimized. This is actually an optimistic approach and one that is surely needed today.

The book is intended for the general public. In the first footnote, Taylor explains that the main text "…is for those who use screen readers, those whose minds easily meander, and those who aren't trained in reading academic work…." The extensive and well-documented footnotes are like the aquifer, a web of relations and contexts that creates

deeper meaning for what is written above. For those who want it, this is a complex and thought-provoking read, to be read slowly and pondered over. There are several useful maps, although maps 2, 4, and 5 would have benefitted from expansion to a full page. Most of the images are photos of relevant news reports. There is a good timeline at the end, a thorough Bibliography, and a useful Index.

—Marshall D. Sundberg. Kansas University Affiliate and Roe R. Cross Distinguished Professor of Biology – Emeritus, Emporia State University.

The Ecology of Herbal Medicine: A Guide to Plants and Living Landscapes of the American Southwest



Dara Saville
2021. ISBN: 978-0-8263-6217-9
US$24.95 (Hardcover); 286 pp.
University of New Mexico Press, Albuquerque, U.S.

The American Southwest is more than just red rock mesas and shrublands with stretches of chaparral and sagebrush. To eyes more familiar with eastern deciduous or boreal forests, the landscape of the American Southwest may appear old, or ancient even. And it is. Saville's Ecology of Herbal Medicine: A Guide to Plants and Living Landscapes of the American Southwest is a sort of primer for understanding not only its changing ecology, but also the history of the use of its medicinal plants. In this way, Saville explains the landscape of the present-day American Southwest.

Structured in two parts and six chapters, *Ecology* begins with "Knowing the Land," where Saville describes the regions, defines ecological herbalism, and tells how we can form a sustainable relation to the land and the plants that grow in this biome. The "antiquity of the landscape" (p. 15), Saville says, has much to tell us about the historical and current effect of the human presence in the American Southwest—home to thousands of plant species living in its many deserts, shrublands, mountain ranges, grasslands, riparian corridors, and coastal areas.

In particular, plants such as the ocotillo, vital to migrating hummingbirds, tell the story of how human enterprises, such as urbanization, logging, water diversion, and grazing, affect current and historic land-use patterns. Saville notes that ecological herbalism explains how intensified water use and land conversion degraded the ecosystem of native southwest plants. By "ecological herbalism," she means the study of the ways in which plants have adapted to ecological disruption, interacted with each other and the environment, and survived in a changing landscape. Interdisciplinary in nature, ecological herbalism is an approach to practicing herbalism that promotes the preservation and protection of plants' habitats and ecosystems.

In the "Medicinal Landscapes of the Southwest" chapter, Saville uses three different plants to frame her extensive descriptions of three regions of the southwest. In geographical and ecological time, she explains how the ecosystems of the southwest's desert basin, western mountain range, and riparian floodplain that once sustained arid grasslands, bee balm, and yerba mansa have changed and adapted to the invasion of non-native species. These plants exemplify major changes in land patterns. *Ecology* also includes 161 figures of color photographs depicting before-and-after images of ecological and demographic

changes and plants in their habitats and various life cycles. Two color-coded maps, encompassing southern Wyoming, Utah, Colorado, Arizona, New Mexico, and down into northwestern Texas, describe the region's major habitat types. Albuquerque and major cities, rivers, mountain ranges, and plateaus show readers how far each biome stretches across those states.

The chapter "The Importance of Weeds, Commoners, and Wild-Spirited Gardens" shows how to work with and make good use of weeds and commoners, such as the ubiquitous dandelion (*Taraxacum officinale*) or yarrow (*Achillea millefolium*). Herbology and herbalism have now become more popular, but Saville also notes that this recent return and growing popularity of herbal medicine can also put stress on herbal wild populations. As such, she champions the importance of sustainable herbalism, which can ground and shape foraging practices so as not to degrade the fragile ecosystems where plants live. Growing our own herbs and creating an ecosystem in our own yards can alleviate the stress and distress that often follows in the wake of popular trends.

To that end, the two tables, "Medicinal Plants for Southwest Gardens" and "Solvency Rates for Dry Herb Tinctures," highlight what medicinal plants to grow in a southwest garden and the herb-to-solvent ratio for formulating one's own tinctures. Like the "Solvency" table, the "Materia Medica" section includes which part of the plant to use as well as detailed descriptions of 35 plants of this region, including four species of invasive trees. This section also includes traditional and medicinal uses of each plant. The creosote bush (*Larrea tridentata*), for example, has been studied for its anti-inflammatory and anti-oxidant properties. Of interest to scientists is the phenolic lignan nordihydroguaiaretic acid (NDGA), which has antitumor properties. In addition to the botanical and medicinal descriptions, Saville discusses how plant communities are changing to adapt and respond to ecological disruption and stress. The ecology of herbal medicine is a guide to preserving and living with the plants in a changing biome defined by the Rocky Mountains and the Colorado Plateau and the Chihuahuan, Sonoran, and Mojave Deserts.

Although Saville's focus is on the American Southwest, Ecology is a useful guide for all botanists and herbalists who wish to understand the way plant species in their own biomes survive and adapt to a changing ecological landscape. The strength of Saville's well-researched book is in its detailed description of regional, ecological, and geographical history. Another strength is that *Ecology* is above all a botanical, ecological, and herbal guide. As such, it takes its place among classic herbals, such as Mrs. M. Grieve's comprehensive, two-volume *A Modern Herbal, Juliette de Bairacli Levy's Common Herbs for Natural Health*, and Susun S. *Weed's Healing Wise.*

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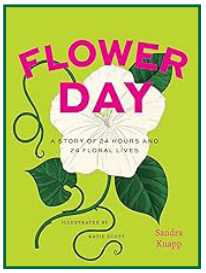
Flower Day: A Story of 24 Hours and 24 Floral Lives

Sandra Knapp
2025. ISBN 978-0-226-83452-8
US$18 (hardcover); 183 pp.
The University of Chicago Press



Flowers are perfect focal points for learning about botany, ecology, evolution, climate change, Indigenous knowledge, and more. "*Flower Day: A Story of 24 Hours and 24 Floral Lives,*" by Sandra Knapp, is the newest installment in the "Earth Day" series, with previous books on birds, frogs, mushrooms, and trees—each of which uses 24 species or examples across the globe to teach readers about the living world. In this small book (approximately 6.5 inches × 5 inches with large print font), Knapp uses her 24 chosen examples to teach the reader about all the above in a manner that is digestible to both plant experts and novices alike, with accompanying pen and ink illustrations by Katie Scott. Knapp is a senior research botanist at the London Natural History Museum, as well as a Fellow of the Royal Society, with special expertise in global plant taxonomy and the Solanaceae family, whereas Scott is a freelance illustrator who has worked on multiple other botanical books. Together, they use storytelling and artwork to highlight the incredible biology and diversity of flowers.

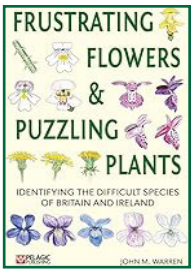
Knapp sets the stage in the preface with a quote from Georgia O'Keeffe before diving into a brief explanation about the reproductive parts of flowering plants. Her descriptions are presented in a way that does not require background expertise without losing any scientific accuracy, and they exemplify a holistic, liberal arts approach to plant biology with references to Greek mythology and framing botany through a lens of beauty and wonder. From there, she dives into the first of the 24 chapters: "Midnight, Moonflower, *Ipomoea alba* (The Americas)." Each chapter is titled with the hour of the day, the common name of a plant, its scientific name, and a location, with an illustration of said flower and approximately 5–6 pages of text describing the plant and its unique attributes.

The bulk of the book is focused on these 24 chapters, with brief themes that capture the reader's attention and span a huge variety of topics. Many of these include species interactions, with a focus on various biotic pollinators, but also seed dispersal agents, the phytochemistry involved, and the nuance found in many of these relationships (not all having only "good" or "bad" outcomes). Knapp also weaves stories of taxonomy and evolutionary relationships among plants, tales of hybridization, domestication of crops, and the impacts of climate change and other human-induced changes on these species. Importantly, she highlights Indigenous knowledge and uses of many of these plants, and the history of the plant and people before discovery by "science." Knapp's style is easy to follow and beautifully interweaves botanical terms with analogies, quotes, historical anecdotes, and (in my opinion) the perfect amount of etymology behind these plant names.

The book concludes with an inspiring epilogue warning the reader about the impacts of humans and encouraging them to look at flowers more closely. The back of the book also includes a "Further Reading" section with references to peer-reviewed literature articles for each chapter, followed by an index with plant names (common and scientific), people, and other themes to look up.

As someone who has been fascinated with plants since toddlerhood and who now teaches a college-level Plant Systematics course, I absolutely loved this book. I think it is a great introduction to the more scientific side of plants for those with a love of gardening or horticulture, and a great resource/reminder for academics who teach about plants (both for majors and non-majors). Knapp mentions how difficult it was to choose just 24 plants for this book, yet she covers a huge breadth and depth in a small amount of space without overwhelming the reader. I will certainly be gifting this book to family, friends, and graduating students, and referring back to it as I prepare to teach each semester!

—Nora Mitchell, Department of Biology, University of Wisconsin – Eau Claire, Eau Claire, Wisconsin, USA



Frustrating Flowers & Puzzling Plants: Identifying the Difficult Species of Britain and Ireland

John M. Warren
2024. ISBN: 9781784273316 (paperback), 9781784273323 (ebook) £37.99 (paperback, ebook); 36 pp.
Pelagic Publishing

John Warren, Professor of Botany at Aberystwyth University, Wales, with Jonathan Mitchley, and Henry Ford provide an identification guide to 23 groups of flowering plants from Great Britain and Ireland. These groups of plants are famous for their complicated taxonomy and frequently represent an insuperable challenge for the majority of botanists. Numerous books have been published to help plant identification in the British Isles, from guides based on photographs (e.g., Gibbons and Brough, 1992; Gibbons and Davies, 1994; Sterry, 2006) or line drawings (e.g., Coates, 2008; Rose, 2006) to more formal descriptive floras (Sell and Murrell, 1996–2018; Parnell and Curtis, 2011; Stace, 2021), as well as some keys based on flower characters (e.g., Hayward, 1995) or vegetative characters (Poland and Clement, 2020). However, to my knowledge, this is the first attempt to deal specifically with these "frustrating and puzzling" groups in a single book. The approach is highly original by placing these groups into four sections based on their reproductive modes or biological specificities (apomictic species, hybrids, inbreeders, polyploids) and into a fifth section named "Successful families with lots of species."

Each section reflects upon the biological origin of the identification problem and deals with one genus or a group of closely related genera, using the vernacular names or a short descriptive name (e.g., short white-flowered crucifers)—probably an attempt to avoid using taxonomic nomenclature at this stage. Then, the author tries to answer four questions: (1) Why is this group of plant complex? The answer brings further details about the causes of the complexity, usually to be found in their reproductive biology and evolutionary history; (2) How can I tell them apart? The key features to look at with or without a hand lens are here stated; (3) Have others recognized this level of variation? A small section about the history of when and who described the diversity of that group; (4) How far should I go? Here the reader will get some idea to which level of taxonomic resolution he can expect to achieve, as in several cases it will demand too much of an amateur botanist (e.g., to identify one the 400 microspecies of *Hieracium*), or virtually impossible without access to DNA analysis in the case of hybrids (e.g., *Viola*). This section also provides the next step to species or infra-specific levels referring to one of the Botanical Society of Britain and Ireland Handbooks (available for nearly half of the 23

groups) or the floristics treatments in Sell and Murrell (1996–2018) and/or Stace (2021).

The use of tabular keys (i.e., multi-access or multi-entry keys) is definitely one of the greatest achievements of this book. They are very clear and straightforward, and the use of pale green shading to indicate polymorphic characters within species helps a lot. The illustrations deserve a special mention for their quality and represent a perfect example of the superiority of line drawings over photographs, in the context of plant identification, by their sharp focus, eliminating extraneous traits, and showing just the essential (Hickman et al., 2017). Overall, this is a very refreshing approach to tackle the challenges of identifying these groups of plants not only for amateur botanists but also professional taxonomists that are not expert on these genera.

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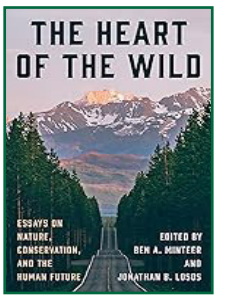
The Heart of the Wild: Essays on Nature, Conservation, and the Human Future



Ben A. Minteer and Jonathan B. Losos (eds)
2024. ISBN: 9780691228624
$26.95 ((hardback); 290 pp.
Princeton University Press

The *Heart of the Wild* is an ambitious collection of essays compiled by editors Ben Minteer and Jonathan Losos, who bring together a star-studded cast of biologists and nature writers to tackle two urgent questions: (1) "What do we need to observe, experience, and value in nature and the wild as it changes under human influence in order to square our role within it, now and in the future?" and (2) "How can we keep a love of nature and wild things alive in an increasingly human-defined age?" The resulting volume offers a set of nuanced and sometimes contrasting views of the current conservation landscape, reflecting rapid shifts in philosophies around conservation priorities—shifts that are predominantly driven by recognition of humanity's profound influence on the natural world.

The book is organized into three thematic sections: (1) "Conservation's Shifting Ground," (2) "Wilderness, Wildness, Wild: Legacies and Liabilities," and (3) "Knowing Nature in the Human Age." This ordering feels natural, taking readers on a journey that starts by establishing the current state of the natural world and corresponding conservation efforts, before launching into a philosophy-heavy second section confronting humans' relationship with nature and the colonial foundations of conservation ideals, before finally grounding readers with a third set of perspectives exploring the intricate links between humans and nature.

For me, the overarching theme of navigating conservation in a human-influenced world spurred plenty of self-reflection and conversation with colleagues about my evolving perspective on conservation and the value of concepts like "nature" and "wilderness." As a child in rural Arkansas, I benefitted from hands-on experiences with wildlife, but I often took these backyard experiences for granted in favor of dreams of the romanticized wilderness depicted by authors like Edward Abbey. Now, having lived in big northeastern-U.S. cities for the past decade, I am re-conceptualizing my nature ethic, especially regarding the role of humans as "a part of" vs. "apart from" nature (a recurring theme throughout this book). I am also working to appreciate natural beauty around me even in human-modified landscapes. Across the board, the authors of this book are grappling with these exact concepts, as they consider human impacts on, and relationships to, non-human nature. As Richard Shine asks, "How can we teach our children to love the wild, if the only wild places within reach are irretrievably broken?" In addressing this and other difficult questions, this volume presents the readers with perspectives that range from preservationist (e.g., Kathleen Dean Moore's "In Feral Land Is the Preservation of the World") to interventionist (e.g., Peter Raven's "How Did We Get Here?"). There's broad variation in style, with some essays presenting practical frameworks for contemporary conservation (e.g., Peter Raven) and with others (e.g., Gary Paul Nabhan's "When Natural History Brings Us to Our Senses") offering touching vignettes from the Anthropocene through the eyes of a naturalist. Finally, several philosophical essays grapple with conservation in its societal context (e.g., Christopher Schell's "Hope for the Wild in Afrofuturism"), pointing toward an equitable future and toward inclusion as a source of new inspiration.

At times, the contrast between perspectives is jarring. For example, to begin Part II, Kyle Whyte ("Why Does Anything Need to be Called Wild") argues that "wildness" (as a colonial construct) should "be discarded as a term or concept." The subsequent essay ("Affirming the Wilderness Ideal") is Eileen Crist's defense of wilderness preservation, with statements like: "it is deeply ironic that wilderness critics repudiate wilderness as a putatively Western ideal." This juxtaposition feels grating but is surely intentional by the editors to highlight the contested landscape. I came to appreciate these contrasts and found myself noticing bits and pieces of different perspectives coming up around me in daily life. The beautiful Introduction ("Wild Hearts and Minds") by Minteer and Losos and Afterword ("A Part or Apart: Ought Nature Lovers Ever Wear Fur?") by Harry Greene help to tie the distinct essays together, with Greene stating: "The authors of this volume, despite varied perspectives, care about individual organisms,

the fate of species, and wild places on a rapidly changing Earth. […] Our essays won't provide the last words on wildness and wilderness, but I hope they encourage others to engage ever more deeply in this vital conversation."

Each author naturally emphasizes their unique area of expertise, and the editors did a nice job of selecting authors whose writing could reflect a broad range of geographical and cultural contexts, generational perspectives, and professional backgrounds. Despite the variety, several contemporary themes consistently emerge from the essays making up *The Heart of the Wild*, including:

- Tension between concepts of wilderness and humans as an integral part of nature.
- Environmental change and shifting baselines in biodiversity.
- Respect for Indigenous cultures and critical examination of the colonial history of conservation.
- Complicated perspectives on invasive species and the wild/feral/domestic divide.
- Digital technology's expanding role in nature interaction and conservation.
- Viewing human–nature relationships through the lens of the COVID-19 pandemic (since these essays seem to mostly have been written in 2020 or 2021).

Notably, the absence of a plant-focused essay feels like a missed opportunity, as plants present unique conservation considerations. Plants are often overlooked (Schemske et al., 1994) in environmental writing—a bias that could easily merit its own essay, since animal-favoritism has been well characterized in the scientific literature and has resulted in comparatively little funding for plant conservation (Balding and Williams, 2016).

Given that *The Heart of the Wild* surveys current conservation themes and showcases a breadth of environmental writing styles, it would be an obvious choice for undergraduate courses hoping to sample modern perspectives on conservation. For me, reading this book feels in some ways akin to watching an episode of *Saturday Night Live*, in which a full episode spans a broad array of contemporary comedy, but within which only a small subset of sketches feel made for me. Similarly, not every essay in *The Heart of the Wild* resonates equally; my favorites are those that appeal to my imagination, like Emma Marris's exploring an urban wilderness in "There Goes a Badger," Gary Paul Nabhan's recounting his Sonoran Desert naturalist experiences in "When Natural History Brings Us to Our Senses," and Ben Minteer's meshing of the lives and works of artists Thomas Cole and Ansel Adams with environmental philosophy in "Introduction: Wild Hearts and Minds" (with Jonathan Losos) and "Picturing the Wild." But beyond picking favorites, I know an exposure to a range of perspectives is essential for crafting an environmental ethic, just as exploring a range of styles is necessary for a sketch comedian fine-tuning their persona. Ultimately, the diverse perspectives offered by the complete set of essays in this volume provide a timely and thought-provoking foundation for navigating the complexities of conservation in the 21st century.

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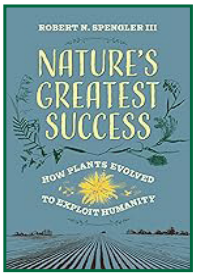
Nature's Greatest Success: How Plants Evolved to Exploit Humanity

Robert N. Spengler III
2025. ISBN: 9780520405837
US$29.95 (Hardcover); 501 pp.
University of California Press,
Oakland, CA



"All the stories you have been told about the origins of agriculture are fictious; it was not sudden and not invented by humans (p. 1).

Spengler, an anthropologist/archeobotanist by training, is reacting to the dogma promoted by his discipline that humans invented farming and purposely chose the plants and animals they would domesticate. He begins with a historical survey of the traditional hypotheses to explain the origin of agriculture, and the arguments, over time, against each. The main problem, he argues, is the almost universal assumption that domestication and cultivation are the same thing. Anthropologists, like most people, focused on the origins of cultivation—why, how, where and when. Spengler argues that domestication far preceded cultivation and that, as suggested by Darwin (1909), domestication is evolution. He goes on to suggest "...humans did not domesticate plants…but were seduced into becoming plants' labor force" (p. 3).

Spengler's focus is on domestication, and he makes a convincing argument that plant domestication arose as a special case of "island evolution" following Darwin's Theory of Natural Selection, with plants and animals coevolving since their origins, and with humans being only the most recent dominant animal in the coevolutionary process. Furthermore, for most of humans' existence, the process was unconscious, like other animals, until the rise of directed breeding and ultimately genetics over the past 300 years.

Spengler defines domestication in the second chapter and expands on Darwin's Plant Domestication Syndrome: (1) reduced seed dispersal (without humans); (2) reduced physical and chemical defenses; (3) reduction in vegetative growth; (4) reduction in seed dormancy; (5) enlarged seeds and fruits; (6) predictable synchronous germination; (7) loss of photoperiod sensitivity; and (8) bigger and more inflorescences. The striking similarities between evolutionary domestication syndrome and ecological island syndrome drives the arguments presented throughout the book

A whole series of exaptation traits evolved in plants before humans began taking over the role of plant disperser. Prolific production of small seeds with hard seed coats and seed dormancy had already evolved in response to heavy herbivory by ruminant grazers. An annual life cycle was promoted by high developmental plasticity, rapid growth, and seed dormancy. The shortened lifecycle reduced selection pressure for defensive compounds and structures. Traditional perennials, including woody plants, tended toward polyploidy and production of larger seeds and sugary/fleshy fruits. Most likely these fruits originally coevolved with birds as the primary dispersers, but the emergence of mammals, and eventually megafauna, drove selection for larger fruit size. "Monkey gardens" is the term used to describe hot spots of fleshy-fruited tropical trees in which most primates are associated with restructuring entire forests. Thus, plants were already domesticated when humans replaced earlier primate dispersers and in doing so, chose which plants would continue to coevolve

with humans to become today's agricultural crops, and which would revert to more weedy conditions—the so-called "forgotten crops."

To reinforce many of his points, and appeal to a more general audience, Spengler also includes discussions of a number of co-evolving animals beyond primates. In fact, Chapter 6 (Adaptability and Domestication) focuses primarily on the self-domestication of canids and cats, which provides a good introduction to Edgar Anderson's "dump heap hypothesis" for the origin of agriculture (1952). In a sense, weedy crop progenitors were auditioning for human selection in the waste and dump heaps of early human camps. Order of human selection differentiated future crops from weeds.

Spengler argues that agricultural fields function as islands of an archipelago, and he provides numerous examples through time and in different locations around the world. In both situations small populations undergo strong selection pressure, resulting in rapid evolution. The origin of seed saving turned each farmer's field into a genetic island with a new founding population every year. Even if the farmer saved the best seed every year, as one traditional story goes, the fact that most domesticated traits are coded by suites of genes and sexually propagated seeds do not breed true makes eugenic-style improvement approaches futile. With small population size in each garden, extreme variations frequently appear, such as dwarfism, gigantism, and melanism in animals. Even in a small overall area, landraces may have evolved even between neighboring plots.

There are separate chapters on developmental plasticity, domestication of cereal crops in the fertile crescent, small-seeded annuals, megafruits, and Island Biology Syndrome. Spengler presents a solid foundation of ecological and evolutionary theory as well as a good understanding of the history and biases of traditional anthropological interpretations, and he weaves these together into an interesting and scientifically well-supported story. Each chapter has well-documented endnotes and concludes with a useful one- or two-page summary. There is a thorough list of references as well as a useful index.

This is by far the most comprehensive treatment of the origins of domestication and cultivation of crop plants (and domesticated animals). It is thought provoking and well written, covering both theory and application. I could see it as the basis of a graduate seminar in several different science and social science disciplines—quite a feat.

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Plant Breeding Technology: Future Trends and Challenges

Zeba Khan (editor)
2025. ISBN: 9781800626614
$155.00 (hardcover); 256 pp.
CABI Books

The rapidly evolving field of plant breeding technology aims to ensure both food security and sustainability for a growing global population and to aid in our understanding of how to effectively mitigate the negative impact of climatic changes in the 21st century. In her thoughtfully written and well-organized book, *Plant Breeding Technology: Future Trends and Challenges*, scientist, plant genetics researcher, and editor Dr. Zeba Khan, gives readers an overview of the contemporary, innovative technology, and approaches used to improve upon the growth and development of vital agricultural crops that has taken place over the last five years. By providing a detailed examination of the current and potential trends of plant breeding technology, Khan has edited a text that offers readers both an engaging and timely understanding of important advancements in biotechnology and genetic engineering that could have both short- and long-term impacts on the agricultural sector and key decisions of global policymakers.

The book is organized into 10 chapters that represent a range of topics related to the most recent advancements in plant breeding technology. She has chosen a selection of research papers that further our understanding of next generation sequencing (NGS), marker assisted selection (MAS), genome-wide selection (GWS), marker assisted back crossing (MABC), and marker-assisted recurrent selection, as well as specific points related to plant phenomics, creating disease resistance crops with the use of precision gene editing, and the integration of artificial intelligence. Khan has adeptly curated the critical perspectives of a diverse set of scientists and experts in the fields of botany, genetics, bioengineering, agri-food biotechnology, plant breeding, horticultural biosciences, and fruit and vegetable development to present the argument that the efficient and ethical use of technology can improve upon the overall quality of the agricultural plants that are both needed and valued by the global community.

One of the many strengths of this book is the inclusion of case studies and the variety of examples that researchers have used to illustrate some of the most advanced applications of genomics in plant breeding technology innovations. Khan has chosen authors that have provided chapters that offer readers a detailed analysis of key technologies with the inclusion of their specific benefits and limitations. The authors' writing style and visual presentation of information, through colorful charts and diagrams, is easy to follow, making this a truly accessible text and resource for readers that range from upper-level undergraduate and graduate students to experts in the plant genetics and biotechnology fields.

Khan's book broadens the conversation about plant biotechnology and its relationship to artificial intelligence (AI). Since the use of AI is being integrated into a variety of scientific disciplines, its role in the development of plant biotechnology must be centered in discussions regarding future innovations in this field. This text includes a chapter ("The Artificial Intelligence (AI) and Data-Driven Plant Breeding," authored by Debnath et al.) that invites readers to explore how innovations in the field of AI could impact the future of plant biotechnology. In this chapter, readers

are introduced to the potential use of AI as it relates to boosting crop yields that have become vulnerable to abiotic stressors, as well as quickly aggregating and analyzing data related to a plant's phenotype, biochemistry, physiology, and genetic profile.

Although Khan attempts to include chapters from experts and researchers that offer a balanced, analytical perspective on the application of plant biotechnology and its potential impact of the future of agriculture, some of the research papers fall short in fully addressing key public arguments that have been recently presented against the proliferation of genetic modification of agricultural crops—arguments that have been advanced by those with a deep concern of the long-term environmental impact of plant biotechnology. Also, the language and explanations used in some of the chapters may require a basic understanding of genetics and biotechnology.

Overall, Khan's "*Plant Breeding Technology: Future Trends and Challenges*" is an affordable text that can be used as an important reference guide for understanding the application of emerging technological trends in plant breeding technology. For the most part, the language of this text is accessible, and the key concepts presented in the research papers can be used as topics for further discussion and exploration in both labs and classrooms. The innovations that have been highlighted in Khan's book can be applied to critical discussions related to climate resilience, increased crop yields, crop diversity, as well as methods that can be used and adapted into the burgeoning subfield of botany known as astro-botany or space agricultural technology.

I highly recommend this book to those who want to understand the many complex and interesting ways that plant biotechnology can provide a pathway toward more sustainable global agricultural practices. As a valuable information source for a variety of stakeholders invested in global food security, this text can serve as a dependable and quality source of information.

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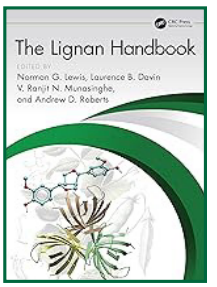
The Lignan Handbook



Norman G. Lewis, Laurence B. Davin, V. Ranjit N. Munasinghe, Andrew D. Roberts (eds.)
2022. ISBN 1032197005; 9781032197005
$320.00 (Hardback), $112.00 (Paperback, eBook); 1044 pp.
CRC Press, Boca Raton, FL; Routledge, London

Lignans are a category of plant phenols, primarily phenylpropanoid dimers, found widely in terrestrial plant species. Two thousand of these constituents are known, and researchers are identifying approximately 200 new examples annually. These compounds exhibit a broad spectrum of biological activities, including antibacterial, antifungal, anti-inflammatory, antioxidant, antitumor, antiviral, and neuroprotective effects. One celebrated example is the lignan podophyllotoxin found in the rhizomes of *Podophyllum peltatum L. (mayapple),* which was customized to produce currently approved anticancer agents, including a cytotoxic inhibitor of cell cycles in animals. It is the starting material for etoposide, an FDA-approved cancer drug used to treat testicular and small-cell lung cancer.

Described by the publisher as an "authoritative and comprehensive review of lignan chemistry, biochemistry, nomenclature, uses, and occurrence," this volume is the product

of decades of research by editors Lewis and Davin on various aspects of phenylpropanoid metabolism. One major contribution of this work is their systematic revision of lignan nomenclature, since at the outset, researchers named compounds informally. The publisher promotes the handbook's feature, a comprehensive lignan dictionary section, drawn from the prestigious Dictionary of Natural Products (Buckingham, 1994). Lewis currently holds positions of Regents Professor and Eisig-Tode Distinguished Professor, Institute of Biological Chemistry, Washington State University. He is regional editor of *Phytochemistry.*

Opening with a historical perspective about the pioneering advances leading to lignan and neolignan chemical structure discoveries, the authors argue that the International Union of Pure and Applied Chemistry (IUPAC) rule-derived systematic naming of lignans becomes essentially unworkable when considering larger size lignan/neolignan oligomers possessing different substructure types in their overall molecules. Next, they discuss the occurrence and diversity of potential "lignan building blocks" in nature. Core contents begin with the revelation that phenylpropanoid-derived natural products and their offshoots are ubiquitous in vascular plants. They have a propylbenzene skeleton, consisting of an intact aromatic (benzotriyne) ring. In terms of chemotaxonomic occurrence, the propylbenzene natural products have a broad, but not uniform, pattern of distribution throughout the plant kingdom, and more sporadically among bacteria, fungi, and animals. They are highly diverse structurally, in terms of aromatic ring substitution patterns, differing in hydroxylation, methoxylation, methylenedioxy group, and prenylation patterns, and in side-chain functionalization. Roadmaps to their biochemical pathways in various plant species include understanding the various proteins, enzymes, and genes involved in their species-specific lignan biosynthetic pathways. It is important to note that countless plant species remain under-investigated for their phytochemical constituents.

Overall, the *Handbook* is germane to natural product chemists whose expertise is in biochemistry of lignans. Inasmuch as lignans have a wide variety of applications, this book will be useful to those working with specialty chemicals, pharmaceuticals, flavors and fragrances, agriculture and forestry, evolution and ecology, renewable energy, and the pulp and paper industry. Each entry for a specific compound in the second part of the volume provides within the chapter, references to those topics, particularly their detailed chemical characterization and properties. Weighing 6.45 pounds, this *Handbook* is more suited to being set on a sturdy library table.

Lignans are of great interest to food scientists since they have various beneficial health effects. As a reader, I approached this hefty reference work to search for compounds found in species of interest. Beginning with sesame (*Sesamum indicum* L.), initially I sought to locate the publications and pathways to formation of their antioxidant constituents sesamin and sesamolin, found in the crop and its progenitor species, as well as several of its wild relatives (Bedigian et *al., 1985;* confirmed subsequently by other research groups). Although the authors' Foreword indicates that the contents are comprehensive, and admittedly new publications make those words moot once the pages leave the press, I observed omissions relevant to my interest. The discoveries as well as the structure of sesangolin from *Sesamum angolense* Welw. (Jones et al., 1962; Potterat et al., 1987, 1988; Kang et al., 1995), are absent. The text (p. 87) indicates a proposed bi-

osynthetic pathway to sesame lignans via an unknown glucosyltransferase, UGT; however, the authors omitted the identification of two new UGTs involved in sesaminol triglucoside biosynthesis (Harada et al., 2020; Ono et al., 2020). Ono and colleagues have now identified additional enzymes in sesame lignan biosynthesis (manuscript in prep.).

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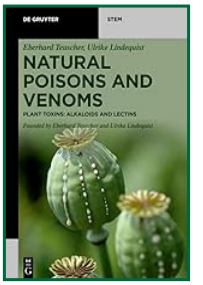
Natural Poisons and Venoms: Plant Toxins: Alkaloids and Lectins



Eberhard Teuscher and Ulrike Lindequist
2024. ISBN: 978-3111136219 (Paperback), 978-3111136213 (eBook)
$87.99; 462 pp.
De Gruyter, Berlin, Boston

Alkaloids are a diverse group of naturally occurring organic compounds found widely in the plant kingdom, mostly among seed-bearing plants, especially in Papaveraceae and Solanaceae. They are present in various plant parts, with concentrations differing by species, in leaves, fruits, seeds, bark, and roots. Significantly, alkaloids occur among foods and beverages in the human diet. We meet alkaloids chosen for their pharmacologically beneficial effects; others can be toxic. Chapter organization is by chemical formulation, illustrated with representative botanical case studies, action mechanisms, and indications of intoxication.

Its attractive green cover with a photo of an unripe capsule of the opium poppy (*Papaver somniferum* L.) oozing milky latex after scoring, invites readers to study its detailed list of contents. A brief general introduction to alkaloids discusses nomenclature, chemistry and classification, biogenesis, metabolism, transport, and storage in plants. The next chapter (Isoquinoline Alkaloids) sets the style format: details about the botany of poppy species, history of opium, harvest, toxicology, use as therapeutic agent, and abuse.

The authors state that the first evidence of opium use comes from the Sumerians; the Ebers Papyrus (1550 BCE) also mention opium. Although ethnobotanical artifacts are not a fo-

cus of this guide, its brief history of opium reminded me of a captivating object on display at New York's Metropolitan Museum of Art, modeled after a poppy capsule: a 13-cm long pin of pure gold, with spherical head and rosette cap, from the Hittites of Central Anatolia, dated to 14th–13th c. BCE. Its fluted globe holds loose objects meant to rattle like seeds when shaken. Opium use and cultivation were well-established in the broader Near East and Mediterranean during the Late Bronze Age (coinciding with the Hittite New Kingdom), with evidence of poppy harvest and trade routes linking Cyprus, Egypt, and the Levant. Given the interconnected nature of ancient civilizations, it's reasonable that this knowledge and the substance itself reached the Hittites through trade or cultural exchange.

Succeeding sections in this chapter discuss isoquinoline alkaloid occurrence in celandine, bloodroot, and barberry, among others. The next chapters discuss Tropolone Alkaloids of Autumn crocus (*Colchium* spp.*) and Gloriosa superba* L.*;* Indole Alkaloids of Calabar bean *(Physostigma venenosum* Balf.), African rue *(Peganum harmala* L.), LSD, *Vinca* spp., Madagascar periwinkle *(Catharanthus roseus* (L.) G. Don)*, Strychnos* spp.; Quinoline Alkaloids: *Cinchona* spp., rue *(Ruta graveolens* L.); Pyrrolizidine Alkaloids as toxins of Asteraceae, Boraginaceae, *Crotolaria* spp.; Tropane Alkaloids in Solanaceae, e.g., deadly nightshade *(Atropa belladonna* L.), jimson weed *(Datura stramonium* L.), angel's trumpet *Brugmansia* spp. and *Coca* spp. Pyridine Alkaloids as toxins of tobacco *(Nicotiana* spp.), covers 18 pages including pharmacodynamics and passive smoking; Piperidine Alkaloids of disparate Betel palm *(Areca catechu* L.), and *Equisetum* spp.; Quinolizidine Alkaloids of *Lupinus* spp.; Purine Alkaloids featuring caffeine, theophylline, theobromine, methylxanthines in seeds of *Coffea* spp. and leaves of *Camellia* spp., Mate Tea Bush *(Ilex paraguariensis* A. St.- Hil.), Guarana Bush *(Paullinia cupana* Kunth), seeds of cocoa tree *(Theobroma* spp.). Terpene Alkaloids are represented through sesquiterpene alkaloids and toxins of pond lilies *(Nuphar* spp. and *Nymphaea alba* L.), and Diterpene and Nor-Diterpene alkaloids of *Aconitum s*pp. Steroid alkaloids occur among Solanaceae, including Black Nightshade *(Solanum nigrum* L.), potato *(Solanum tuberosum* L.) and tomato *(Lycopersicon esculentum* Mill.); alkaloids of the latter, having germinating seeds within the tomato, sickened me for 4 days during the summer of 2023.

Given its length, obviously this compendium is not exhaustive. Since *Nigella sativa* L. was omitted from the series, I queried the authors. Ulrike Lindequist agreed: "Until now, *Nigella sativa* and thymoquinone are not mentioned in our books. We will follow the topic and possibly consider it in the future." An earlier book (Teuscher et al., 2006), provides five pages about *N. sativa* alkaloids, including molecular structures and photos. That work won the James A. Duke Excellence in Botanical Literature Award from the BSA in 2006.

Nigella sativa indazole and pyrazole alkaloids nigellicine and nigellidine and their isoquinoline alkaloids (e.g., nigellicimine and nigellicimine-N-oxide) offer diverse medicinal benefits, including potent anti-inflammatory, antioxidant, and immune-boosting effects, which help reduce the risk of chronic diseases (e.g., diabetes and heart disease). They also have anticancer properties by inhibiting tumor cell growth and promoting cell death. Furthermore, these alkaloids have shown therapeutic potential in treating neurodegenerative conditions, enhancing memory, and manifesting antimicrobial effects against various pathogens. Recent reviews (Dalli et al., 2021; Hannan et al.,

2021; Salehi et al., 2021; Al Dhaheri et al., 2022; Abbas et al., 2024; Arshad et al., 2025) summarize past studies and encourage more robust clinical trials.

Lectins are ribosome-inactivating proteins, especially found in Fabaceae. Castor bean, *Ricinus communis* L., poses strong dangers. Consuming foods with active lectins, particularly in raw legumes, can cause acute food poisoning with gastrointestinal distress. Risk is neutralized by cooking.

This manual is an essential resource for physicians, veterinarians, pharmacists, chemists, biochemists, and food chemists. A generous number of plant photographs and chemical structural formulas illustrate the book, and each chapter is self-contained with references.

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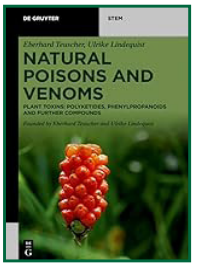
Natural Poisons and Venoms: Plant Toxins: Polyketides, Phenylpropanoids and Further Compounds



Eberhard Teuscher and Ulrike Lindequist
2024. ISBN: 978-3110728514 (Paperback), 9783110728538 (eBook)
$88.99; 412 pp.
Walter de Gruyter GMBH, Berlin/Boston

Now in their retirement, natural product chemists Eberhard Teuscher and Ulrike Lindequist have assembled a splendid five-volume reference work incorporating the vast literature about biogenic plant toxins, representing an enormous diversity of chemical structures and pharmacological actions. These include health hazards as well as their beneficial contributions, which can potentially provide valuable sources of medicines. The subjects covered include structural chemistry, mode of action, and toxicology, arranged according to chemical structure, with examples of representative species possessing each constituent.

Chapters are organized according to chemical classification: Aliphatic acids and their lactones; Polyenes and alkynes; Polyketides; Phenylpropane derivatives; Napththalene and anthracene derivatives; Amino acids; Amines;

Cyanogenic compounds; Glucosinolates; and Aliphatic nitro compounds. Each chapter is self-contained, ending with references cited for coherence. It ends with a summary bibliography of seven pages titled "Cross-chapter literature and further reading," and an Index of 17 pages where I found only one tiny typo, spelling "pecannut" instead of "pecan nut."

My specific interest in examining this title developed from a focus on urushiols and related compounds, all structurally based on the catechol molecule (a benzene ring with two hydroxyl groups attached at adjacent positions), that share a long, hydrophobic side chain. They are responsible for the allergic reactions caused by plants in the Anacardiaceae family, most notably poison ivy (*Toxicodendron radicans* (L.) Kuntze) found in eastern North America. Monroe (2020) provides a detailed review of symptoms and treatments with case study. Anacardiaceae includes several other species that are both edible and can cause severe skin irritation.

Teuscher and Lindequist describes urushiols as "lipophilic haptens that accumulate preferentially in cell membranes. They are oxidized in vivo to electrophilic o-quinones. These are susceptible to nucleophilic attacks at the catechol ring in positions 4, 5, and 6 by proteins of the skin to form a complete antigen. In sensitized individuals, these antigens trigger extremely violent T-cell-mediated defense reactions that result in allergic or systemic contact dermatitis (ACD, SCD). Urushiol-induced skin inflammation is dominated by CD1a-dependent TH17 cells that secrete IL-17. The interruption of mitochondrial electron transport chain contributes to the allergy introduced by urushiols. [….] Cross-reactivity may occur between the individual representatives of alkylphenols" (p. 73).

A description of the severe allergic reaction is highlighted with a blue background: "Shortly after skin contact with material containing urushiols, sensitized people react with allergic inflammation of the skin and mucous membranes. Skin redness, swelling, rashes, fever, pain, and unbearable itching occur. Although there was only external contact, acute urethritis was observed…. Skin inflammation and pruritus usually lasts for weeks. The intense pruritus often forces scratching behavior that injures the skin, exacerbates inflammation, and may lead to infections. […] Patients are usually treated with glucocorticoids and antihistamines. However, antihistamines are mostly ineffective for treating itch…..Eating of urushiol containing food…should be avoided" (p. 75). Argo et al. (2023) defined this response as "an underappreciated disease seen in the emergency department."

For most people, mango (*Mangifera indica* L.) has no such effect, but in sensitive individuals, contact with or ingestion of mango peel can cause a poison ivy-like rash (Catalano, 1984; Knödler et al., 2009; Schieber and Carle, 2009; Kienzle et al., 2013; Alipour Tehrany and Coulombe, 2021; Berghea et al., 2021; Raison-Peyron et al. 2021; O'Hern et al., 2022; Edpuganti et al., 2025). Tucker and Swan (1998) discussed the case of a 27-year-old man who had a pruritic and eczematous rash for three days. One week earlier, he had peeled a mango, become distracted by a telephone call, and rested his left hand on his right leg. Three days later, contact dermatitis became apparent. When much younger, the patient had been sensitized to poison oak and poison ivy. The sap of the mango rind contains oleoresins that cross-react with the oleoresins of poison ivy. Mangoes possess a class of phenolic lipids called alkylresorcinols. Teuscher and Lindequst state: "The peels of

mango fruits contain alkylphenols" (p. 77). Similar outcomes can occur by ingestion of cashews (*Anacardium occidentale* L.) or pistachio nuts (*Pistacia vera* L.) (Fernandez et al., 1995; Garcia et al. 2000; Fong et al., 2019; Rozas-Muñoz et al. 2022; Tawde, 2004). Sheehan (2020) described a case of systemic allergic contact dermatitis reported from inhalation of cashew oil smoke after at-home roasting of raw cashew nuts.

Since it seems likely that readers of Plant Science Bulletin may encounter poison ivy, here are some cautionary details regarding the potential for cross-reactivity between poison ivy and other plants in Anacardiaceae. Exposure to poison ivy can trigger a cross-reaction upon exposure to other edible species in Anacardiaceae, e.g., mango (Oka et al., 2004; Weinstein et al., 2004; An et al., 2020; Watchmaker et al., 2021; Zhao et al., 2024). Teuscher and Lindequist state: "Cases of contact dermatitis after ingestion of mango fruits are reported [….] Cross-sensitization between different alkylphenol containing plants is possible [….] An otherwise healthy man presented a delayed but significant reaction to mango fruit, incited by mango handling after remote exposure to poison ivy 2 years before. Secondary to pruritus, he developed insomnia" (p. 78). The exhaustive review by Schulze-Kaysers et al. (2015) cites Glassman (2006), who indicated that members of the Anacardiaceae family cause more allergic contact dermatitis than all other plants combined.

Cross-reactivity is a phenomenon wherein the immune system reacts to multiple antigens that share similar structural features. When an individual is allergic to one substance, their immune system may also react to other substances with similar proteins. Kim and Christiansen (2015) reported that a patient evaluated for a rash after eating unpeeled mangoes recalled that he had developed a pruritic papulovesicular rash on the lower extremities after contact with poison oak 7 years earlier. Yoo and Carius (2019) reported an example of a severe emergency from prior urushiol exposure by hypersensitization to mango fruits for a 41-year-old man with suspected mango dermatitis, incited by mango handling after remote exposure to poison ivy.

Through an unfortunate request by a neighbor who brought a plant growing in her yard for identification enclosed in an opaque bag, I learned that when a sensitive person is exposed to poison ivy, consumption of mango or pistachio nuts can amplify the impact from urushiol from exposure to poison ivy. Upon untying the bag, I identified poison ivy stems immediately, which I discarded; I then washed my hands and arms thoroughly. Nevertheless, I developed a severe rash, with 1-inch diameter blisters. These blisters continue to form, even 11 months after initial exposure.

Since symptoms persisted, despite having eliminated these foods in Anacardiaceae from my diet, I searched for another source in my environment. Careful reading of the labels of several soothing lotions and Vitamin E creme, led to the fact that the oil-rich seeds of mango prevail in commerce, esteemed as a value-added by-product for use in face creams and body lotions. Mango seed butter is also widely used by the confectionery industry, particularly in the production of chocolates (Jahurul et al., 2015; Kaur et al., 2022) and bakery items. The seed residue remaining after manufacturing mango nectar from its pulp contains high concentrations (nearly 22%, according to Bastawesy et al., 2007) of fatty acids that manufacturers have repurposed

to generate additional income. Awolu and Manohar (2019) found the quantity of lipids, primarily oleic and stearic acids varied, affected by solvent type and extraction time. Kaur et al. (2022) discovered that the texture and organoleptic properties of mango butter compared favorably with cocoa butter at 80:20 ratio, seen as an advantage when cacao kernels are scarce.

It is significant that mango kernels contain resorcinol (95.846 mg/100 gm), a constituent structurally related to urushiol that causes an allergic response (El-Bastawesy et al., 2007). Gallic acid is also present, used as a preservative for lotions, but its derivatives can also cause allergic contact dermatitis. These findings should serve as a warning to the food and personal care industry, since what may seem on the surface to be beneficial adaptive reuse of a waste product, has allergenic compounds (e.g., urushiol with the capacity to harm human health) (Lenucci et al., 2022; Gharibi et al., 2023).

Separately, Teuscher and Lindequist describe several lignans (pp. 171-178), compounds that have intrigued me over decades for their antioxidant and anti-inflammatory properties (Bedigian, 2015). Among phenylpropanoid derivatives with toxic effects, they cite Larrea tridentata (Sessé & Moc., DC) and *Podophyllum peltatum* L. A review by Cui et al. (2020) describes lignans as having "large structural diversity and pharmacological activities including antivirals" (p. 12).

As I searched the literature to better understand the medical condition that I have experienced, this volume has impressed me with the details it provides so compactly. Extensive reading also reveals that while these species have toxic effects, they also possess admirable health benefits that can be exploited as pharmaceuticals. The book has a comfortable heft, with its 17 x 24.5 cm size, and it is compelling to read and generously illustrated with 181 color photographs and 77 figures of chemical structures. It should appeal to a broad audience of chemists, pharmacists, biologists and medical professionals, and professors and students in these fields. Perhaps of special interest to recreational readers, 13 pages discuss cannabinoids.

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Radical by Nature: The Revolutionary Life of Alfred Russel Wallace

James T. Costa
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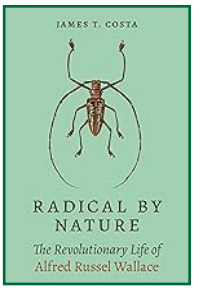
US$22.95 (Paper); 515 pp.
Princeton University Press, Princeton and Oxford.



James Costa, who among other things published annotated facsimiles of both *Darwin's Origin of Species* and Wallace's *Field Notes*, is perhaps the best scientist to tackle a biography of Alfred Russel Wallace. He notes in the Preface that while many today are aware of Wallace and his connection to Darwin, many aspects of Wallace's life are "not well enough known to be sure" (p. xi). As homage to Wallace's lifelong interest in boundaries in space and time, Costa notes on the first page that "Wallace was born atop the Llanbadoc fault…" (p. 1). This is a fitting way to begin Wallace's story, because he, like Darwin, was strongly influenced by Charles Lyell's uniformitarian view of geology. In fact, as suggested throughout the book, Lyell's impact on Wallace, and later Wallace's on Lyell, was much greater than is usually acknowledged.

Wallace's early training as a surveyor made him acutely aware of landscape and patterns and his reading of Lyell's (1835) *Principles of Geology*, while a young surveyor, provided the physical and historical mechanisms explaining the geographical and biological boundaries Wallace observed. As noted above, boundaries are one of the themes Costa develops throughout the book, beginning with the geology of Wales and southern England responsible for the striking landscapes recalled by Wallace from his youth. This approach continues through each of the geographical and biogeographical boundaries Wallace observes during his years of collecting. The first striking example from the Amazon was two closely related rare butterflies, one on either side of the river, between Monte Alegre and Santarém during his first year in the tropics. He found this pattern repeatedly, for a variety of species while collecting during the next three years along both sides of the Amazon and Rio Negro Rivers. He also made meticulous anthropological notes on indigenous peoples and noted that different tribes also tended to conform to recognizable geographical boundaries. Most everyone knows about his disastrous return to England with the sinking of his ship and loss of specimens. Most do not know that this included a 50-foot leaf of Royal Palm (now *Roystonea regia*). Indeed, Wallace was also collecting plants. He developed his love of botany early; Lindley's *Elements of Botany* was one of his earliest book purchases as a teen and *Palm Trees of the Amazon and their Uses* was his first published book.

Wallace's surveyor training proved invaluable not only for the detailed comments and maps in his field notes, but his map of the Amazon and Rio Negro, published shortly

after his return to England, both solidified his reputation as a geographer and led to funding from the Royal Geographical Society to support the next stage of his collecting in the Malay Archipelago. The first indication of his namesake boundary was the result of a fortuitous accident of missing a ship, a direct connection between Singapore and Makassar, and having to do a two-stopover connection between Bali and Lombock first. He had just spent months collecting in Malaysa, Borneo, and Sarawak and found their birds redundant and "uninteresting," which led him to conclude that they must all have been connected in the recent geological past. As expected, there were few new birds in Bali but even those were mostly related to his previous collections. Fifteen miles away, on Lombock, it was entirely different—many fewer species but they were all different and obviously related to those of Australia. Once again boundaries become important to Costa's story-telling. Wallace describes evidence of uplift and subsidence on individual islands, such as successive fossil coral terraces on some and meanders of sunken rivers between smaller islands. To embellish and explain Wallace's geographical and geological descriptions, Costa adds our current understanding of the complex plate tectonics of the region. It becomes clear why Wallace found the Islands of Sulawesi and Halmahera so biodiverse, and so strangely contorted in shape. It is the meeting place of three tectonic plates exposing five tectonic provinces—boundaries in space and time. As in the Amazon, Wallace made extensive notes on the indigenous peoples and how different groups were spatially arranged. He also noted the irony that while native people seemed to take their wildlife for granted while in a balance relationship in nature, the arrival of civilized Europeans, who valued the aesthetic beauty of the wildlife, invariably led to their extinction. "This consideration must surely tell us that all living things were not made for man" (p. 201).

Another tool Costa uses to add interest to his story is to update for the reader the current appearance of particular places mentioned by Wallace. One of the more interesting is that the location of the house used by Wallace when he posted his famous letter to Darwin was recently identified and the city plans to rebuild the house as a museum (p. 221, 454). So, what of that letter containing his species paper? Another major theme throughout the book is that Charles Lyell was both an "inspiration and foil" for Wallace in his effort to make a case for transmutation. (See also Costa, 2013.) Wallace read "Vestiges…" (Chambers, 1844) and became a transmutationalist before leaving for the Amazon, with one of his goals being to find evidence to support this view. Lyell, while building a solid geological case for uniformitarianism in geology, was definitively opposed to transmutation of species and argued so in his *Principles. By Ternate*, Wallace realized he had evidence to counter every argument made by Lyell, and in fact Costa notes that "practically every paragraph contains direct or indirect references to *Principles*…" (p. 225). Wallace had corresponded with Darwin previously and knew he was also working on transmutation—and was a friend of Lyell. Who better to have pass his paper on to Lyell to solicit Lyell's response and reaction?

The response to Darwin's dilemma, resulting in shared (but unequal) priority, is well known, and in recounting this story and its aftermath, Costa is clear that Wallace had no qualms with crediting Darwin. While Huxley may have been "Darwin's bulldog" after publication of "*Origin of Species*," Wallace was "more Darwinian than Darwin" (p. 306) in defending the work with data from a string of significant papers. That, according to Costa, may have been part of the problem. In two 1864 papers, "On the Variety of Man…" and "Origin of Human Races…," Wallace explicitly used natural selection to explain human evolution. Seven years later Darwin finally addressed

human evolution, but he posited sexual selection as a necessary mechanism beyond natural selection—the first serious split in their thinking. Ironically, in the autumn of 1864, Wallace was engaged to be married but the engagement was broken off days before the wedding. Wallace became distraught and incapable of working. It was then that Wallace developed a new interest in spiritualism. Two years later he did marry and found his way back into researching and publishing, but now with an additional focus on spiritualism, the mind, and developing a means of scientifically investigating them at a "preternatural" level parallel to the natural world. This of course was rejected by his scientific peers, but Costa makes a good case that Wallace was just being Wallace: challenging convention and proposing alternative hypotheses whenever supporting data was lacking, while focusing on humanity, social justice, and considering alternative points of view. These heretical aspects to Wallace's science were the major focus of Shermer's (2002) psychological history of Wallace, but Costa weaves this into his story in an easier-to-understand way.

As co-discoverer of natural selection, Wallace's place in the history of biology would be secure, even without including any of his other landmark breakthroughs: biogeography, biological species concept, mimicry and protective coloration, sexual selection, allopatry, reinforcement, and Wallace Effect. And then there are contributions to anthropology, geology, physical geography, climatology, archaeology, taxonomy, systematics—and don't forget botany! From his return to England from Malaysia until his death, Wallace owned nine different homes, and predictably Costa describes the settings of each because they were all associated with physical and biological boundaries. They also provided diverse habitats for cultivating Wallace's personal living collections. "Corfe View," his penultimate property, contained more than 1000 species in outdoor plantings, houseplants, and four orchid houses (out-Darwining Darwin—again).

Radical by Nature came out in hardcover in 2023, the bicentennial of Wallace's birth, and was a *Choice* Academic Title of the Year and won the PROSE Award in the History of Science, Medicine, and Technology. Reading it feels like a personal introduction to Wallace himself. The author provides three plates of maps identifying locations and features described in the text: a full-page split between South Wales, Central and Southern England and Greater London; a two-page plate for the Amazon with a series of three successive insets; and a two-page plate for Malaysia with insets for Sarawak and Halmahera. There are black-and-white illustrations throughout the text with a 16-page center-text insert of color plates. There are extensive endnotes to each chapter and a detailed index. If you teach evolution or are interested in the history of evolutionary biology, you will want this on your bookshelf for easy access.

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Science with Impact: How to Engage People, Change Practice, and Influence Policy

Anne Helen Toomey
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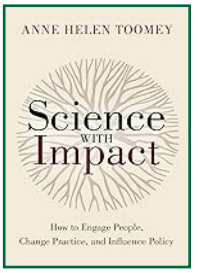


I liked *Science with Impact: How to Engage People, Change Practice, and Influence Policy* so much that I read it twice, gleaning even more important lessons the second time through. In flowing prose and without technical jargon, Anne Helen Toomey makes a compelling argument for why there remains a significant communication gap between scientists in a wide variety of fields and the public, especially people in the area where they are conducting their research. According to Toomey, this situation is especially concerning when scientific breakthroughs and practical solutions are not shared with the communities where it can make the most difference, not only in the locality of the research, but also with policy- and decision-makers, donors, non-government organizations, legislators, and advocacy groups. This naivety is explored more deeply in Chapter 10 on the lack of understanding of how laws and policies are changed; this process involves many levels of people and priorities, not necessarily in the control of elected officials.

One of the main issues that Toomey addresses is the 20th-century way that scientists have approached communication, which is more of the "telling" model than the listening model. In a variety of examples, she highlights that, despite good intentions, many efforts to share research results and recommendations might even backfire and lead to even more resistance. In addition, many communities (especially in rural communities and a variety of developing counties) have become exhausted by what she calls "parachute" science, with researchers dropping in, doing their projects, and then leaving without even sharing basic findings with community leaders. Instead, she advocates an approach where scientists listen first, immerse themselves in a locality or population group, and establish trust and rapport that allows mutual support and long-term sustainability for change. Toomey also discusses the role of an individual's peer group as having a powerful influence on that person's belief system, using childhood vaccination as but one example.

Another opportunity for how scientific methods can be enhanced in the 21st century is through the concept of "citizen science." Although the application of extensive analysis techniques is likely beyond the ability of ordinary people, Toomey reports many successful projects involving the public in data collection. This not only increases the amount of data available to researchers, but also engages citizens who can then be influencers and advocates within their communities. As an observer with Nature's Notebook, Chapter 6 was especially appealing to me.

Having served on my campus Institutional Review Board (IRB) for many years, as well as its IACUC (Animal Care and Use Committee), I was especially interested in Chapter 5. As Toomey notes, engaging in human subject research goes beyond just "not doing harm," but on truly giving a choice to communities and people who might like to participate. As a lawyer, I was often the primary reviewer of any studies that involved persons who were incarcerated to prevent any unintended consequences to those who chose to—or not to—be part of a study. Toomey advocates for a more robust process of informed consent

where evidence of this process to granting agencies goes beyond checking a box.

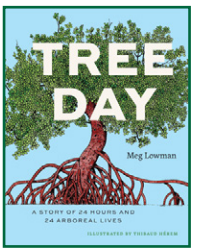
In Chapter 9, Toomey discusses one of the other issues with communication between scientists and the public, which is that research is an evolving process. What the average citizen may not realize is that theories and results do change over time, with additional study and with increasingly better technologies. This situation may be confusing and maddening for the public, but Toomey notes that it is important to be honest about the lack of absolutes in science and that admitting not knowing is better than speculation or opinions based on faulty assumptions or incomplete data.

In summary, I highly recommend *Science with Impact: How to Engage People, Change Practice, and Influence Policy.* Keep a copy in your office and make it required reading on your syllabi.

–Sara Anne Hook, Professor Emerita, Indiana University, and Affiliate Friesner Herbarium, Butler University, Indianapolis, Indiana shook@butler.edu

Tree Day: A Story of 24 Hours and 24 Arboreal Lives

Margaret (Meg) Lowman
2025. ISBN-13: 978-0-226-83396-5
US$18.00 (cloth); 225 pp.
University of Chicago Press, Chicago



The author, sometimes known as "CanopyMeg," has spent her career studying the ecology of "Life in the Treetops," the title of her first book in 1999. In that book, she suggested that Figs are "perhaps my favorite trees in the rain forest…"(p. 206). More than 25 years later, the first chapter (Midnight) of her new book focuses on Figs, *Ficus* spp. This small book of 24 chapters, one for each hour of the day, provides a brief introduction to 24 of the author's favorite tree species, including what you might observe in, on, or around that tree at that hour. Though focused primarily on the tropics, it includes examples of temperate and boreal species that will be familiar to many readers.

As might be expected, each chapter focuses on canopy ecology and the various organisms making up the canopy food web. For figs there are the obvious pollinators, fruit eaters and dispersers, predators that feed on the herbivores, and multitudes of beetles and other insects roosting in the canopy. There are also the decaying fruits and leaves that fall to the forest floor interacting in the terrestrial food web. The author also provides interesting anecdotes about the species. For instance, the English tropical botanist E. J. H. Corner trained four "botanical monkeys" to fetch figs from the canopies of forest trees, enabling him to collect fruit and identify about 350 fig species in the Malay rainforest. Alexander the Great claimed to have sheltered 10,000 of his troops from torrential rain under a single banyan. An interesting fact I learned is that banyans are classified as strangler figs.

Ginkgo is the star of the 7 p.m. slot because, according to Lowman, this is when the ripening female fruits on the ground are most smelly as the air cools at sunset and temperature inversion traps the scent nearer the ground. Most of us are aware that this living fossil probably owes its existence to being planted around temples in its native China. Another odoriferous tree, Red Stinkwood (*Prunus africana*), is a red-listed endangered species having contemporary dependence on another religious community. Ethiopian Orthodox Coptic priests tend forests around their churches and more than 70 have stone conservation walls around them to protect

the trees from sheep, cattle, and poachers. For the past 20 years, Lowman has assisted fundraising efforts of the Orthodox Church in Ethiopia to construct and maintain these walls around rare forest remnants.

Like the Fig, mentioned above, several of the other highlighted trees are keystone species in their environment, including Vedippala (*Cullenia exarillata*) which supports about 40% of India's epiphytic species, including the black orchid. Technically the Dragon's Blood Tree (*Dracaena cinnabari*) is classified as an umbrella species, one of 37 endemics of the Socotra Archipelago off the coast of Yemen. The overall shape of this 30-foot tree is umbrella-like, but the term refers in general to keystone-like species that impact smaller ecosystems—in this case including 12 endemic reptiles and 32 of the other 36 endemic plants on the islands.

Also like the Fig, with a dedicated canopy walkway in Samoa, several other species are associated with canopy walkways, including three of the tropical canopy emergent—Great Kapok (*Ceiba pentandra*), Red Meranti (*Shorea curtisii*), and Tornillo (*Cedrelinga cateniformis*)—which supports the highest research tower along the walkway of the Amazon Conservatory for Tropical Studies in Peru. Other trees associated with canopy walkways are Coastal Redwood (*Sequoia sempervirens*) and African Baobab (*Adansonia digitata*). In 2020, Lowman founded Mission Green, a project to bring attention to forest "hot spots" and build canopy walkways that are donated to the local communities to provide sustainable employment through ecotourism and to discourage logging in the area. The walkways listed above are the first half of ten proposed canopy projects.

This small format book (12.5 x 16 cm), with large type and short chapters, is a comfortable and informative read. Thibaud Hérem's beautiful pen-and-ink tree portraits, at the beginning of each chapter, are constrained by the small page size; they deserve to be art prints. The text concludes with a listing of 11 suggestions for further reading followed by a section of a few (usually 3–6) appropriate references for each chapter and a detailed index. It is an engaging book targeting school students and the general public and is meant to introduce them to the beauty and complexity of tree communities. Donate a copy to your favorite library.

REFERENCES

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