



PLANT SCIENCE BULLETIN

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A PUBLICATION OF THE BOTANICAL SOCIETY OF AMERICA



See the BSA Award Winners!



Also In this issue...

Using General Interest Science Books to Arouse Student Interest and to Substitute for an Introductory Textbook
by Marsh Sundberg... p. 152



FROM the EDITOR



Greetings,

You may have noticed that we are publishing our summer issue a bit later than usual this year. This is so we can include news and reports from Botany 2024, which was held in June due to the occurrence of the XX International Botanical Congress. There will be even more post-conference content in our Fall issue! This issue also includes a look inside the role of the BSA president, written by Past President Brenda Molano-Flores and an update from the Public Policy Committee. In our peer-reviewed article section, look for an article by Marsh Sundberg with advice for using general interest science books in teaching.

Sincerely,

A handwritten signature in black ink that reads "Mackenzie". The signature is written in a cursive, flowing style.



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Start Planning for



www.botanyconference.org



SOCIETY NEWS

A Retrospect: A Year (or Three) in the Life of a BSA President

I cannot believe that a year has already passed since the Botany 2023 meeting in Boise, ID where I became your President. In actuality, though, my presidential commitment did not begin at Botany 2023, but rather a year earlier at Botany 2022 in Anchorage, AK when I became President-Elect. And while my term as President ended at Botany 2024 in Grand Rapids, MI, you will not be rid of me yet, as I will become Past-President until Botany 2025 in Tucson, AZ! Although President for just a year, my service to BSA is a three-year commitment.

In this retrospective, I would like to share my journey and what I have learned as your BSA President and President-Elect. During my time as President-Elect, I was like a fly on the wall listening to everything that President (Vivian Negrón-Ortiz), Past-President (Michael Donoghue), and BSA Executive Director (Heather Cacanindin) said during our Board meetings and special sessions. This

was my time to get up to speed and learn the ins and outs of what would be expected of me as President. As the President Elect, I was also the Chair of the best committee ever (-:, get this—the Committee on Committees!!! This position allowed me to learn more about each of the BSA committees and work with an excellent group of people to make sure that all of our BSA committees had the expertise and representation needed for them to be successful. In addition, I was an *ad-hoc* member of two other committees: Distinguished Fellow and Emerging Leader Award Committee and Charles Edwin Bessey Teaching Award Committee.

One more thing—although not a main role of the President-Elect—I became one of two BSA steering committee members of the NSF Root and Shoot group (<https://rootandshoot.org/>). The ROOT & SHOOT program is a collaborative effort among seven scientific societies (including BSA) to address issues associated with DEI within and among the participating societies. Being a part of this group gave me the opportunity to learn new ways to make our society and meetings more inclusive and safer. Lastly, I was a member of the ROOT & SHOOT Capstone Project Team - BSA Election Processes, Outcomes, and Recommendations for Reform with Catrina Adams, Min Ya, and Imeña Valdes.



By Brenda Molano-Flores

BSA Past President

E-mail: molano1@illinois.edu

For a summary of the project, go to: <https://rootandshoot.org/bsa-capstone-bsa-election-processes-outcomes-and-recommendations-for-reform/>.

At Botany 2023, I officially became your President (2023-2024). Well, I can tell you that my presidential speech was the most stressful part of this entire presidency! Thinking about what to talk about and how to keep an audience engaged after they had already experienced three days of amazing talks, posters, and dedicated events was nerve-wracking! I figured the last thing anyone would want to see after so many days of presentations would be more data, charts, and graphs, so I went a different route. I decided to talk about the joy I find in botany and to ask the audience where they find plant joy. At the end of my presentation, I posed the question, “Where do you find plant joy?” and I was so thrilled to see how many of you took a turn to share your plant joy as we passed the mic around! I was also amazed to see that my talk sparked a #plantjoy campaign and that so many of you posted your stories and photos of where

you find plant joy across our social media platforms. That truly brings me #plantjoy!

After my presidential talk was over, my absolute favorite part of any Botany Conference began: the celebration, and by that, I mean the dancing! After a last-minute cancellation, a new band had to be found for the celebration. A local band, Jimmy River and the Groovers, was found (thanks to Ingrid Jordon-Thaden), and boy did we groove! As Jimmy later said on his Facebook post, “These people danced, sang, made conga lines, did the limbo, etc. I could go on. Wow! I am here to tell you that botanists are party people!” I will admit that the best part of that night was the joy of dancing with so many of you and celebrating that night together. And jumping around with those glo-sticks! Where did those come from? What fun!

After the pomp and circumstance of my inauguration ball was over, I put on my presidential hat and got to work. Every two weeks I have looked forward to my Friday meetings with Heather. During these meetings we talk about the progress of BSA Strategic Plan initiatives, concerns of our members, awards, BSA partnerships with other societies, and past Botany Conferences and those to come. Other duties of my presidency included leading the BSA Board meetings, conducting the annual evaluation of our Executive Director with assistance from other board members, and approving her monthly timesheets.

On several occasions during my term, I was able to assist with conflict resolution and to provide a space for open discussion and communication. Also, I was able to interact with the leadership and members of other scientific societies as part of ROOT & SHOOT.



These interactions reinforce that BSA as an organization continues to seek pathways to address all aspects of DEI, and to navigate the geopolitical and socioeconomic landscape of a changing world—and that we need to do more to make sure that we show that we value every member of BSA. Lastly, and when possible, I provided feedback for our amazing and informative BSA newsletter (many thanks to Membership & Communications Manager Amelia Neely). And I do not know if you noticed, but even my photo at the end of the newsletter became more presidential—go and check earlier issues and the last newsletter and you will see what I am talking about. (-:

As your President I can attest to the commitment to service of the Executive Board, the members and chairs of the many committees, and the BSA staff. Our student representatives are also active and looking after the well-being of their fellow students. Our DEI committee is making sure that we do not lose track of our commitments to diversity, equity, and inclusion and that we are transparent with the decisions that we are making. Also, it has been impressive to see behind the scenes of all that putting together a Conference and Conference Program entails (many thanks to Johanne Stogran and Melanie Link-Perez). All the work that goes into this—sometimes years in advance!—is amazing to see.

By the time you read this retrospect, I will have ended my term as President, and I will be your Past-President (2024-2025). Because of the IBC, my presidency was only 11 months because our annual meeting was moved up one month earlier. (Sorry to soon-to-be President, Jenny Xiang, as your presidential gig will be 13 months!) As Past-President I will continue my participation with the society by serving as the Chair of the Election Committee, by doing my best to implement the changes recommended as part of our ROOT & SHOOT Capstone Project (mentioned above), and by continuing to engage with our members. I am here to listen, and I hope that you will continue to share your thoughts and concerns with me about BSA and our conference. Also, during this period, I plan to focus on engaging federal and state agencies and developing partnerships with them. Increasing the participation of agency botanists in BSA is a special aspiration of mine.

As I look back, I am thankful that I was nominated, and that you elected me to be your President. It has been a blast!!! I have furthered my leadership skills, met and worked with so many thoughtful and hard-working people, and had an amazing time heading up the #plantjoy campaign and seeing your responses. So, remember, it is never too early or too late to get involved in BSA, and I hope that you will consider doing so. We are always looking for good people to serve on or chair our committees or become part of the Executive Board. BSA is the premier botanical organization of the United States and we strive to be the best in the world. And I am here to tell you—*botanists are party people!*

Botanical Society of America's Award Winners

Distinguished Fellow of the Botanical Society of America

The “Distinguished Fellow of the Botanical Society of America” is the highest honor our Society bestows. Each year, the award committee solicits nominations, evaluates candidates, and selects those to receive an award. Awardees are chosen based on their outstanding contributions to the mission of our scientific Society. The committee identifies recipients who have demonstrated excellence in basic research, education, public policy, or who have provided exceptional service to the professional botanical community, or who may have made contributions to a combination of these categories.



Dr. Steven Neil Handel

Rutgers University

Steven Handel, Distinguished Professor of Ecology and Evolution at Rutgers, is an internationally recognized botanist who has experimentally explored mutualisms, plant population growth, ecological genetics, and now applies these findings to the ecological restoration of urban degraded lands. Dr. Handel aims to understand new ecological restoration protocols, based on a botanical foundation, and use these in the design of public lands by collaborating with landscape architects. This groundbreaking collaboration is a hallmark of his recent work and opens new doors for the application of botanical knowledge to the public sphere. Dr. Handel's collaborative efforts with landscape architects and urban planners have been instrumental in transforming degraded urban landscapes into thriving ecosystems. As examples, projects such as the restoration of Brooklyn Bridge Park and the Jamaica Bay Wildlife Refuge, exemplify his commitment to integrating scientific rigor with practical application.

He has been a BSA member for 40 years, the Genetics Section chair, served on several BSA committees and the advisor of four Young Botanist Awardees. Dr. Handel's dedication to

education is evident through his mentorship of numerous graduate students and in the many nomination letters we received. Working with Dr. Handel is a pleasure. He teaches his students and post-docs how to encourage and to mentor, to be curious and enjoy life, and to remember the humanity of the people they are teaching and to use kindness always.

Dr. Handel is leaving a lasting impact on the field of botany and ecological restoration. His work continues to inspire and educate, emphasizing the vital intersection of several disciplines. Dr. Handel's actions to improve the botanical components of public landscapes has expanded the reach of our field in important new ways and we are pleased to honor him with this Distinguished Fellows Award.

Charles Edwin Bessey Teaching Award

(BSA in association with the Teaching Section and Education Committee)



Dr. Joan Edwards, a professor at Williams College for five decades, has shaped a career characterized by an unwavering commitment to nurturing the next generation of botanists and environmental stewards. Through her innovative teaching methods, she has instilled a sense of curiosity and wonder in countless students. As one of her nominators pointed out, “Very few faculty members at any higher education institution have the stamina to remain in their position this long, and even fewer do so while not only maintaining their teaching and research standards, but continuing to pioneer and adjust to changes in technology, student needs, and pedagogical understanding in the way that Dr. Edwards has.”

BSA Emerging Leader Award

The Emerging Leader Award of the Botanical Society of America is given annually in recognition of creative and influential scholarship as well as impact in any area of botany reflecting the breadth of BSA. Awardees have outstanding accomplishments and also have demonstrated exceptional promise for future accomplishments in basic research, education, public policy, exceptional service to the professional botanical community, or a combination of these categories.

Her courses, such as Field Botany and Conservation Biology, have served as catalysts for intellectual growth, fostering interdisciplinary exploration and hands-on research experiences. Dr. Edwards has remained dedicated to student-centered research, teaching the value of observation, curiosity, interconnection, integration, and that the unexpected is always interesting. She has cultivated a collaborative environment where students are empowered to make meaningful contributions to the field. One of her former students stated, “Joan’s ability to convey the excitement and wonder of biological phenomena and then make the underlying concepts (whether physical, molecular, developmental, ecological, or evolutionary) seem simple and accessible to all of her students is the core of her approach to teaching.”

Beyond the classroom, Dr. Edwards’s outreach efforts transcend boundaries, engaging with the broader community to foster conservation efforts and a deeper appreciation for the natural world. Dr. Edwards epitomizes the essence of excellence in botanical teaching, embodying a profound passion for plants and a steadfast dedication to inspiring future generations of botanical enthusiasts.



Dr. Aaron S. David

Archbold Biological Station

Dr. Aaron David received his PhD from the University of Minnesota in 2016. From his early days as a postdoctoral researcher to his current role as the Director of the Plant Ecology Lab at Archbold Biological Station, Aaron’s pioneering research stands as a testament to his innovative thinking and commitment to addressing pressing ecological challenges.

Dr. David’s expertise spans various disciplines, from sequencing and plant biology to modeling and computer programming, laying a solid foundation for his subsequent contributions that bridge the gap between plant population demography and microbiology to understand the intricate dynamics of threatened and endangered plant species. His work with

endangered plant species like *Hypericum cumulicola* has not only deepened our understanding of plant-microbial interactions but also shed light on the intricate mechanisms driving population dynamics.

His scientific integrity, collaborative ethos, and proactive approach to conservation underscore his potential to shape the future of plant biology and environmental stewardship. As he continues to push the boundaries of scientific inquiry and inspire the next generation of scientists, BSA is proud to honor him with the Emerging Leader Award.

Impact Award

The Botanical Society of America Impact Award recognizes a BSA member or group of members who have significantly contributed to advancing diversity, accessibility, equity, and/or inclusion in botanical scholarship, research and education.



Dr. Kristine Callis-Duehl

Driemeyer Executive
Director of Education

Donald R. Kaplan Memorial Lecture

This award was created to promote research in plant comparative morphology, the Kaplan family has established an endowed fund, administered through the Botanical Society of America, to support the Ph.D. research of graduate students in this area.



Dr. Cynthia Jones
University of Connecticut

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. Else Marie Friis, Museum of Natural History, Stockholm, Sweden

Dr. Mark Olson, Universidad Nacional Autónoma de México, Ciudad de México, México

THE BSA DEVELOPING NATIONS TRAVEL GRANTS

Elton John de Lirio, University of São Paulo, Brazil

Carina I. Motta, Universidade Estadual Paulista Júlio de Mesquita Filho, Rio Claro, Brazil

Boniface Ngarega, Oklahoma State University, USA

Malka Saba, Quaid-i-Azam University, Islamabad, Pakistan

Jackeline Salazar, Universidad Autónoma de Santo Domingo, Dominican Republic

Anju Batta Sehgal, Retd. Principal Govt. College Hamirpur Himachal Pradesh, India

Prabha Sharma, University of Delhi, India

THE BSA PROFESSIONAL MEMBER TRAVEL GRANTS

Kelsey J.R.P. Byers, John Innes Centre

Elton John de Lirio, University of São Paulo

Lekeah Durden, Central Michigan University

Elizabeth McCarthy, SUNY Cortland

Pedro Henrique Pezzi, University of Arkansas

Prabha Sharma, University of Delhi

BSA MEMBER TRAVEL GRANTS TO ATTEND THE IBC

Erin G. Bentley, University of Wyoming

Patricia W. Chan, University of Wisconsin-Madison

David Hoyos, Instituto Multidisciplinario de Biología Vegetal (IMBIV-CONICET)

Masoumeh Khodaverdi, University of Vermont

Andrew E. McDougall, The University of Adelaide

Juan Pablo Ortiz Brunel, Universidad de Guadalajara

Resmi Sekarathil, Botanical Survey of India

Aleena Xavier, Indian Institute of Science Education and Research Bhopal

AWARDS FOR ESTABLISHED SCIENTISTS GIVEN BY THE SECTIONS

Hermann Becker Student Field Work Grant

(Paleobotanical Section)

Niall Whalen – Florida State University

Remy, Remy, and Winslow Award

(Paleobotanical Section)

Eva Maria Silva Bandeira – University of Kansas

For the paper: *The oldest record of reproductive structure of Nothofagaceae and Proteaceae from the Campanian of Antarctica*. Co-Authors: Ari Iglesias, Brian Atkinson, Mauro Passalia, Pablo Picca and Selena Smith

Emma Casselman – California State Polytechnic University, Humboldt

For the paper: *Characterizing and distinguishing early euphyllophytes with woody growth based on secondary xylem anatomy: method development and applications*. Co-Author: Alexandru M.F. Tomescu

Ellie Frazier – California State Polytechnic University, Humboldt

For the paper: *Early steps in pith evolution: euphyllophytes of the Lower Devonian Battery Point Formation of Gaspé (Quebec, Canada)*. Co-Author: Alexandru M.F. Tomescu

Madison Lalica – California State Polytechnic University, Humboldt

For the paper: *Plant periderm as a continuum in structural organization: a tracheophyte-wide survey and hypotheses on evolution*. Co-Author: Alexandru M.F. Tomescu

Meg Nibblelink – University of Kansas

For the paper: *A rare lycopod macrofossil from the Triassic of Antarctica*. Co-Author: Kelly Matsunaga

Caroline Siegert – Cornell University

For the paper: *Earliest record of Malpighiaceae: four-winged fruits from the early Eocene of Patagonia, Argentina*. Co-Author: Maria A. Gandolfo

Keana Tang – University of Kansas

For the paper: *Fossil flowers support a Cretaceous diversification of crown-group Laurales*. Co-Authors: Kelly K.S. Matsunaga, Brian A. Atkinson

Zane Walker – Oregon State University

For the paper: *Late Cretaceous (Campanian) bryophyte flora: A permineralized moss from James Ross Island, Antarctica*. Co-Authors: Ruth A. Stockey, Gar W. Rothwell, Brian A. Atkinson, Selena Y. Smith, and Ari Iglesias

Tengxiang Wang – Pennsylvania State University

For the paper: *The Pliocene Kon Tum flora from central Vietnam — ancient analog of Mainland Southeast Asia's endangered tropical seasonal forests*. Co-Authors: Jia Liu, Peter Wilf, Jian Huang, Shi-Tao Zhang, Truong Van Do, Hung Ba Nguyen, Tao Su

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.

Blake Fauske, Duke University

For the Presentation: Comparative analysis of RNA editing in Pteridaceae reveals a potential regulatory function.

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.

May Yeo, University of Cambridge

For the Presentation: Genetic basis of bullseye patterning in *Hibiscus trionum*

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.

Facundo De Benedetti, Museo Paleontológico Egidio Feruglio, Argentina.

For the Paper: Patagonia: refuge to evaluate mass extinction events and diversity recovery – a palynological approach.

AWARDS FOR EARLY CAREER SCIENTISTS

AJB Synthesis Papers and Prize

The AJB Synthesis Prize is intended to showcase early-career scientists and to highlight their unique perspectives on a research area or question, summarizing recent work and providing new insights that advance the field. The Prize comes with a \$2000 award and recognition at the BSA Awards Ceremony at the Botany Conference.

Dr. Meghan Blumstein, Massachusetts Institute of Technology

For her article “The drivers of intraspecific trait variation and their implications for future plant productivity and survival,” (*American Journal of Botany* 111(4): e16312).

Botanical Advocacy and Service Grant

This award organized by the Environmental and Public Policy Committees of BSA and ASPT aims to support local efforts that contribute to shaping public policy on issues relevant to plant sciences.

Susana M. Wadgyamar, Davidson College

For the proposal: Companion ethnobotanical gardens at Davidson College and Catawba Indian Nation

BSA Public Policy Award

The Public Policy Award was established in 2012 to support the development of tomorrow's leaders and a better understanding of this critical area.

Cael Dant, Northwestern University and the Chicago Botanic Garden

Jenna Miladin, University of Arkansas

AWARDS FOR STUDENTS

AJ Harris Graduate Student Research Award

This award is named in honor of the late Dr. AJ Harris whose research spanned traditional specimen-based science, paleobotany, phylogenomics, biogeography, and computational biology. This award is given in conjunction with the Graduate Student Research Awards and is given to a graduate student whose research is representative of one of the areas above.

Malith Viduranga Weerapperuma achchi athukoralage don, Texas A & M university
For the Proposal: Phylogenetics and biogeography of Family Balsaminaceae: Special emphasis on South and southeastern Asia

Donald R. Kaplan Dissertation Award in Comparative Morphology

This award was created to promote research in plant comparative morphology, the Kaplan family has established an endowed fund, administered through the Botanical Society of America, to support the Ph.D. research of graduate students in this area.

Andrea Appleton, Harvard University
For the Proposal: Diversity and development of the intricate staminodes across Loasaceae (Cornales)

GRADUATE STUDENT DISSERTATION AWARD IN PHYLOGENETIC COMPARATIVE PLANT BIOLOGY

This award supports the Ph.D. research of graduate students in the area of comparative plant biology, broadly speaking, from genome to whole organism. To learn more about this award go to <https://botany.org/home/awards/awards-for-students/cpd-award.html>.

David M. Kunkel, Oklahoma State University
For the Proposal: Linking Functional Traits and Niches to Lineage Diversification in Asclepias

THE BSA GRADUATE STUDENT RESEARCH AWARD INCLUDING THE J. S. KARLING AWARD

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

The J. S. Karling Graduate Student Research Award

Chinedum Anajemba, Utah State University

For the Proposal: Unraveling the Macroevolutionary Fate of Polyploids: A Comprehensive Study of the Cystopteridaceae Fern Family

The BSA Graduate Student Research Awards

Richard Baker-Strader, San Francisco State University

For the Proposal: The genome, origins, and evolution of the Hawaiian tetraploid *Chenopodium oahuense*

Martín Batalla, Old Dominion University

For the Proposal: Biogeography of *Nototriche* (Malvaceae), one of the most diverse plant genera endemic to the high-Andes

Bridget Bickner, Harvard University

For the Proposal: Genetic architecture of the flower size/number and seed size/number tradeoffs in Phlox

Thomas Buchloh, Clemson University

For the Proposal: Investigating the Role of Diploid Gamete Formation on Polyploid Abundance in a Widespread Fern

Emma K. Chandler, University of Georgia

For the Proposal: Impacts of climate change on the maintenance of gynodioecy: the pattern, mechanism, and demographic processes underlying population level sex ratio

Nikhil R. Chari, Harvard University

For the Proposal: How will plant root exudation respond to climate change in situ?

Kaitlyn Dawson, Queen's University

For the Proposal: Fitness consequences of divergent selection on clonal reproduction in a perennial plant

Aidan Harrington, University of Minnesota Twin Cities

For the Proposal: The establishment and persistence of neopolyploid plants and consequences for geographic range

Rachel Hopkins, State University of New York: College of Environmental Science and Forestry (SUNY ESF)

For the Proposal: Plants on the move: Tracking 60 years of climate-induced vegetation shifts on a northeastern mountain

Sierra Jaeger, University of South Carolina

For the Proposal: Do pollinators or herbivores select on floral betalain pigmentation in sand verbenas?: A multiple-year field experiment

José Esteban Jiménez, University of Florida

For the Proposal: Phylogenomics of two poorly known terrestrial subgenera in *Peperomia*

Daniel Mok, Michigan State University

For the Proposal: Investigating the carnivorous genus *Pinguicula* (Lentibulariaceae) as a candidate novel model system of plant resilience research

Lydia Morley, Texas A&M University

For the Proposal: Using spatially explicit phylogenetic networks to uncover variation in gene flow across *Spiranthes* lineages

Aislinn Mumford, Louisiana State University

For the Proposal: Evolution of Fruit Color and Nutritional Signaling in *Palicourea*, a Genus of Neotropical Flowering Plants

Austin T. Nguyen, University of Kansas

For the Proposal: Investigating Homology, Heterochrony, and Trait Evolution in the Cypress Family

Carlos J. Pardo De la Hoz, Duke University

For the Proposal: Opening the black box of horizontal transmission of symbionts: do environmental aposymbiotic communities shape the communities within symbiotic systems?

Kyle Simpson, Texas A&M University

For the Proposal: On the origin of (rare) species: Combining phylogenetic biogeography and niche modeling to understand the diversification of rare plant species

Cameron So, McGill University

For the Proposal: Testing gene flow effects on range-edge population fitness and range expansion success

Edward Sun, University of British Columbia

For the Proposal: Revealing plant adaptations to mycoheterotrophy using a high-quality chromosome-scale genome assembly

Ryan Thummel, Cornell University

For the Proposal: Using Convolutional Neural Networks to Predict the Phylogenetic and/or Ecological Affinities of Moss Spores

April Wallace, University of Nevada, Las Vegas

For the Proposal: Exploring shikimate pathway disruption as a possible intrinsic isolating barrier in trees

Elizabeth White, University of Florida

For the Proposal: Comparative phylogeography along a seepage slope gradient: a case study in the genus *Xyris* with implications for patterns of speciation and endemism in the North American Coastal Plain

Ziqi Xie, Portland State University

For the Proposal: Fitness Effects of Adaptive SNPs in a Recent *Ranunculus* Hybrid Zone

Matthew Yamamoto, Claremont Graduate University

For the Proposal: A Flora of the McGee Creek Watershed, Mono County, California

The BSA Undergraduate Student Research Awards

The BSA Undergraduate Student Research Awards support undergraduate student research and are made on the basis of research proposals and letters of recommendation.

Bridget Badali, Queen's University

For the Proposal: Genetic variation and population differentiation in vegetative pigmentation across the range of invasive New Zealand *Mimulus guttatus*. Co-author: Dr. Jannice Friedman

Sasha Carrasco, Eastern Kentucky University

For the Proposal: Investigating the bioactive properties of the genus *Lygodium* through phytochemical composition analysis. Co-author: Dr. Sally Chambers

Luis Hurtado, Texas A&M University

For the Proposal: Environmental DNA detection of an endangered moss. Co-authors: Katie K. Sanbonmatsu, Dale Kruse, Daniel Spalink

Isabel Smalley, University of Minnesota Duluth

For the Proposal: Resolving Phylogeny Through Deep Time: An Exploration of *Myriopteris covillei* (Pteridaceae).

The Botany and Beyond: PLANTS Grants Recipients

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

Mariana Acevedo Garcia, Pomona College, Advisor: Carrie Kiel

Giorgio Casini, University of Colorado Boulder, Advisor: Jonathan Henn

Kendall Cross, St Cloud State University, Advisor: Angela McDonnell

Carmen Curry, Virginia Tech, Advisor: Jordan Metzgar

Kylie Gieser, Old Dominion University, Advisor: Lisa Wallace

Hannah Herrick, California Polytechnic University - Pomona, Advisor: Edward Bobich

Riley Jackson, Utah Valley University, Advisor: Michael Rotter

Asma Jamil, University of Michigan-Dearborn, Advisor: David Susko

Danielle Keysaw, Utah Valley University, Advisor: Erin Riggs

Mellifera Letterman, California State University, Fullerton, Advisor: Joshua Der

Elizabeth Mandala, Idaho State University, Advisor: Kathryn Turner

Austin Melancon, University of Michigan, Advisor: Charles Davis

Alison Munaylla-Bohorquez, Marymount University, Advisor: Megan Romberg

Giovanna Munoz-Gonzalez, California State University, Fresno, Advisor: Katherine Waselkov

Amaya-Jean Roberts, Utah Valley University, Advisor: Erin Riggs

Rose Roberts, Oregon State University, Advisor: Juan Navarro

Sydney Sauls, Howard University, Advisor: Janelle Burke

Reynalda Vazquez, University of South Carolina Upstate, Advisor: Benjamin Montgomery

Sydney Ward, Hope College, Advisor: Jennifer Blake-Mahmud

Amiya Whitson, Auburn University at Montgomery, Advisor: Vanessa Koelling

THE BSA YOUNG BOTANIST AWARDS

The purpose of these awards is to offer individual recognition to outstanding graduating seniors in the plant sciences and to encourage their participation in the Botanical Society of America.

Certificate of Special Achievement

Nadia Alhassani, Barnard College, Advisor: Hilary Callahan

Megan O. Callahan, University of Cincinnati, Advisor: Theresa Culley

Addison G. Darby, Oklahoma State University, Advisor: Sierra Jaeger

Cari DeCoursey, Weber State University, Advisor: Jim Cohen

Olivia C. Degreenia, Louisiana State University, Advisor: Laura Lagomarsino

Sophie Demaisy, Connecticut College, Advisor: T. Page Owen

Aubanie Dubacher, Fort Lewis College, Advisor: Ross McCauley

Elanor Fuller, Louisiana State University, Advisor: Laura Lagomarsino

Cecelia “Ginkgo” Hemmerle, Miami University, Advisor: Richard Moore

David Klump, Miami University, Advisor: Richard Moore

Elizabeth Lay Mandala, Idaho State University, Advisor: Kathryn Turner

Brais Marchena Fernández, Weber State University, Advisor: Sue Harley

Valerie McCauley, Miami University, Advisor: Richard Moore

Shannen McIntyre-Quinn, Miami University, Advisor: Richard Moore

Sumayya Mokit, Barnard College, Advisor: Hilary Callahan

David M. Neelappa, Connecticut College, Advisor: T. Page Owen

Riley Rees, Ohio University, Advisor: John Schenk

Andrew Ruegsegger, University of Arkansas, Advisor: Maribeth Latvis

Emily Scott, University of Virginia, Advisor: Hanna Makowski

Renee Smith, Connecticut College, Advisor: T. Page Owen

Zach H. Smith, University of Wisconsin, Advisor: Christopher Krieg

Luke Sparreo, Connecticut College, Advisor: T. Page Owen

Sarah Ellen Strickland, Oberlin College, Advisor: Michael Moore

Owen E. Tapia Daly, University of Guelph, Advisor: Hafiz Maherali

Emma Terry, Plymouth State University, Advisor: Diana Jolles

My N. Trinh, Oberlin College, Advisor: Michael Moore

Certificate of Recognition

McKenna M. Oyer, Miami University, Advisor: Richard Moore

Will Payton, Miami University, Advisor: Richard Moore

Vernon I. Cheadle Student Travel Awards

(BSA in association with the Developmental and Structural Section)

This award was named in honor of the memory and work of Dr. Vernon I. Cheadle.

Haylee Nedblake, University of Kansas; Advisor: Lena Hileman;

For the Presentation: Parallel evolution of corolla tube width shifts in *Penstemon*. Co-authors: Carolyn Wessinger, Lena Hileman

Austin T. Nguyen, University of Kansas; Advisor: Kelly Matsunaga;

For the Presentation: Intercalary Growth and Seed Cone Development in *Taxodium distichum* and *Juniperus virginiana* (Cupressaceae). Co-authors: Ana Andruchow-Colombo, Kelly Matsunaga

The BSA Student and PostDoc Travel Awards

(Winners were selected by lottery)

Ioana Anghel

Madeline Bednar

Shiran Ben Zeev

Matthew Finzel

Megan Gauger

JianJun Jin

Ishveen Kaur

Masoumeh Khodaverdi

Mason McNair

Wesley Radford

AWARDS FOR STUDENTS - GIVEN BY THE SECTIONS

Developmental & Structural Poster Award

Best Student Poster

Caitlin Cooler, Ohio University

For the Poster: Structural Developmental Evolution of Aquatic Legumes. Co-authors: Caitlin Cooler, L. Ellie Becklund, and John J. Schenk

Emanuel D. Rudolph Award

(Historical Section)

Madison Bullock, Texas Tech University

For the Presentation: The Botanical Time Capsule: Using herbaria to study the effects of global change on Guadalupe Mountains flora

ECOLOGICAL SECTION STUDENT PRESENTATION AWARDS

Best Undergraduate Presentation Award

Grace R. Gutiérrez, Ohio State University

For the Presentation: Moss-lichen layers increase mycorrhizae in juvenile grasses yet nullify plant performance benefits of warming. Co-authors: Sidonie Loïez, Martijn Vandegehuchte

Best Graduate Student Presentation Award (Tied)

Rosemary Glos, University of Michigan

For the Presentation: Eco-Evolutionary Insights in the Function and Diversification of Complex Trichomes in Loasaceae. Co-author: Marjorie Weber

Devani Jolman, Old Dominion University

For the Presentation: Hybridization as an Ecological Mechanism: The Environmental Influence on Functional Traits in Hybrid Highbush Blueberries. Co-author: Lisa Wallace

Ecological Section Poster Award

Boniface Ngarega, Oklahoma State University

For the Poster: Assessing niche divergence across bulbous geophytes. Co-Author: Cody Coyotee Howard

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.

Hannah McConnell, University of Washington

For the Presentation: Reconstructing the origin of reproductive function for the flower development gene LEAFY. Co-authors: Jancee Lanclos, Nicholas Gjording, Genevieve Stockman, Julin Maloof, Andrew Plackett, and Veronica Di Stilio

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 Presentation

Cierra Sullivan, Clemson University

For the Presentation: Variegated *Hexastylis* leaf morphs express greater tolerance to environmental stress than uniformly colored morphs. Co-authors: Matthew Koski

Best Student Poster

Lena Berry, University of Wisconsin-Madison

For the Poster: Unraveling the Physiological Function of Leaf Anatomical Traits in Cycads. Co-authors: Christopher Krieg, Katherin McCulloh, Duncan Smith, Zachary Smith

PHYSIOLOGICAL AND ECOPHYSIOLOGICAL SECTION STUDENT PRESENTATION AND POSTER AWARDS

Best Student Oral Presentation

Dominique Pham, Donald Danforth Plant Science Center

For the Presentation: Quantification of Reactive Oxygen Species to Understand High Light Adaptation in C4 *Setaria viridis*. Co-authors: Boominathan Mohanasundaram, Kirk Czymmek, Tessa Burch-Smith, Sona Pandey, Ru Zhang

Best Student Poster

Shannen McIntyre-Quinn, Miami University

For the Poster: Step one: Breaking dormancy of the novel aerial bulbil in *Mimulus gemmiparus*. Co-authors: Deannah Neupert, Evan Gallagher, David Klump, Richard Moore

PHYTOCHEMICAL SECTION PRESENTATION AWARDS

Best Presentation

Jayne Hart, Michigan State University

For the Presentation: Making plant specialized metabolism enzymes more efficient: a BAHD test case. Co-authors: Rhiannon Stevens, Rachel E. Kerwin, and Robert L. Last

Amanda Agosto Ramos, University of California, Davis

For the Presentation: Convergence and constraint in glucosinolate evolution across the Brassicaceae.

Best Poster

Sarah Barr, University of North Carolina Wilmington

For the Poster: Evaluation of Fasted and Fed Gastrointestinal Transformation of *Withania somnifera* (Ashwagandha) Plant Extracts and Bioactive Compounds via UPLC-MS and Untargeted Metabolomicsidal activity. Co-authors: Melissa Bollen, Amala Soumyanath, Robert Thomas Williamson, and Wendy Strangman

SOUTHEASTERN SECTION STUDENT PRESENTATION AWARDS

The following winners were selected from the Association of Southeastern Biologists meeting that took place at the end of March 2024.

Southeastern Section Paper Presentation Award

Meredith Woodward, University of Tennessee at Chattanooga

Southeastern Section Poster Presentation Award

Kaya Rosselle, NC State University

STUDENT TRAVEL AWARDS

Developmental & Structural Section Student Travel Awards

Sanam Parajuli, South Dakota State University; Advisor: Dr. Madhav Nepal
For the Presentation: Predicted Genetics of Floral Patterning in *Amborella trichopoda* Baill Revealed by Genome-wide Survey and Expression Analysis of MADS-Box Transcription Factors. Co-authors: Madhav Nepal, Bibek Adhikari

Pei-Jun Xie, National Tsing Hua University; Advisor: Li-Yaung Kuo
For the Presentation: Comparative anatomical study in *Tectaria* species with different leaf dimorphism levels in a world of diverse reproductive strategies. Co-authors: You-Wun Hwang, Li-Yaung Kuo

Ecological Section Student Travel Awards

Elton John de Lirio, University of São Paulo; Advisor: Dr. Jenn Yost
For the Presentation: Phylogenetic position and sex expression of the first known Neotropical *Monimiaceae paradioecious* species. Co-authors: Heloisa Alves de Lima, Ariane Luna Peixoto, Marc Pignal, Vitor dos Santos Gomes Maia, Gabriel Silva Santos, Cassia Sakuragui

Ethan E. Grant, Miami University; Advisor: Dr. Richard Moore
For the Presentation: Floral scent and intersexual mimicry in dioecious highland papaya *Vasconcellea parviflora*. Co-author: Richard Moore

Genetics Section Student Travel Awards

Bibek Adhikari, South Dakota State University; Advisor: Dr. Madhav Nepal
For the Presentation: Chloroplast Phylogenomics Supports Monophyly of Genus *Morus*. Co-authors: Sanam Parajuli, Madhav Nepal

Pteridological Section & American Fern Society Student Travel Awards

Qiao-Yi Xie, National Taiwan University; Advisor: Ko-Hsuan Chen
For the Presentation: Fungal Community Dynamics Across Generations and Compartments in the Epiphytic Fern *Ophioderma pendulum*. Co-authors: Li-Yaung Kuo, Chiung-Chih Chang, Chien-Jung Lin, Wen-Hong Wang, Ko-Hsuan Chen

Updates from the BSA Public Policy Committee

As the committee chair of the Public Policy Committee for the Botanical Society of America (BSA), which is also jointly affiliated with the Environment and Public Policy Committee of the American Society of Plant Taxonomists (ASPT), I would like to update our readership on the committees' activities for this year. The committee held an online meeting in the Fall of 2023 and most recently at the beginning of July 2024. Between the two meetings, the committee has fulfilled two items of its core mission: getting the word out, and evaluating and reviewing applicants and proposals for the Public Policy Award and Botanical Advocacy and Service Grant. I am pleased to provide updates on this year's round of funded awardees/grants and exciting new business recently discussed within the committee.

PUBLIC POLICY AWARD

For those who may not know, the BSA Public Policy Award provides two recipients with funding to participate in the Biological Sciences Congressional Visits Day (CVD), which typically takes place in March or

April annually in Washington, DC. CVD is a two-day event hosted by the Biological and Ecological Sciences Coalition. The first day includes training provided by the American Institute of Biological Sciences (AIBS) on science funding and how to effectively communicate with policymakers. Participants meet with their Congressional policymakers on the second day to advocate for federal support of scientific research.

The Committee received two proposals and provided the BSA Public Policy Award to **Cael Dant** (Graduate Student, Northwestern University and the Chicago Botanic Garden) and **Jenna Miladin** (Graduate Student, University of Arkansas), who both participated in the 2024 Congressional Visits Day and AIBS Boot Camp training. We look forward to learning more about their experience in the Fall issue of the PSB!

BOTANICAL ADVOCACY AND SERVICE GRANT

The Botanical Advocacy and Service Grant is co-sponsored by both BSA and ASPT (with both societies contributing \$500 for a total grant of \$1000). The aim of the grant is to support local efforts that contribute to shaping public policy on issues relevant to plant sciences. The joint committee received half a dozen proposals for the grant, which were evaluated by members of the joint committee. We are excited to have selected **Susanna Wadgyamar** for her proposal titled



By **Andrew Pais**

*BSA Public Policy Chair
Email: paisa@vgcc.edu*

“Companion ethnobotanical gardens at Davidson College and Catawba Indian Nation.” More details on the mission and impacts of this proposal will be shared in a future article.

PLANT SCIENCE BULLETIN

Beyond this update, we are eager to share the most recent testimonials of this year’s Public Policy Award recipients in the fall issue of the *PSB*, followed by a report in the spring issue from awardees of the Botanical Advocacy and Service Grant within the past two years. Based on discussions at our most recent meeting, the committee would also like to update readers on the status of the Duke Herbarium and its planned closure. We are soliciting those with unique perspectives on the issue to reach out and contact our committee so we can continue publishing pieces to keep this important item front and center.

PLANNING A BOTANY 360 EVENT WITH THE PUBLIC POLICY COMMITTEE

In addition to following up through the *PSB*, the Public Policy Committee is in talks to plan and deliver an online event to continue engaging plant scientists beyond the Botany conference. We would like to invite readers to join us in an event that seeks to highlight an ongoing topic of interest related to policy and the botanical sciences as well as activate new members who would like to get involved in the committee. Please stay tuned for future Botany 360 events being posted!

NEW LEADERSHIP FOR THE 2024-2025 YEAR

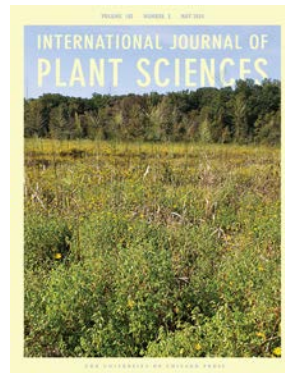
I am pleased to announce that **Naomi Fraga** will be stepping onboard to chair the Public Policy Committee. Naomi has long served on the joint committee, both as a member of the BSA as well as chair for the Environment and Public Policy Committee of the ASPT. We are excited to have a leader with strong ties to both societies and a strong working knowledge of the committee business as well as policy issues more broadly. Please reach out to either the current or upcoming committee chair if you would like to know more about the Public Policy Committee or get more involved!

INTERNATIONAL JOURNAL OF PLANT SCIENCES

Call for Proposals: Primers in the Plant Sciences

IJPS is seeking contributions for a series of occasional papers, Primers in the Plant Sciences. “Primers” are short, peer-reviewed, accessible introductions to well-defined topics in the plant sciences.

Each Primer is both an introduction to a topic in plant science and a narrow-in-scope review that serves as a useful first-stop reference to scientists at all career stages. Primers are intended to provide the reader with a foundation in the topic and introduce them to leading research questions and methodologies in the field.



For more information, visit

journals.uchicago.edu/journals/ijps/primers



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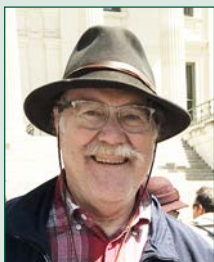
SPECIAL FEATURE

Using General Interest Science Books to Arouse Student Interest and to Substitute for an Introductory Textbook

INTRODUCTION

As a student in 1967, I used Cronquist's (1961) *Introductory Botany* as the textbook in the introductory Vascular Plants and Non-vascular Plants courses at Carleton College. At the end of every chapter was a "Suggested Readings" section and my instructor, Bill Muir, placed all of these on reserve in the college library and suggested that we take a look at some, especially in areas that we found interesting. These were often the "jumping off point" for term papers and reports. Fuller and Tippo's *College Botany* (1949) was the first botany textbook I am aware of to include this learning aid, and by the 1960s it became a common feature. With rapidly expanding enrollments and programs, many college faculty, especially from two- and four-year

colleges, were interested in having access to a "library list" of essential books to guide purchase recommendations. The Panel on Biological Facilities of the Commission on Undergraduate Education in the Biological Sciences (CUEBS) took up this challenge and produced two such lists. The first, containing about 430 books listed alphabetically by author, was based on the holdings of six selective liberal arts colleges and became the Basic Library List (CUEBS, 1969). To produce a more expansive guide, the Panel requested input from notable scholars who represented a number of professional societies, including Irving Knoblock, from the Botanical Society of America, who chaired the BSA Teaching Section in 1969–1970. The updated booklet appeared in 1971 (CUEBS, 1971). Its 823 books are subdivided into subject categories according to the Library of Congress system and then arranged alphabetically by author. Each entry includes additional information such as number of pages, cost, and recommendation percentages (out of 306 reviewers like Knoblock). The section for general botany, plant anatomy, plant physiology, and plant ecology contained 82 entries. As Knoblock pointed out, these resources should be available not only to



By Marshall D. Sundberg
*Roe R. Cross Distinguished
Professor of Biology –
Emeritus
Emporia State University,
Emporia, KS*

provide additional background in a particular area, but also because of their general interest, which could attract students to major in botany (Knoblock, 1968).

MY READING LIST FOR STUDENTS

Another of Muir's many influences on me was to promote critical reading by annotating the text, in pencil, while reading (see Appendix 1). Today, educational psychology suggests the act of handwriting itself promotes learning and retention (Van der Weel and Van der Meer, 2024). Muir encouraged us to do this in all his classes, and my marginal notes included many of his comments as we discussed the material during class. Many of my undergraduate textbooks—Alexopoulos' (1962) *Introductory Mycology*; Esau's (1960) *Anatomy of Seed Plants*; Foster and Gifford's (1959) *Comparative Morphology of Vascular Plants*; Sinnott's (1963) *The Problem of Organic Form*; and Stebbins' (1966) *Processes of Organic Evolution*—are now considered classics. My annotated copies were even more useful when I later used many of them in graduate classes. Also, thanks to Muir, I began frequenting used bookstores where I could purchase additional "classics" as well as more popular works like Anderson's (1952) *Plants, Man and Life*, Kreig's (1964) *Green Medicine*, Large's (1940) *Advance of the Fungi*, or Abbey's (1968) *Desert Solitaire* to add to my growing collection. In graduate school I began to make my own list of suggested readings in anticipation of using them in my classes when I began teaching.

When I began my career at the University of Wisconsin-Eau Claire (UWEC), in 1978, I lectured in a traditional fashion and made the readings optional. However, after moving

to Louisiana State University (LSU) in 1986, I began to shift to student-active pedagogies and typically required every student to read and critique two or three books from the list during a semester. Each critique was due at the beginning of the exam for that portion of the course. I included a short page on "How to write a critique" as a syllabus supplement (Appendix 2). The point value of the critique was 50% of the value of an exam.

The purposes of this assignment were three-fold: first, supplemental readings could stimulate student interest in different aspects of botany not covered in the course and thus attract students to botany as suggested by Knoblock. Second, critique-writing encouraged students to not only read the text, but to read it critically. Third, these assignments provided relatively easy points for students to earn that would balance critically challenging exams (comparable to AP biology questions and those in the CUEBS [1967] Testing and Evaluation booklet) that most students were not used to. Not all students took advantage of these opportunities.

My current reading list has 13 subcategories: Biomedicine; Botany/Plant Biology; Ecology/Natural History; Economic Botany; Evolution; Forensic Botany; History of Biology/Biography; Mycology (Fungi); Microbiology/Molecular Biology; General Science/Philosophy of Science; Phycology (Algae); Women in Science; and Zoological. It is available at <https://docs.google.com/document/d/1USkGueM93AmqnsFpTNzaEWDGcrlgXZvL3mtQfJXDXY/edit>. Within each category, books are arranged alphabetically by author and each entry includes a brief annotation describing the book to assist students in choosing between options. Some books are included in more

than one category. In this case, only one entry is annotated with the others cross-referenced to it. For honors biology, and introductory biology and botany courses, I would make the entire list available to students. Most upper division courses, such as Evolution or Plant Anatomy and Physiology, would include titles from only that subsection.

GENERAL INTEREST BOOKS AS A SUBSTITUTE FOR A TRADITIONAL TEXTBOOK

At both LSU and Emporia State University (ESU), majors' and non-majors' biology courses were taught by multiple faculty, and textbook decisions were a committee decision. In 1988 I became the founding Biology Coordinator at LSU, responsible for developing a new core of Introductory Biology integrating the introductory curricula of the Botany, Microbiology, and Zoology Departments. As part of our curriculum design, we identified 11 Key Concepts areas, focusing on common misconceptions related to Process of Science; Characteristics of Life; Biological Chemistry; Carbon Cycle; Growth; Sexual Reproduction; Inheritance; Variation; Natural Selection; Population Growth; and Community Ecology. We designed and validated an assessment instrument to evaluate changes in student understanding of these concepts.

We also identified five attitudinal categories and designed and validated an assessment instrument to measure how different teaching approaches affected student attitudes toward biology. The Categories were: Science in Everyday life; Personal Comfort with Science;

the Power and Limits of Science; Science and Religion; and Satisfaction with University Science Requirements. We administered these instruments as pre- and post-tests in every section of introductory biology for both majors and non-majors through 1994, and I have used them as pre-course benchmarks in every introductory course, including honors courses, I have taught for the rest of my career both at LSU and ESU.

In 1992, LSU founded its Honors College, and I designed honors biology lecture and laboratory courses with a more student-active approach than in the regular majors' biology program. The lecture was a Socratic discussion format based on Raven and Johnson's majors' *Biology* textbook (1989) supplemented by two general interest books: Gould's (1977) *Ever Since Darwin* and Thomas's (1974) *The Lives of a Cell*. I required that students annotate both their textbook and the supplementary readings, and I spot-checked and evaluated their annotations during exams. I also required students to read and critique two additional books from the reading list.

For the laboratory component, I developed a series of inquiry-based activities similar to those we were using in the non-majors' laboratories (Sundberg, 1994; Sundberg and Dini, 1993; Sundberg and Moncada, 1994; Sundberg et al., 1994; see also Sundberg (2002) and Sundberg et al. (2000)). In addition, lab teams from both the honors and non-majors' courses were responsible for designing and carrying out an independent research project at the end of the semester. As a result, we were able to use standardized assessments to compare the effectiveness of different permutations of lecture and laboratory approaches on student learning and student attitudes toward science. The unanticipated

consequence was that honors students and non-majors showed greater learning gains and more positive attitudes than majors, using the same assessment instruments. (A dean's comment, when we first reported the preliminary results at a college meeting, was that this can't be right and that there must be something wrong with the data or analysis.) I also realized that the honors students really engaged with the trade books and the depth of our discussions of these books covered as much, or more, content than the topics where only the textbook was used.

When I moved to ESU in 1997, I had the opportunity to re-institute an honors biology course, but this time as a general education alternative combining majors and non-majors. I used the same format as LSU except that rather than separate lecture and lab sessions, I scheduled a 2- and 3-hour block weekly in the botany laboratory that allowed flexible scheduling of integrated lecture/discussions and inquiry-based lab activities. Also, instead of a textbook, each year I chose four trade books focusing respectively on ecology, evolution, genetics, organismal biology, and/or critical thinking (Box 1). Majors were particularly anxious that this non-traditional format would not be as successful as the traditional lecture and majors text. However, I could assure them, based on previous classes and testing, that their preparation would be as good as, and probably better than, their peers taking the traditional majors course. To further address this anxiety, I provided a variety of majors' textbooks that students could check out to use as supplemental reading for particular topics. Students were still required to read and critique two or three additional books from the reading list. I required all students in all of my courses to annotate their "texts," and,

like at LSU, I scored their annotations during exams. Several upper division and graduate students subsequently told me they began annotating all their reading assignments, including journal articles, for all their classes because they found it an effective way to study.

How effective can trade books be for teaching an introductory college course? More effective than college professors imagine! Our earlier work at LSU, comparing majors' with non-majors' outcomes, cited above, suggested that this might be the case. We had constructed and validated a content assessment instrument and an attitude assessment instrument that we used as common pre-test/post-test tools to evaluate student learning and attitude change in the two tracks. For the 7 years I chaired the department at Emporia, I used these same instruments to assess the majors, non-majors, and honors courses every semester—and as an end-of-program "exit survey" prior to graduation. Pre-test scores of majors were slightly higher than non-majors, and honors students were intermediate. Both majors and non-majors were taught with a traditional lecture/lab format using majors' or non-majors' texts and manuals. Honors students used a discussion format of trade books and inquiry-based lab activities. Post-test gains were not significantly greater for majors than for non-majors, but honors scores were frequently significant (Figure 1). Data in the first four categories, relating to evolution, were published previously with further differentiation between majors and non-majors and different combinations of inquiry and traditional labs (Sundberg, 2003). These are pooled data from 3 years of the honors section and the three highest-scoring sections of the majors' classes. Data on the other concepts have not been reported previously. The trends between the honors

Box 1. *Trade Books Used as a “Text” over 25 Years in Honors Biology (2–4 per year) at LSU and ESU.*

- Armstrong, J. 2014. *How the Earth Turned Green: A Brief 3.8 Billion Year History of Plants*. University of Chicago Press, Chicago.
- Carroll, S. B. 2005. *Endless Forms Most Beautiful: The New Science of Evo Devo*. Norton, New York.
- Carroll, S. B. 2006. *The Making of the Fittest: DNA and the Ultimate Forensic Record of Evolution*. Norton, New York.
- Gould, S. J. 1977. *Ever Since Darwin: Reflections in Natural History*. W.W. Norton, New York.
- Kolbert, E. 2014. *The Sixth Extinction: An Unnatural History*. Henry Holt and Co., New York.
- Mann, C. 2018. *The Wizard and the Prophet: Two Remarkable Scientists and their Dueling Visions to Shape Tomorrow’s World*. Alfred Knopf, New York.
- Miller, J., and B. Van Loon. 1982. *Darwin for Beginners*. Pantheon Books, New York.
- Montgomery, B. L. 2021. *Lessons from Plants*. Harvard University Press, Cambridge, MA.
- Odum, E. 1998. *Ecological Vignettes: Ecological Approaches to Dealing with Human Predicaments*. Harwood Academic Publishers, Amsterdam.
- Pimm, S. L. 2001. *The World According to Pimm: A Scientist Audits the Earth*. McGraw Hill.
- Ridley, M. 1999. *Genome: The Autobiography of a Species in 23 Chapters*. Harper Collins, New York.
- Seethaler, S. 2009. *Lies, Damned Lies, and Science: How to Sort through the Noise around Global Warming, the Latest Health Claims, and other Scientific Controversies*. F.T Press Science, Upper Saddle River, New Jersey.
- Thomas, L. 1974. *The Lives of a Cell: Notes of a Biology Watcher*. Viking Press, New York.
- Zimmer, C. 2018. *She Has Her Mother’s Laugh: The Powers, Perversions, and Potential of Heredity*. Dutton, New York.
- Zimmer, C. 2021. *Life’s Edge: The Search for What it Means to Be Alive*. Dutton, New York

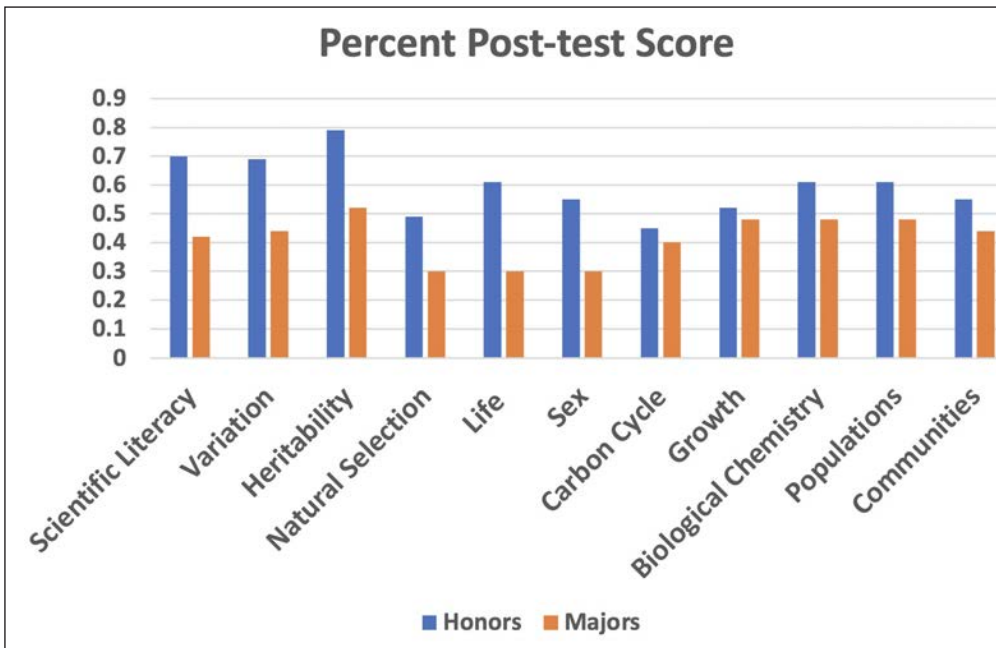


Figure 1. Post-test scores in honors and biology majors courses using the same content assessment. The first four categories are an abbreviation of previously reported data comparing a variety of teaching approaches (Sundberg, 2003); the final seven categories are newly reported data. The honors course described in the text and a traditionally taught majors' course, with textbook and accompanying laboratory, were the two highest-scoring approaches for all concept categories.

on the other concepts have not been reported previously. The trends between the honors course and majors' courses were similar for all of the concepts assessed. Post-test scores in the honors course exceeded majors scores for every concept tested. In some cases the differences were not significant, but the trend remained clear. For instance, one of the concepts related to carbon cycle is that plants both photosynthesize and respire. Yet, most students have internalized that plants are autotrophs and photosynthesize whereas animals are heterotrophs and respire, as usually taught in textbooks, and this remained resistant to change regardless of pedagogy. Perhaps surprisingly, while biology majors in the honors course had the highest pre-test scores, classmates majoring in economics or

English frequently showed the greatest gain and earned the highest grades!

RECOMMENDATIONS

My first recommendation is to encourage (require) your students to read some relevant botanical/biological trade books for general interest outside of class. This is quite possible even in team-taught courses or courses with multiple sections. For instance, 2 years ago, ESU dropped a decades-old biology core curriculum that required a one-semester introductory course followed by one semester each of Botany, Microbiology, and Zoology and replaced it with a two-

semester introductory biology sequence: Cell/Molecular followed by Organismal/Ecology/Evolution. It was an easy sell in the organismal course to encourage the team of instructors to require students to critique two trade books from the reading list for course curricula. A selection of partial quotations from recent student critiques was a convincing argument (Appendix 3). Indeed, most of the new instructors recommended several additional favorite books from their discipline to add to the reading list.

If you are the sole instructor in an introductory course, I encourage you to consider selecting appropriate trade books as an alternative to a traditional textbook. There are other precedents. It is not novel to find a college professor who doesn't use a textbook in undergraduate courses and instead uses primary literature (Goudsouzian and Hsu, 2023). This is considered to be especially effective in developing students' science process skills. At the K-12 level, the National Science Teachers Association has promoted using trade books to teach science for years, primarily to improve student attitudes toward science (Royce, 2012). Improving content understanding, science process skills, and student attitude can be combined with the trade book approach.

However, in departments with team-taught introductory courses, it may be difficult to convince colleagues to do something as drastic as substituting trade books for a textbook, especially in the majors course. Like my former dean would say, it just doesn't "make sense" that this could work. Of course, the results of data are not always what we expect or what make sense. When we were discussing our new courses, I did not even try the trade book route. Instead, I argued that

how you use a textbook is more important than the textbook you choose and that we should simply go with one of the Online Educational Resource (OER) Biology books freely available to students. However, the vote came down to either Campbell's *Biology* or Raven and Johnson's *Biology*. My argument was that the English, business, history, and science majors who took Honors Biology did not even use a textbook, and yet consistently outperformed our students in majors biology (Sundberg, 2003; Figure 1). Nevertheless, the faculty committee firmly believed that a comprehensive textbook (adequately covering each of their specialties) was necessary for students to learn the required material. It just "doesn't make sense" that you can do without a textbook. This is a strongly engrained faculty belief, especially when talking about majors' courses. However, in my experience, faculty are less concerned with such experimentation in the non-majors' courses, so that is where I always started.

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Appendix 1. Textbook Annotation

1. Use a mechanical pencil that lets you write CRISPLY and PRECISELY. Pencil lasts longer than ink and is easily erased.
2. Annotation is NOT highlighting!. You are not just emphasizing important ideas from the text. Instead, you are holding a running conversation with the author—“talking back” to him as you read.
3. As you read, REACT to what you read by writing down your thoughts and connections along the margin of the page.
4. Write down AT LEAST ONE legible annotation PER PAGE of assigned reading.
5. Print if your handwriting is not easily legible.
6. Connect your annotations to particular statements or sentences if appropriate.
7. Include emotions (+/-) in some or all of your annotations if you wish. Research shows that learning tied to emotion is more readily recalled.
8. Annotation makes a book your own. It records what you were thinking when you read the book, and it saves your good ideas for you.
9. Annotations should take the form of CONNECTIONS you see between the book’s content and your own work, ideas you see in the text for innovations that you want to make, links between what this author is saying and what other authors you have read say, examples you thought of that illustrate the author’s point, contrary positions you wish to take, names of people who would agree or disagree with what the author said, historical connections—noting something entirely new and intriguing to you, something that contradicts what the author just said, things that make you angry or sad or happy, your own definition of what has just been described in the text, connections to geography and places, connections to other cultures and sciences, origins of ideas you see being expressed in the text, things you see as ideal but not practical in your situation, ideas that remind you of a work of art, things you can use to prepare for your own career, things you consider humorous, ironic, or paradoxical, and so forth. Annotation makes your copy of the book valuable because it captures your otherwise elusive thought and makes finding key ideas easy for you later. It is an heirloom, a historical document, and an archive of your cognition—should you become famous someday!

Taken from “The Polymath System”™ by James H. Wandersee, 1996.

Textbooks will be collected and annotations examined during each examination.

Appendix 2. *Writing Summaries and Critiques*

For assignments in writing summaries and critiques, you are asked to read either a book or a paper from the original scientific literature and then summarize or assess what you read in fewer than two double-spaced, typewritten pages. Brief does not, in this case, mean easy. In fact, producing that one- or two-page summary or critique will probably require as much mental effort as that involved in preparing an essay or term paper of five to ten pages in length. To do well in these short assignments, you must fully understand what you have read, which usually means that you must annotate or take notes on your book or read the paper many times, slowly and thoughtfully.

Follow the same procedures whether you are asked to write a summary or a critique; indeed, a critique begins as a summary, to which you then add your own evaluation of the paper.

When reading a book, look over the table of contents and read the preface to give you a feel for what will be discussed and some perspective on the authors' intentions. Then annotate while you read following the same guidelines presented in the syllabus for annotating your textbook.

For a paper, begin by reading the paper once or twice without taking notes. Fight the temptation to underline, highlight, or otherwise create the illusion that you are accomplishing something. It is often difficult to distinguish the significant from the not-so-significant points during the first reading of a scientific paper; skim the paper once for general orientation and overview. Don't try for detailed understanding in the first reading, but do jot down any unfamiliar terms or the names of unfamiliar techniques so that you can look these up in a textbook before you reread the paper. It often helps to consult a textbook about the general biology of the organisms being studied before returning to the paper.

During the next, more careful, reading of the paper, pay special attention of the Materials and Methods and the Results sections. The essence of any scientific paper is contained here. The results obtained in a study depend on the way the study was conducted. Were samples taken only at one particular time of year? Was the study replicated? How many individuals were examined? What techniques were used? In an experiment, what variables (for example, photoperiod, temperature, salinity, or food supply) were held constant? Were proper controls provided for each experiment? Which factors might affect the outcome of the study?

As you begin to study the Results section, scrutinize every graph, table, and illustration, developing your own interpretations of the data before rereading the author's verbal presentation. We are readily influenced by the opinions of others, especially when those opinions are well-written. Keep an open mind when reading the author's words, but try to form your own opinions about the data first; you may see something that the author did not.

Appendix 2. *Writing Summaries and Critiques, con't.*

WRITING THE FIRST DRAFT

You will know that you are ready to write your first draft of the critique when you can distill the essence of the paper into a single (or at most two) summary sentence. This sentence should include all of the points, present an accurate summary of the study, and be fully comprehensible to someone who has never read the original. As a general rule, do not begin to write your review until you can write such an abbreviated summary; this exercise will help you discriminate between the essential points of the paper and the extra, complementary details.

1. If you cannot write a satisfactory one- or two-sentence summary, reread the article; you'll get it eventually. Once your summary sentence is committed to paper, ask yourself these questions:
2. Why was the study undertaken or the book written? What purpose did the author have in mind?
3. What specific questions were addressed or important points made?
4. How were these questions addressed? What approach did the author take to address each question?
5. What were the major findings of the study or conclusions reached?
6. What questions remain unanswered by the study? These may be questions addressed by the study but not answered conclusively, or they may be new questions arising from the findings of the study under consideration.
7. For books that are a collection of essays, choose two or three that you found most interesting and write on them. Don't try to summarize the whole book.

WRITING THE SUMMARY

When you can answer these questions without referring to the paper you have read, you can begin to write. Your introductory sentences must lead up to a statement of the specific questions the authors set out to address. Next, tell (1) what approaches were used to investigate each question and (2) what major results were obtained. Be sure to state, as succinctly as possible, exactly what was learned from the study.

A critique is much like a summary, except that you get to add your own assessment of the paper you have read. What were the good points; what were the bad points? Was there something you thought the author did particularly well or were you hoping the author would have included more of? Would you recommend this work to a friend? Why or why not?

Pechenik, J. A. 1993. *A Short Guide to Writing About Biology*, 2nd ed. New York, Harper Collins.

Appendix 3. Some Selected Excerpts from Student Critiques of Trade “Textbooks”

Carroll, S. B.: *Making of the Fittest*

Overall, I believe the book is thought-provoking and insightful. Carroll writes in a way that is easy to read, with the complicated aspects of DNA sequencing and genome expressions explained in a clear and concise way. An aspect of his writing that I liked was the use of humor. In a few places he made jokes such as adding comedy to the story of the man who ate a poison newt and by treating one scientific name as a tongue twister. Although the rest of the book’s tone is more serious and argumentative, these brief moments of humor helped lighten the mood and made the content feel more personal. I also enjoyed the use of multiple examples for every topic he discussed.

Montgomery, B.: *Lessons from Plants*

While plants do not have eyes, ears, or a sense of touch, they are aware of their environment just as much as we are with those senses. They distinguish kin, friend, and foe, and they are able to respond to ecological competition despite lacking the capacity of fight or flight. Plants are even capable of transformative behaviors that allow them to maximize their chances of survival in a dynamic and sometimes unfriendly environment.

The way Brenda writes this book, you can tell she is passionate about plants and what she studies. She explains the behaviors and strategies of plants in a way that is easy to understand, even if someone is not very knowledgeable about plants. She transitions from personal experiences to how the plant deals with a certain problem and survives, and what lessons to learn from them extremely smoothly. She uses words that some people would associate with humans to explain the way plants work, which makes it easier for the reader to connect the lessons. The book is very organized and builds on what is already stated and refers to what she has talked about already. She provides a different point of view of the world and of plants that people, and especially me, never thought of before. I would recommend this book to a friend because there are many lessons that can be learned, and it never fails to keep your attention.

Zimmer, C.: *She Has Her Mother’s Laugh: The Powers, Perversions, and Potential of Heredity*

The more questions that arise, the more we are able to discover about our own genome and the unique ways it functions. The book demonstrated that over time, numerous profound discoveries have occurred, but there are still many unanswered questions.

This book was interesting because it showed the historical development of genetics and modern evolutionary theory since the days of Mendel and also touched on the topic of eugenics, which is a dark part of the history of genetics. My biggest complaint with the book is that there was no clear concise timeline of events as chapters jumped back and forth throughout history with little discretion. I would have enjoyed the book more if it had been ordered more chronologically.

Appendix 3. *Some Selected Excerpts from Student Critiques of Trade “Textbooks”, Con’t.*

Thomas, L.: *The Lives of a Cell: Notes of a Biology Watcher*

"The Lives of a Cell," the collection's title essay, challenges the notion of the human as an individual organism. Rather than belonging entirely to us, Thomas explains, our bodies are produced by trillions of cells that work tirelessly and in harmony. In addition, he suggests we may be able to perceive the planet as a single cell if we apply this metaphor to a planetary scale.

Mann, C.: *The Wizard and the Prophet: Two Remarkable Scientists and their Dueling Visions to Shape Tomorrow's World*

Prophets, as Mann describes, are mostly concerned about the carrying capacity of planet Earth and believe that human consumption should be limited to prevent disaster. Wizards, on the other hand, think that human ingenuity and science can be used to reap more resources for humanity. Mann examines the challenges facing humanity as the world population approaches 10 billion by 2050, and questions how someone like Vogt or Borlaug would respond. These issues include producing food, obtaining freshwater, providing energy, and addressing man-made climate change. Throughout the book, Mann remains even-handed in his depiction of the wizard and prophet ideologies. He makes no attempt to choose which idea about how humans should interact with the world is correct.

My favorite thing about this book was the back and forth between the wizard and the prophet. Looking at one idea and then looking at another view right after really made me think. My least favorite thing about this book was the sadness it brought me. No one wants to hear that planet Earth is struggling and the only one who can save it is YOU. This is quite a daunting task.

This book is my favorite book out of the four. It was incredibly engaging read into the lives of Vogt and Borlaug as they developed such massive societal forces as the green revolution and modern environmentalism. Learning about the process of artificial breeding for specific traits under Borlaug was incredibly fascinating and the political activism of Vogt, while sometimes misled, is rather inspiring. I disliked how the book constantly switched between the two men rather than focusing on one over three or four chapters.



MEMBERSHIP NEWS

BSA Virtual Symposium on Climate Change: *Plant Resilience and Conservation for a Changing Climate*



SAVE THE DATE! You are invited to the BSA Virtual Symposium on Climate Change November 14-15, 2024, from 11 a.m. to 3:30 p.m. ET. Each day of the symposium will focus on its own theme, with a networking session to foster discussion and build new connections and collaborations.

This free global event is open to the public and includes 6 featured

speakers, as well as 12 contributed talks. Featured speakers include:

- **Dr. Sally Aitken**, University of British Columbia
- **Dr. Jill Anderson**, University of Georgia
- **Dr. David W. Inouye** (Professor Emeritus), University of Maryland
- **Dr. Nicholas J. Kooyers**, University of Louisiana, Lafayette
- **Dr. Holly R. Prendeville**, U.S. Department of Agriculture (USDA)
- **Dr. Tanisha M. Williams**, University of Georgia



By Amelia Neely

*BSA Membership &
Communications
Manager*

*E-mail: ANeely@
botany.org*

To register, or find more information, visit: <https://climatesymposium.botany.org/plant-resilience-and-conservation-for-a-changing-climate>.

BOTANY360 UPDATES

Botany360 is a series of programming that connects our botanical community during the 360 days outside of Botany Conferences. The Botany360 event calendar is a tool to highlight those events. The goal of this program is to connect the plant science community throughout the year with professional development, discussion sessions, and networking and social opportunities. To see the calendar, visit www.botany.org/calendar. If you want to coordinate a Botany360 event, email aneely@botany.org.

Recent Botany360 event recordings:

- **Now You're a New PI, What's Next?** (May 28, 2024)
<https://www.youtube.com/watch?v=-HjLVHv9JHA>
- **Longwood Gardens Fellows Program Informational Webinar*** (May 8, 2024)
https://www.youtube.com/watch?v=fYNMHCV4v_Y
- **Fulbright US Scholar Program: Insights from an Alumni Ambassador** (April 29, 2024)
<https://www.youtube.com/watch?v=D-dPEvKBLY8>
- **Getting Involved in Service to BSA and Beyond** (January 8, 2024)
<https://www.youtube.com/watch?v=kh-btx0L9c4>

*Sponsored Event

BSA SPOTLIGHT SERIES

The BSA Spotlight Series highlights **early-career and professional scientists** in the **BSA community** and shares both scientific goals and achievements, as well as personal interests of the botanical scientists, so you can get to know your BSA community better.

Here are the latest Spotlights:



- **Lucy Adhiambo**, Research Associate, Center for Ecosystem Restoration – Kenya
<https://botany.org/home/careers-jobs/careers-in-botany/bsa-spotlight-series/lucy-adhiambo.html>
- **Elton John de Lirio**, Postdoctoral Fellow, University of São Paulo
<https://botany.org/home/careers-jobs/careers-in-botany/bsa-spotlight-series/elton-john-de-lirio.html>
- **Funmilola Mabel OJO**, Postdoctoral Visitor, Royal Botanic Gardens, Kew, Richmond Surrey, TW9 3AE, London, United Kingdom
<https://botany.org/home/careers-jobs/careers-in-botany/bsa-spotlight-series/funmilola-mabel-ojo.html>

Would you like to nominate yourself or another BSA member to be in the Spotlight Series? Fill out this form: <https://forms.gle/vivajCaCaqQrDL648>.

CAREERS IN BOTANY PROFILES

The **2024-25 Careers in Botany Profiles** are now available at <https://botany.org/home/careers-jobs/careers-in-botany/careers-in-botany-profiles-2024.html>! These professionals in the field of the botanical sciences were part of the Careers in Botany Luncheon at Botany 2024 on June 17, 2024. Learn more about the variety of careers that are represented by these nine talented individuals from academia, industry, government, and more! This link provides these and past Careers in Botany Profiles.

BSA SPONSORSHIP OPPORTUNITIES

Do you know a business or organization that would benefit from being in front of over 3000 botanical scientists from over 70 countries, and over 60,000 followers on social media? The BSA Business Office has many opportunities for sponsorship including:

- Sponsored *Membership Matters* newsletter articles and footer ads
- BSA website banner ads
- Hosting Botany360 events
- Botany360 event logo advertisement during event, a slide before/after event, or time to discuss product at beginning or end of event
- Sponsored social media ads
- Advertisement space in the *Plant Science Bulletin*

Because we value our community, the above opportunities are limited with the hope of being informative without being intrusive. Sponsorships will allow BSA to fulfill our strategic plan goal of being financially responsible during this time of economic shifts.

To find out more about sponsorship opportunities, email : bsa-manager@botany.org.

FROM THE *PSB* ARCHIVES

60 years ago

“Dr. Constantine J. Alexopoulos, President (1963) of the Society, suggested to the Council that the category of Sustaining Member be created. Dr. Alexopoulos pointed out that the Mycological Society has such a membership category, and it is an attractive one. The Council appointed Dr. Lawrence Crockett, Business Manager, to make preliminary investigations of the idea as chairman of a committee.

For \$250 a company or organization will be given sustaining membership, a subscription to the Journal, and a 10 per cent discount on advertising in the Journal. Initial investigations have resulted in acceptance by three companies: Stechert-Hafner, Publishers; The Johnson Reprint Corporation; and Triarch, George Conant, Ripon, Wisconsin.”

—*Sustaining Membership*. PSB 10(1): 7

50 years ago

Wm. Bridge Cooke responds to recent discussions in implementing certification for botanists.

“I assume that a certified horticulturalist is one who will have earned his credentials in an accredited college totally through graduate programs or through apprenticeships with reputable firms. There will probably be a variety of ways of attaining the prized certificate. The company composed of certificated personnel or having such personnel on the payroll, will have a superior advantage over a company without such personnel. Of course, the possession of a certificate will restrict the activity of the holder to the province of the certificate. Have you ever met a situation in which your neighbors, casual acquaintances, or even trades people, because you are known to be a botanist, thought that you had the key to any and all problems of botany, horticulture, biology, local and national politics, and even moon-exploration? This will hopefully get you “off the hook”, but you will not have time to produce the documentation necessary to prove it before your interrogator’s face falls to the floor incredulous of this communication gap. Also, what IBY questionnaire even hinted that a certificate would be required? With the horticulturalists I can see some reason to have such a program of certification since professionals who got that way “legitimately” through schooling and labor are in a position to be pushed out by others who in their own way “legitimately” by labor and an innate uncanny ability to handle plants have risen to relatively high positions in the profession.

I cannot see any reason for botanists to be concerned with such a certification program. Of course, I have not been in any position to discuss the matter with anyone or hear anyone discuss it. I would think that a prospective employer would want to see transcripts and recommendations and other vitae in addition to any certificate which should only indicate adeptness in one or more administrative manipulation which could or could not be regarded as demonstrating a technique for killing time!

I hope botanists have more productive matters to discuss than any proposed “certification requirements” for being called a botanist!”

—*Cooke, Wm. Bridge. 1974. Opinion/Commentary*. PSB 20(2): 28

40 years ago

“The American Liberty elm the first true, totally American elm to be remarkably Dutch elm disease resistant and to closely resemble its disease-prone relatives is soon to become available. The Elm Research Institute is so confident of its new species’ disease resistance that it warrants all its trees for ten years. The Institute has initiated its “Johnny Elmseed” program to find and computerize the exact locations of all mature elms in the entire nation. In return for finding and reporting such a live American elm, The Elm Research Institute will send one free American Liberty elm seedling to the persons reporting its exact street location and owner identification.”

—*Disease Resistant American Elm 1984*. PSB 30(3): 18.



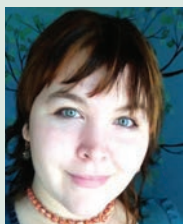
HIGH SCHOOL TEACHERS AND EARLY-CAREER SCIENTISTS PREPARE TO COUNTER STUDENT PRECONCEPTIONS ABOUT PLANT SCIENTISTS AND PHOTOSYNTHESIS AT PLANTINGSCIENCE F2 PROFESSIONAL LEARNING WORKSHOPS

Twenty-five high school teachers from 20 different states nationwide are preparing to participate this fall with their students in PlantingScience's Power of Sunlight photosynthesis and respiration Investigation Theme. Online and in-person professional learning workshops took place in June and July and featured close collaboration with 17 early-career scientists selected as "PlantingScience Fellows." The workshops are part of the BSA-led PlantingScience Digging Deeper F2 grant (NSF DRL#2010556), which is in its fourth year.

Core components of the workshop included: (1) teachers and scientists experiencing the Power of Sunlight activities as students will,

(2) analyzing video clips of teachers using BSCS Science Learning's evidence-based STeLLA pedagogical strategies (bscs.org/stella/), (3) discussing strategies teachers and scientist mentors can use to address common student preconceptions about photosynthesis and cellular respiration and about who scientists are and what they do, (4) analyzing transcripts and other artifacts of past student-scientist interactions from the website, and (5) discussing how teachers, Master Plant Science Team (MPST) Liaisons, and scientist mentors work together to reach our goals for student outcomes.

The workshops were led by a team from BSCS Science Learning (Anne Westbrook, Jenine Cotton-Proby) and by BSA Education staff (Jennifer Hartley and Catrina Adams). This year's workshops were greatly enhanced through co-facilitation by three scientist leaders with prior experience serving in the mentor and liaison roles. We so appreciate the help of Cari Ritzenthaler, Phillipa Stone, and Edi Wipf in this role. Three teacher leaders also participated, drawn from teachers who participated in last year's workshops. Next



By Dr. Catrina Adams,
Education Director



Jennifer Hartley,
*Education Programs
Supervisor*

year's workshops will be primarily facilitated by these teacher and scientist leaders as part of our sustainability plan.

We would also like to recognize the 17 scientists recruited from the BSA and partnering scientific societies who participated in these summer workshops and who will be working closely with the participating teachers and their students this fall: **Gina Errico, Sanbon Gosa, Betsy Justus Brijju, Stephanie Kate, Micayla Lamb, Joanna Lumbsden-Pinto, Stephen Mills, Emma Parker Miller, Santiago Pérez Ospina, David Riera, Bela Starinchak, Evan Stark-Dykema, Stephen Stresow, Joshua Toran III, Lakshmi Benkat Sai Ram Nagalla, and Balasaheb Vitthal Sonawane.**

WANT TO LEARN MORE?

PlantingScience was featured in a recent Spotlight on Collaborative Teacher Learning (<https://cadrek12.org/spotlight/collaborative-teacher-learning#adams>) from NSF's CADRE (Community for Advancing

Discovery Research in Education). The article provides a lot more information about the PlantingScience Digging Deeper F2 research project and how these collaborative teacher/scientist workshops fit into the research plan as well as some preliminary results.

PLANTINGSCIENCE UPDATES

Spring 2024 Session Recap

After a hectic session of juggling our usual PlantingScience participants with our F2 research participants last fall, we enjoyed taking a breath with a smaller session this past spring. The Spring 2024 session served over 560 students from 18 different schools. The teams tackled various themes, with Wonder of Seeds and Agronomy Feeds the World comprising most of the projects. We also had student teams studying celery tissues, Brassica genetics, and C-Fern development. Take a moment when you can to enjoy our



This summer, the BSA's Education booth at the Botany conference featured a lollipop pull game and fun botanically themed prizes for PlantingScience mentors and those suggesting resources for our State-by-State Resources website update. Jeremie Morel (right) shows off the soybean toy he won after signing up to mentor, while 2023 PlantingScience Fellow Josh Felton points to the "Ask me about PlantingScience" ribbon he was using to recruit new mentors to join the program.

Star Projects from this session: <https://plantingscience.org/about/sampleprojects>

As always, we extend our sincere thanks to the BSA members who assisted these student teams as mentors and liaisons—your support is what makes our program so special and successful! If you have never mentored for us, please check out our website at [Plantingscience.org](https://plantingscience.org) and consider signing up. You'll be making a difference in the lives of students all over the U.S. and helping to grow the next generation of plant scientists!

BSA MASTER PLANT SCIENCE TEAM RECRUITMENT IS UNDERWAY!

As we look ahead to the coming academic year, we seek early career scientists interested in supporting PlantingScience as liaisons! Members of the Master Plant Science Team support PlantingScience by helping teachers line up mentors for their students and then moderating the team conversations as they unfold. This is a great way to contribute to the PlantingScience program, and selected applicants will receive a free BSA membership, discounts on Botany 2025 registration, and other perks! For more information, visit: <https://plantingscience.org/getinvolved/joinmpst>



BSA EDUCATION COMMITTEE UPDATING CURRENT RESOURCES BY U.S. STATE/TERRITORY

The Education Committee would like to share links to up-to-date floras and field guides, academic programs (where in your state can people pursue a botany-related degree?), as well as organizations and quality, durable web resources focused on the botany of the state or region.

The first goal is to create the most comprehensive undergraduate student-appropriate state flora/field guides listed for each state. This will be useful resource for faculty who want to refer students to their local flora, or for botanists moving from one region to another. We would like to finalize this resource to promote at the Botany 2025 meeting in Tucson, AZ next summer.

After a push for attendees to submit their local resources during the Botany conference this summer, we now have 34 resources submitted representing 21 U.S. states. Thanks so much to everyone who has contributed to creating this useful resource!

We are still seeking more resources to complete the update, so please take a moment to share resources from your state or region. It should take less than 5 minutes to submit your resource(s), which will be vetted by the Education Committee and then added to the botany.org website. To submit a resource, please use this link: <https://forms.gle/VjpHPYM9pVKJ4dmh9>



Help us fill the map! Submit a resource for your state. We are marking each state as resources are submitted. We're almost halfway to getting all states represented.

NEW TEACHING RESOURCE: ANNOTATED LIST OF POPULAR BIOLOGY BOOKS

Marsh Sundberg has compiled an extensive list of popular biology (mostly botany) books with an eye to their use in teaching contexts and would like to share these with the BSA community. The list (which Marsh will occasionally update) is available as a Google Doc here: <https://docs.google.com/document/d/1USkGueM93AmqnsFpTNzaEWDGcrlgXZvL3mtQfjXDrXY/edit>

Suggested books are categorized into the following topics: **Biomedicine, Botany/Plant Biology, Ecology and Natural History, Economic Botany, Evolution, Forensic Botany, History of Biology/Biography, Mycology (Fungi), Microbiology/Molecular Biology, Philosophy of Science/ General Science, Phycology (algae), Women in Science, Zoological.**

If you are teaching or planning to teach courses involving these topics (or if you are just looking for a new book for your nightstand), please check out his curated list—and check out Marsh's article in this issue of the *Plant Science Bulletin!*

Q. Member of
MANRRS,
SACNAS, or
AISES?

Q. Curious
about plant
science?

A. Apply for a ROOT &
SHOOT travel award! Up to
\$3000 to attend a plant
science conference in 2025.

MANRRS
PRIORITY IN AGRICULTURE,
NATURAL RESOURCES AND RELATED SCIENCES

SACNAS
Advancing Chicanos/Hispanics
& Native Americans in Science

AISES
ADVANCING CHICANOS/HISPANICS
& NATIVE AMERICANS IN SCIENCE

**NSF RCN: BIO-LEAPS:
ROOT & SHOOT**
Rooting Out Oppression
Together and SHaring Our
Outcomes Transparently

ROOT AND SHOOT RCN TRAVEL AWARDS TO BOTANY AND OTHER PLANT SCIENCE CONFERENCES FOR STUDENT/MENTOR PAIRS WITH SACNAS, AISES, OR MANRRS AFFILIATIONS

Travel awards for the Botany 2025 conference are available for student/mentor pairs through the ROOT & SHOOT RCN. The group will launch recruitment for these awards in September, and applications are due December 2, 2024. Check out the rootandshoot.org website and join the mailing list to be notified of upcoming awards and other opportunities to participate.

A panel discussion will be held to kick off the recruitment for this award, featuring some of the 2024 travel awardees who will talk about their experiences and answer questions about the program. More details are available on this page: <https://rootandshoot.org/plan-ahead-for-2025-root-shoot-travel-awards/>.



STUDENT SECTION

Getting to Know Your New Student Representative

We are excited to welcome our incoming BSA Student Rep, Benjamin Ajayi! Ben's term began the day after the Botany Conference and will last for two years from 2024 to 2026. Get to know them in the interview below.



BENJAMIN ADEREMI AJAYI

Ph.D. Student at Florida State University

When did you join BSA and what motivated you to do so? Will you encourage other students to become members and participate in the society as well?

In 2020, I joined the BSA because I was determined to expand my research network and improve my skills as a botanical researcher. My membership in BSA has given me access to information and opportunities that have helped me grow academically. I can't wait to take advantage of these advantages in order to advance my career and significantly advance the field of botanical study. In addition, I am excited to see more people join BSA and become involved so that we can all work together to create a lively and cooperative community inside the Society.

What motivated you to run for the position of Student Representative to the Board of Directors and what do you plan to do as the student representative of BSA?

I joined the BSA back in 2020, which became a nurturing ground for my passion in plant biodiversity. As time passed, my professional journey and BSA's mission have aligned perfectly. The Society has been more than just a professional association—it has provided a strong network, fostered research collaborations, and facilitated career growth. Now, at this thrilling point in time, I see a path forward where the BSA can expand its impact, particularly in enriching the experiences of the more student community. As a student



**By Josh Felton and
Benjamin Aderemi Ajayi**
BSA Student Representatives

representative elect, I am committed to ongoing efforts to enhance diversity, equity, and inclusivity in our Society. It would be a privilege to represent and work alongside my present and future colleagues in the BSA.

What have you gained from being a student member of BSA and why would you encourage other students to become members and participate in the society?

During my attendance at a Botany Cconference held in Alaska in 2022, I discovered captivating new research findings in the fields of ecology and evolution. Additionally, I formed valuable professional connections, one of which ultimately led me to find a PhD advisor. The experiences gained during the conference had greatly impacted my ongoing doctoral research at Florida State University.

What's your research about and how did you discover your research interest?

I am interested in exploring the quantitative genetic variation in Florida endemic Panhandle lily (*Lilium iridollae*) for Enhanced Management and Conservation Strategies.

What sorts of hobbies do you have?

Reading and traveling.

BOTANY 2024 REVIEW

It was so great seeing so many of your faces again in person at Botany 2024 in Grand Rapids! Students made up 47% of the total conference attendees with 409 total students!

The student reps worked to encourage more interactions between students and the botanical community at a variety of events. Our first event of the week was the *Data Analysis and Visualization in R* on Sunday, where students got the chance to learn the basics of R while also analyzing their own datasets. The next day, we held the widely popular *Careers in Botany Luncheon* where we had 10 panelists for students to connect with. We then helped host a very well-attended *Student Social* at the B.O.B.'s House of Music and E where we chatted late into the night.

For those of you who have not filled out the **Conference Survey**, please visit <https://www.surveymonkey.com/r/Botany2024> to help us make the conference a better experience for you in the future.

Reach us by email or X: Josh (feltonjosh@icloud.com; @JoshFelton12) or Ben (baa23a@fsu.edu; @ajayibenmi).

Careers in Botany Luncheon

At the Careers in Botany Luncheon, we had nine panelists who represented the spectrum of career stages and jobs, with panelists working in academia, government, non-governmental organizations, herbaria, and botanical stations. A total of 88 students attended! Read more about the panelists at the *Careers in Botany Profiles*: <https://botany.org/home/careers-jobs/careers-in-botany/careers-in-botany-profiles-2024.html>.

Data Analysis and Visualization in R

Our first CV writing/website building workshop was a great success with 4 panelists and 20 attendees. This workshop introduced basic concepts, syntax, and usage in R programming, statistical analysis, and visualization techniques for botanical data. In the first half of this workshop, we provided an overview of R and its basic usage. We covered basic information about R syntax and the RStudio interface, and we moved through how to import CSV files, the structure of data frames, how to manipulate data frames, how to calculate summary statistics from a data frame, and a brief introduction to plotting. In the second half of this workshop, we discussed and performed statistical analyses and visualizations best suited to student datasets. We also discussed different data visualizations to illustrate both good and bad applications of design and visualization principles. By the end of the course, students had the essential skills of processing, manipulating, and analyzing data of various types, creating advanced visualizations, generating reports, and documenting codes.



Student Social

Thank you to everyone who attended the Student Social! We had a great time getting to know each other at the B.O.B. Building in Grand Rapids. We look forward to seeing all of you again, or getting to know you for the first time, at Botany 2025 in Tucson, Arizona!



BEYOND THE CONFERENCE

This year, we continue to work with the BSA Early Career Professional Development Committee to support students and early career professionals. This group is working hard to help students and junior botanists meet other professionals, find mentors, and take advantage of various opportunities. Their GRFP workshop and mentorship opportunity is aimed at helping students apply for the NSF award this year. Their Fulbright Webinar discussed the process of applying for Fulbright grants, particularly for those beyond the student level. The committee also hosted a

new PI webinar aimed at new PIs, who just accepted offers, negotiated terms, and are now trying to start a lab and get things going; this webinar aims to discuss the logistics, challenges, and surprises of setting up a new research group and how to navigate through one's first year as a new PI.

They are also putting together another GRFP workshop this fall. Keep your eyes out for more updates from BSA's social media accounts and newsletters.

Learn more about the committee at: <https://cms.botany.org/home/governance/early-career-committee.html>.

New Phytologist Tansley Medal for excellence in plant science

Calling all early career scientists!
Submission deadline: 1 November 2024

- The *New Phytologist* Tansley Medal is awarded annually in recognition of an outstanding contribution to plant science.
- This is a global competition open to all early career scientists with 3–5 years' experience, excluding career breaks, since gaining their PhD.
- The winner receives £2000 (GBP) and will have their work highlighted in *New Phytologist*, a leading plant science journal.

Apply now: newphytologist.org/tansleymedal



Full details, terms and conditions: newphytologist.org/tansleymedal





ANNOUNCEMENTS

IN MEMORIAM DONALD A. LEVIN (1939 – 2022)

An Ecogeographic Perspective

Don, a lifelong Cubs fan, was born and raised in Chicago. He was the preeminent plant evolutionary biologist from the mid-1960s to the early 1990s with 170 publications from 1963 to 1990. In the days when one browsed journals in the stacks, Don seemed to have a paper in every issue of *Evolution* and the *American Naturalist*: from 1966 to 1975 he published 34 papers in these two journals. In addition to 230+ journal articles, Don wrote two books: *The Origin, Expansion, and Demise of Plant Species* (2000) and *The Role of Chromosomal Change in Plant Evolution* (2002). His publications have garnered over 25,000 citations (h-index=74; <https://scholar.google.com/citations?user=1jE4flwAAAAJ&hl=en&oi=ao>).

Don received his PhD from the University of Illinois with Dale Smith, a Charles Heiser student. Following his PhD, he took his first job at the Chicago campus of the University of Illinois (UIC). After 5 years he moved to Yale, and two undergrads from UIC, Morris Levy and Barbara Schaal, became his first graduate students there. After three years at Yale, he moved in 1972 to the University of Texas in Austin.

Don's work has brought about sweeping changes in the analysis and understanding of plant population biology. Trained as a biosystematist, Don's earliest work lay mostly in investigating the frequency and limits to interspecific hybridization in the genus *Phlox*, with studies on reproductive isolation between species. Gene flow in plants was to become his primary interest: in particular, the movement of alleles via pollen transfer.

While at UIC, Don had the good fortune to hook up with Harold Kerster, a herpetologist who was familiar with the population genetic methods of Sewall Wright. In a series of publications, they forged a new direction for plant studies with investigations on evolutionary aspects of gene movement both between and within species. These set the stage for a major shift from studies focused on pollination ecology and pollinator syndromes to an evolutionary approach via plant population genetics.

Their first study on intraspecific allele movements, *Local gene dispersal in Phlox*, estimated both seed and pollen dispersal and estimated neighborhood sizes in the perennial *Phlox pilosa*. They followed this with empirical studies in other species, examined effects of density and plant height on pollen flow, and estimated theoretical neighborhoods and effective population sizes under different plant breeding systems. They topped this all off with their monumental 80-page review, *Gene flow in seed plants*, now with over 1300 citations.



Three generations of the Levin academic lineage at the 2018 Evolution meeting in Austin, TX. (Left to right): Carl Schlichting¹ (F₁), Don Levin (P), James Mickley² (F₂), Courtney Murren³ (F₂), Nora Mitchell⁴, Stacy Krueger-Hadfield⁵, Tim Moore⁶ (F₂), and Ben Flanagan.⁷

Current affiliations: 1-Prof Emeritus, UConn; 2-Herbarium Director, Oregon State University; 3-Professor, College of Charleston; 4-Assistant Professor, Univ. of Wisconsin – Eau Claire; 5-Associate Professor, Virginia Institute of Marine Science; 6-Director of Statistical Consulting, UConn; 7-PostDoctoral researcher, D. Bolnick Lab, UConn.

Don maintained his interest in the effects of gene flow on the evolution of plant populations with many studies on the genus *Phlox* but began to branch out with conceptual investigations and reviews. His curiosity about plant defenses against herbivores led to a series of reviews of plant phenolics, trichomes, and alkaloids. He was interested in the consequences and impacts of polyploidy, including how polyploidy could induce novel phenotypes (1983), and a series of 11 papers between 2006 and 2021 on the importance of polyploidy for plant diversity.

His interest in gene flow and the potentials for hybridization/reproductive isolation led him to further general investigations on the nature of plant species and plant speciation.

Again, not only did he perform empirical investigations, but also produced extensive reviews and keen syntheses. For example, *Phlox drummondii* occurs in both pink and red flower color morphs; the red-flowered variety occurs only in the eastern portion of its range, notably in areas where it is sympatric with the pink-flowered species *P. cuspidata*. Setting out an array of pink- and red-flowered *drummondii* plants in a *P. cuspidata* population, he determined that red-flowered plants had significantly lower levels of interspecific pollen exchange, suggesting that the evolution of the red-flowered morph was an example of character displacement (1985). Robin Hopkins followed up on this work, finding molecular signatures of selection on

an allele that intensifies pigmentation in the red-flowered morph (2011, 2012).

Don's was an insatiable quest for new insights. Back when it was actually possible, Don read *all* the literature and was very quick to identify and deploy useful new techniques, often from the zoological literature. In his early career he employed analysis of hybridization in plants via paper chromatography and was a very early plant adopter of allozyme techniques (1970). But it was not only techniques that he was interested in—he kept an eye on new conceptual ideas and applied them to plants, e.g., he wrote two papers on developmental instability in plants in 1970. He used a dominant allele as a means of distinguishing effective gene flow from pollen dispersal in progeny of *Phlox*, and he made use of the broad range of cultivars of *Phlox* to understand patterns of evolution in annual species. His interest in pollen movement led him to be among the early investigators of the fate of microgametophytes (1975).

Perhaps the best example of his eye for innovation was his 1975 paper, *Pest pressure and recombination systems in plants*. At the time, there was widespread interest in the paradox of sex: what features of sex could provide the necessary advantage to individuals required to overcome its disadvantages? Don proposed that selection pressure to avoid parasites, e.g., herbivorous insects, would provide significant advantages to the

production of novel recombinant phenotypes, e.g., new phytochemical profiles. In essence, this was an application of the Red Queen hypothesis, offered by van Valen in 1973 to explain patterns of extinction in the fossil record. Levin's formulation was proposed several years in advance of similar ideas by John Jaenike, WD Hamilton, and Graham Bell.

Don collaborated widely on 'idea' papers, most notably with an array of animal population geneticists (Wyatt Anderson: competition for pollinators; Alan Templeton: seed pools; Phil Hedrick: population bottlenecks; Alan Wilson: evolutionary rates), but also with plant population biologist Janis Antonovics (density-dependence) and epidemiologist Lauren Meyers.

Don had a dozen or so PhD students whose research spanned many topics; almost all went on to successful academic careers. His innovative studies in natural plant populations and extensive reviews provided the groundwork for the careers of many graduate students.

—Carl D. Schlichting, Professor Emeritus, Department of Ecology and Evolutionary Biology, University of Connecticut



BOOK REVIEWS

Brave the Wild River: The Untold Story of Two Women Who Mapped the Botany of the Grand Canyon

Date Palm

Enchanted Forests: The Poetic Construction of a World Before Time

From Despair to Discovery: The Botanical Odyssey of Matthias Jakob Schleiden and the Dawn of Cell Theory

The Lichen Museum

The Lives of Seaweeds: A Natural History of our Planet's Seaweeds & other Algae

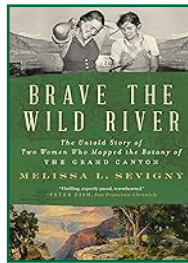
Brave the Wild River: The Untold Story of Two Women Who Mapped the Botany of the Grand Canyon

Melissa L. Sevigny

2023. ISBN 978-0-393-86823-4

US\$30.00 (cloth); 290 pp.

Norton, New York



The Hoover Dam was completed in 1936, and by 1938 Lake Mead was beginning to drown the former riverbank of the Colorado River. Elzada Clover, a 42-year-old recent PhD (1935) and instructor in botany at the University of Michigan, received a \$300 grant to document the plant life along the Colorado River. No one had ever collected along the famous route of John Wesley Powell, and only a few men had matched Powell's feat of floating through the Canyon. Clover was undeterred and focused on finding new species before they were lost forever.

Clover's dissertation was on cacti of the Rio Grande Valley, and her goal was to study all the cacti of the southwest. On a collecting trip to southern Utah in 1937, Clover met Norman Nevills, a lodge owner and river guide who led river trips down the San Juan and Colorado Rivers as far as Lee's Ferry. Clover wanted a

guide for a mule trip into the Grand Canyon to collect cacti; Nevills wanted to run the river through the Grand Canyon, document the experience, and drum up publicity. "In a few minutes they laid out the entire harebrained scheme."

Clover recruited two grad students to the team. Eugene Atkinson, skilled in taxidermy and studying paleobotany, could collect specimens of birds and mammals to sell to help subsidize the trip. Lois Jotter, with a master's in botany and working on a PhD in cytogenetics of *Oenothera*, was a friend and former roommate with back-country experience. Nevills built three flat-bottom boats and recruited LaPhene Harris, a USGS river gauger, and Phil Gibson, an amateur photographer from San Francisco. The six met on June 12 at Green River—along with a reporter from Salt Lake City. The AP was already producing national reports about the trip, which was "a mighty poor place for women," even if they were archeologists. The public caught the novelty of women going down the river, but the press never did recognize that they were botanists and they were going on a scientific expedition to collect plants. Clover made her first collection of the trip that day, personal collection number 1912, a specimen of *Opuntia polyantha* var. *hystrixina*.

On June 20 they started down river. Both Clover and Jotter kept journals and wrote letters focusing on the plants they found, the river they experienced, and personal dynamics within the group. Even before reaching the Colorado River four days later, they noted the spread of invasive Tamarisk along the riverbank. The group had already established a routine. The women cooked and collected, the men steered the boats and rowed.

Early the next day the brownish Green River joined the raging, red Colorado River at flood stage, only 4 miles ahead of their first rapids in Cataract Canyon. The adventure had truly begun, yet that first evening Clover recorded collection number 2104, *Forestiera Neomexicana*—nearly 200 collections in the first 5 days. They experienced rising river, loose boats, raging rapids, capsizing, thunderstorms, and landslides while collecting plants. The days became a blur and personalities began to clash. On July 4, they reached the confluence of the San Juan River and decided to take a detour to visit Rainbow Arch. However, according to their schedule, they were due to be at Lees Ferry and the Press (and resupply) was waiting anxiously. For three days TWA rerouted flights from Los Angeles to allow pilots to search Glen Canyon. On July 7, a U.S. Coast Guard plane spotted them and dropped a message asking them to signal if they were the “party of geologists from the University of Michigan who are overdue at Lees Ferry.” The next day they landed at Lees Ferry and journalists had a field day of (mis)information. Clover arranged for more than 100 cataloged specimens to be shipped back to Michigan, and two of the men left and were replaced.

Finally, resupplied and rested, the expedition resumed on the 13th with the river still at

flood stage but dropping fast. Five days later they were at the base of Bright Angel Trail and again the press was ready. There was no mention of botany; Jotter notes in her journal that the press has always been interested in her as a woman with no mention of botany. Clover arranged to have additional collections brought up from the river and sent to Michigan from Park Headquarters, but they were left at the river. (In October, another river guide who had met the group at Lees Ferry found the presses at the base of Bright Angel Trail and sent them back to Michigan.) From this point on, Clover continued her journal writing but Joiner stopped. At the end of the Grand Canyon and coming into the filling Lake Mead, Clover comments on barrel cacti drowning as the reservoir rises.

Forty-three days (36 on the water) after beginning their expedition, Clover and Joiner reach the end and returned to Michigan. More than 400 species are in their published collection list in the *American Midland Naturalist*, including two type specimens, *Echinocereus canyonensis* and *Sclerocactus parviflorus*, deposited in the U.S. National Herbarium. They also co-published on Grand Canyon Cacti in the *Bulletin of the Torrey Botanical Club*. Clover retired from Michigan as Professor Emeritus of Botany in 1967.

The importance of this work is significant. Sevigny explains “There was simply no other comprehensive plant list published prior to the closure of Glen Canyon Dam.... Anyone who wanted to understand how the vegetation had changed...had to refer to Clover and Joiner’s work.” (p. 343).

Joiner married mycologist Victor Cutter, Jr. in 1942, and upon completing her degree joined the faculty of the Woman’s College of the University of North Carolina. In 1994, at the

age of 80, she was invited to join a 12-day raft trip to reassess the effect of the Glen Canyon Dam on the river. She accepted the invitation because it was about science, according to the author, not because she was a woman who ran the daunting Colorado River through the Grand Canyon.

The author does an excellent job of constructing an engaging account of the expedition from the botanists' journals and letters, while putting it into both historical and ecological perspective. Sevigny's story adds the names of Clover and Joiner to a long list of women, many botanists, who have provided information vital to the conservation movement (Riley, 1999). It should be in every school library and on every teaching botanist's reading list. It would be a great gift for budding botanists.

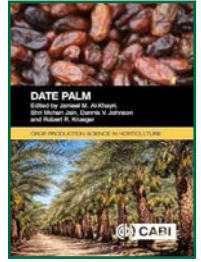
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—Marshall D. Sundberg, Kansas University Affiliate and Roe R. Cross Distinguished Professor - Emeritus, Emporia State University; and Sara B. Sundberg, Professor of History - Emeritus, University of Central Missouri

Date Palm

By Al-Khayri, Jameel M., S. Mohan Jain, Dennis V. Johnson, and Robert R. Krueger (eds)
2023. ISBN 13-9781800620186
US\$100.00 (paper); 638 pp.
CABI, Boston



This book, part of the Crop Production Science in Horticulture series, consists of 18 chapters divided between basic botany, diversity, and genetic improvement—all aspects of production from plantation establishment through post-harvest processing, and future opportunities. Each chapter is a stand-alone essay that leads to some repetition, particularly of the history of date palm cultivation, but this does help put every focused chapter into the general perspective of date cultivation.

General botanical interests are covered in the first five chapters. The first chapter provides the history of date palm cultivation—arguably the first cultivated fruit crop, domesticated in the Middle East (Mesopotamia) approximately 5000 years ago, although exploited prior to domestication for perhaps 2000 years before that. Archaeobotanical evidence supports production expansion to Egypt by 3500 BP and to West Africa and India by 2000 BP. Many current cultural practices were developed in antiquity and documented in art, writing (code of Hammurabi), and cultural artifacts. The date palm is referred to in the sacred texts of all three Abrahamic religions and may have been “the tree of life” (Tree of Knowledge of Good and Evil in the Garden of Eden). Its ancestry is unclear and many traditional varieties still exist. Date is the keystone species of desert oases. Today date palm production is primarily in developing countries where dates remain a primary food crop. Traditional oasis production dominates North African countries, and plantation production dominates in Arabia and Pakistan.

Botany and physiology are the focus of Chapter Two. Some interesting features are highlighted. Although typically a single-stemmed palm, many western varieties have branched individuals. While notably tolerant to heat (and even requiring it), the roots require accessible water and include short, thick 'root tubers', containing mycorrhizae, as well as aerating pneumatophores. Stems are protected and strengthened by ensheathing leaf bases. The sclerified leaves are persistent and contain phytoliths. Surprisingly, stomata were not mentioned in the leaf anatomy section; only in the chapter on plantation establishment and management are the occurrence of sunken stomata mentioned. The plants are dioecious with inter-foliar branched inflorescences. Pollen affects not only embryo and endosperm development, but also development of seed and fruit (metaxenia).

With more than 5000 cultivars worldwide, it would seem that there is adequate diversity for breeding, but there are many limitations. While adapted to high temperatures, plants are not drought tolerant, and climate change is exacerbating even heat stress in most production areas. For decades, tissue culture has been used for propagation and to assess germplasm, but its success is cultivar-dependent, and countries tend to have their own unique set of favored cultivars along with political barriers to protect and prevent sharing of genetic resources. Because different varieties tend to dominate production in individual countries, it is difficult for researchers to focus selection on particular desirable fruit characteristics, environmental tolerances, and disease and pest resistances that will have widespread application. There is a recent shift to using various genetic engineering techniques, but they are small in scale and typically country-specific.

As expected, most of the book focuses on topics of specific interest to producers, elaborating on best practices and case studies from different production areas, but three of the last chapters are again of general interest. Whereas 90% of dates are eaten fresh, 10% are processed in various ways. At harvest, about 25% of the mass of a fruit consists of glucose and another 25% consists of fructose. Date paste is a natural sweetener used as an alternative to sugar in baking and confectionaries. Date syrup is used as a base for carbonated beverages and fermented dairy products. Byproducts of processing are used in alcohol fermentation and animal feed.

Since antiquity, health benefits have been claimed for dates. For instance, the Indian Ayurveda system considers date "a wonder fruit" (p. 528) used to remedy diseases ranging from teeth and gums to a number of dermal and respiratory tract problems, infertility, and nervous conditions. This is the basis for a variety of modern nutraceutical products with anti-inflammatory, immunomodulatory, antitumor, antidiabetic, antioxidant, antimicrobial, and cardio-protective properties.

Finally, there are a number of nonfood products and uses of date palm. Since antiquity, the trunk has been used as wood for construction. Today, panels are produced to provide thermal and sound insulation and as a substitute for cork in stylish women's shoes. Leaves are used to manufacture furniture, handicrafts, art, and decorations. Of course, dates have religious significance: the palms used in Christian observance of Palm Sunday, breaking the fast on the days of Muslim, Ramadan, and lulav used in the Jewish holiday Sukkot.

This book will be the “bible” for commercial date producers around the world. Each chapter, written by one or more experts on the topic, is a compendium of information. Many useful tables and graphs summarize key data, and every chapter has an extensive and current bibliography. For this alone it should be in every agricultural school library. But it also has information of general interest to plant anatomists, physiologists, and ecologists; ethnobotanists; and agricultural economists. It’s pretty expensive, though, so you’ll probably want to borrow it from a library.

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

Enchanted Forests: The Poetic Construction of a World Before Time

Boria Sax

2023. ISBN: 978-1-78914-790-2

US\$35 (Hardcover); 286 pp.

Reaktion Books, London, U.K.



According to Earth.org, 10,000 years ago forests covered 71% (10.6 billion hectares) of the Earth’s surface, an area that has now decreased to 31% (4.1 billion hectares). Today, forests the size of 27 soccer fields are lost every minute. In *Enchanted Forests: The Poetic Construction of a World Before Time*, Boria Sax describes how humans for the centuries prior to our current understanding of forests as biological entities “poetically constructed” them as “enchanted” places, populated according to their fears, and invented mythologies “before time” that would explain forests as primeval, a condition necessary to conquer in order to build civilization.

A poet and social activist with a background in intellectual history, literature, and folklore, Sax found his niche in writing about human-animal interactions. He has written more than 20 books, among them *Avian Illuminations: A Cultural History of Birds, Crow (Animal)*, and *Imaginary Animals: The Monstrous, The Wondrous, and the Human*, all for Reaktion Books. He also teaches in the college program of the Sing Sing Correctional Facility and the online graduate literature program of Mercy College.

Sax describes in his introduction, “Forests and Memory,” how he inherited a tract of forest in upstate New York in 1985 that had been originally purchased by his Russian Jewish Communist grandparents who sought a safe haven from strife in Europe. Ownership prompted him to take a course from the New York State Department of Environmental Conservation, which earned him a Master Forest Owner (MFO) designation. As such, the DEC refers other forest owners to him for advice about managing a forest. While acknowledging that he does not feel “master of anything” or is in any way a professional forester, taking on the responsibility of owning a forest inspired him to take a deep dive into the complex history of human interaction with forests.

Sax writes in his Epilogue that “epic problems require us to think on epic scales.” He has done just that to illuminate our ambivalent relationships with forests over the centuries. The 15 chapters in his book cover every aspect of forests in human culture. Like a veritable Scheherazade, he tells stories that many of us have forgotten in order to document his tour of forests, from “The Primeval Forest to the “Classical, Rococo, and Gothic Woods” to the “Postmodern Forest,” with additional subjects like the “The Royal Hunt” and “The Politics

of Trees” and “The Man with the Big Axe” (Paul Bunyan). *Enchanted Forests* is as much about us as it is about forests. He convincingly argues that “the forest is a monstrous double of humankind, completely alien in some respects and profoundly human in others” (p. 15).

In “Conquest of the Woods,” he tells the story of Gilgamesh, the world’s first epic hero and a deeply flawed human. In the Sumerian version, c. 2100 BCE, Gilgamesh and his comrade Enkidu, the world’s first “wild man,” trick Hambaba (Hawawa), the guardian spirit of the Cedar Forest of Lebanon, to gain access to the cedar trees for timber to build their city. They rob him of his seven powers for protecting nature with worldly gifts and kill his seven daughters. In this version Enkidu regrets that the forest becomes a wasteland. Gilgamesh and Enkidu do not prosper after this “transgression.” Sax writes, “This is an environmental parable that is as relevant today as when it was written” (p. 74). Their deed “is done with all of the fear, hesitation, ambivalence, frenzy and remorse that have accompanied the conquest of nature, real or imagined, up to the present” (p. 74). Finally, after hundreds of years of exploitation of cedar of Lebanon timber by many countries, in 1985 the Committee of the Friends of the Cedar Forest planted 200,000 trees to begin reforestation. The area is now a World Heritage Site with restricted access.

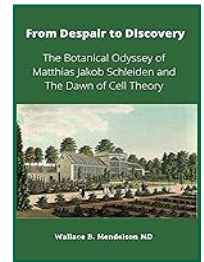
At the beginning of the chapter “Mythic Beings of the Forest,” Sax quotes John Burroughs’ fear that his exuberant writing might cause readers to be disappointed in their own encounters with nature. He asked, “Do such books as mine give a wrong impression of nature, and leave readers to expect more from a walk or a camp in the woods than they usually get?” (p. 49). This is an interesting question. After reading

Sax’s book, readers will carry more insight about the human condition into the woods—with profound regret for how much our fears and lifestyles have led to so much loss of forest diversity. Sax is an optimist. He believes that if we “reject the concept of a primeval past—we will cease to be dominated by an imagined past and more open to the beauty of the forest” and recognize their biological value. Reaktion Books has beautifully produced this wonderful book with a treasure trove of illustrations, each one telling a story that complements the text.

—Elizabeth Lawson (email: www.elizabeth-winpennylawson.com)

From Despair to Discovery: The Botanical Odyssey of Matthias Jakob Schleiden and the Dawn of Cell Theory

Wallace B. Mendelson, MD
2024. ISBN: 9781735334394
US\$13.00 (paperback), 104 pp.
Pythagoras Press



Matthias Schleiden, as in Schleiden and Schwann’s Cell Theory, is little known or appreciated today other than as the botanical co-author of this foundational theory. In part this is because his only biographies are in German—the most recent 20 years ago and two others more than a century old. This is also because his botanical significance was “erased” by the broad stroke of two other “overthrown” theories. The author, a distinguished retired professor of Psychiatry and Clinical Pharmacology at the University of Chicago, explains this in his concise, yet extensively researched, volume that focuses on Schleiden’s upbringing and training, the role of mentors and “the context of science and culture of his era.” The book is organized around eight chronological chapters, each of

which focuses on a critical time in Schleiden's life. The end of the book has separate chapters on Schleiden's personality, Theodore Schwann, Schleiden and Schwann, and Schleiden's legacy. An addendum explains the Cell Theory, as developed by Schleiden, Schwann, and Virchow (three contemporary students of Johannes Peter Müller) and the two discredited theories that diminished his stature in botany: the Theory of Cell Formation and the Theory of Creation of the Plant Embryo.

The author relies heavily on a diary and family letters, various archive collections, and the German biographies to sketch the life of a well-to-do young German at the end of the Romantic age, the early 1800s, struggling to find direction for his life. He met, and was influenced by, Goethe and Humboldt; he studied and practiced law; he studied medicine; he attempted suicide (twice ultimately); and he found a calling in botany, under Friedrich Bartling at the University of Göttingen where he was introduced to microscopy. Mendelson spends some time trying to understand the suicide attempts and put them into perspective because while the first is mentioned in several accounts and "part of legend," there is only a single published footnote mentioning the second. Schleiden's correspondence with his brother is the primary documentation for the latter.

In hopes of finishing quicker, he moved from Göttingen to Berlin where his uncle, Johann Horkel, was professor of plant physiology at the University. There he met visiting scientist Robert Brown, who encouraged Schleiden in his microscopic work, and began work under Johannes Peter Müller's tutelage, along with Theodor Schwann who arrived the year before. Schleiden finished in 1837 and began looking for a job, but the following October he returned to Berlin and had dinner with

Schwann. Schleiden had just published his paper on phytogenesis where he introduced the cell theory for plants, which was certainly the topic of conversation. The author describes several second-hand accounts of this famous dinner, which ultimately led to publication of the Cell Theory in Schwann's book on the similarities in structure and growth of animals and plants the following year.

Schleiden's search for a suitable position eventually brought him to the University of Jena where he obtained a Doctorate in Philosophy and was hired as Associate Professor of Botany in 1840. Here he built his botanical reputation, and saw it erased as he refused to acknowledge errors in his findings as new research was published by others. In 1842 he published the first edition of his textbook on *Principles of Scientific Botany*. Mendelson notes that Schleiden's approach vigorously rejected both Goethe's Natural Philosophy and Linnaeus' rigid taxonomic approach. Instead, he emphasized observation and experimentation over the course of a plant's development, and this was instrumental in transforming botany to a scientific field. Although frequently not recognized today, the importance Mendelson gives to this contribution is not hyperbole. "Schleiden's textbook was the first of its kind that supplied the student with really good figures based on careful observations ...its appearance at once put botany on the footing of a natural science in the modern sense of the word...Botany appeared all at once as a science rich in subject matter..." (Sachs, 1906, pp. 191-192). Nevertheless, current dogma recognizes Hoffmeister, not Schleiden, as the founder of modern morphological study (Kaplan, 2001). Yet Hoffmeister believed that Schleiden's text "is one of the most remarkable and characteristic books that ever appeared in botany" Goebel (1926) said, "It had

a profoundly penetrating influence ... on Hoffmeister and many of his contemporaries.” Schleiden tells the reader, “Anyone who has an idea of learning botany from the present book, may just as well put it at once aside unread: for from books botany is not learnt.” This is Schleiden: the first botanical proponent of experiential learning and the microscope as a research tool that should be used by students. Note that Schleiden predates Charles E. Bessey, in the United States, by more than three decades (Sundberg, 2012).

Schleiden’s lectures, both in class and in public, were popular and four years later he published a popular book titled *Die Pflanze und ihr Leben (The Plant and Its Life)*. This is his only book to have been translated into English (Schleiden, 1848, 1853).

By 1846, with evidence accumulating against both his theory that the plant embryo forms in the pollen tube and his theory that the initial plant cell formed by a kind of spontaneous generation, along with personal difficulties in his family life, he abandoned botanical research. In 1862 he left his position at Jena and for the rest of his life became a private scholar, mostly under the patronage of the Grand Duchess Helene Paulowna in Dresden, Dorpat (Russia), Frankfurt, Darmstadt, and Wiesbaden. He remained a lively and engaging speaker and enthusiastic spokesperson for botany.

Unlike many biographies, this is not simply a story about a historical hero and his exploits and accomplishments. Rather, it is an inciteful perspective on a complex individual who had both personal strengths and debilitating weaknesses throughout his life, but who nevertheless made a profound impact on biology and botany. It is not a simple story that would engage most undergraduates, but it

is filled with insightful details that will satisfy a discerning reader interested in the history of botany.

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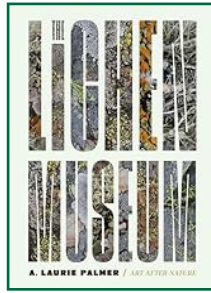
The Lichen Museum

A. Laurie Palmer

2023. ISBN: 978-1-5179-0867

US\$24.95 (paperback); 175 pp.

University of Minnesota Press



Lichens invite speculation. In *The Lichen Museum* A. Laurie Palmer writes that lichens blur the boundary between life and not-life, and she in turn attempts to blur the boundary between human culture and lichen “culture.” Palmer is a professor at the University of California, Santa Cruz, who has been described as an environmentally engaged artist whose work is heavily research based. Her interest in mineral extraction resulted in the book *In the Aura of a Hole: Exploring Sites of Mineral Extraction*. Palmer has artwork in museums worldwide. Extending the museum concept to lichens (artwork) in our environment (museum), she writes, “The Lichen Museum surrounds you as soon you step outside” (p. 63).

Readers will find this a sophisticated nontechnical introduction to lichens in general because Palmer has thoroughly researched and closely observed lichens. She reports having followed their generally slow growth with a video camera for years and includes color photographs from her travels and drawings made with lichen ink. She takes readers on a trip to Svalbard in the High Arctic to look for sightings of lichen groupings called strandflats that appear during periods of melt, which leads to a digression on the Global Seed Vault in Longyearbyen, Svalbard. She generously shares her sources, which includes the work of a diverse group of biologists, social critics, and philosophers, providing detailed endnotes. One example is Rosa Margesin et al.’s *Psychrophiles: From Biodiversity to Biotechnology* (2008). We learn that cryptoendolithic (rock-inhabiting) lichens

that live in extremely cold environments are called psychrophiles and may live for 10,000 years or more. In this context she cites the work of “the visionary Russian geochemist V. I. Vernadsky,” author of *The Biosphere* (1998), “who proposed that mineral and biological forces—life and nonlife—together created the planet from the start” (p. 73). Some scientists have proposed that lichens carried within rocks might take life to other planets. She also includes thought-provoking passages from Kinji Imanishi’s *The Japanese View of Nature* (2002), which offers non-Western perspectives about how to best study nature.

In her effort to understand the nature of the lichen symbiosis, Palmer includes transcripts of Q & A conversations she has had with lichenologists like Alan Orange, Paul Whelan, Rebecca Yahr, and others, who sometimes critique her comments as anthropomorphic, a stance that scientists avoid. In her defense, she notes that physicists and astronomers have often used analogy and metaphor to explain scientific phenomena to lay audiences, and anthropomorphism is just one lens. There is so much diversity in lichens that “the impulse to describe by analogy is compelling” (p. 89). She includes an entire page listing lichen “descriptive species names,” e.g., lipstick powderhorn, whiskered jelly, fog fingers, earth wrinkles, sunken bloodspot ... (p. 82). Lichen scientific binomials are named after the fungus only, which means that in a sense their only names are these metaphorical ones. Lichenologist Trevor Goward writes, “Only in common names is the human mind actually permitted unequivocally to touch the lichen thallus” (Goward 2008).

Palmer seems to hope that the open-ended nature of lichen lifestyles will temper our assumptions about human relationships. She notes that Simon Schwendener, who

first described the lichen as a dual organism composed of a fungus and an alga, assumed that one was dominant, even characterizing the relationship as one of master-and-slave. In fact, current research suggests that neither can be called dominant. Palmer believes that the lichen is better seen as “making queer alliances through cross-kingdom affiliations that do not follow ‘normal’ interrelations, sexual or otherwise” (p. 32). In her perspective, lichens are more like “events—queer and polyamorous, or ongoing performances of complex intra-activity” (p. 84). “Event” actually approximates how some lichenologists describe symbionts joining to make a lichen. In 2015 she queried various Scottish and Irish lichenologists about whether “they could consider the algae as giving its energies ‘willingly’ rather than having them ‘stolen’ by the fungus” (p. 36). This wording was rejected as a “narrative.” Michael Sims points out that whether talking about symbionts or predators, we should think in terms of ecological connectivity (p. 36). The lichen symbiosis may be neither mutualistic nor competitive—rather a series of chemical reactions between molecules from both partners that proceed circumstantially and serendipitously. The discussion of how biologists and nonbiologists talk about lichens is interesting, and her willingness to dialogue across the boundary between professional and amateur is helpful. Palmer wants to explore “how we collectively interpret and describe relationality” (pp. 35–36).

Palmer writes that “The Lichen Museum aims to lichenize humans, not to anthropomorphize lichens” (p. 91). Her significant gifts in observation, research, questioning, and writing encourage readers to consider lichens and humans through a number of lenses. *The Lichen Museum* is a fine book, delivering a solid account of lichen biology embedded in

a framework of cross-disciplinary intellectual inquiry.

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—Elizabeth Lawson (email: www.elizabeth-winpennylawson.com)

The Lives of Seaweeds: A Natural History of our Planet's Seaweeds & other Algae

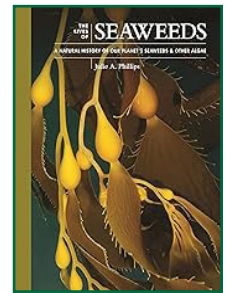
Julie A. Phillips

2023. ISBN 978-0-691-22855-6

US\$35.00 (hardcover); 288 pp.

Princeton University Press,

Princeton, NJ.



This very attractive book, meant as a popular general introduction to the algae, will be very successful in meeting this goal. Most topics are covered in a twin-facing page format with a succinct discussion of the concept or taxon of interest on the left, facing a stunning image (macro/micro, or both) or clear diagram illustrative of the text on the right. Each essay begins with a bold face abstract of the information that will be presented. This is followed by three or four paragraphs with specific details about main points and interesting anecdotes or common applications to stimulate the reader.

In addition to a brief introduction, Phillips divides the book into five sections: Evolution, Morphology, Life Histories, Ecology, and Algae and Humans. The introduction begins with a description of the algal world in art, literature, and cultural usage in various countries. The author then defines seaweeds and algae, emphasizing that they are not a natural group and in fact are classified in four of the six

kingdoms used by the author (see Cavalier-Smith, 1998). The sixth kingdom, Chromista, was new to me, as a non-phycologist, and is the only exclusively algal kingdom.

Because of its significance, the author devotes five units to the symbiotic theory in the Evolution section. The first focuses on the work of two individuals of whom I was unaware. In 1883, A. F. W. Schimper suggested chloroplasts and their host cells were symbionts; in 1905, Constantin Mereschkowski proposed that photosynthetic bacteria, engulfed by animal cells, gave rise to red, green, and brown algae. By 1920 this idea was dismissed as “wild speculation.” A second unit is devoted to Lynn Margulis’ (Sagan’s) resurrection of this idea that we now know as the Symbiotic Theory of the Origin of Eukaryotic Cells. (I did not know that her manuscript was initially rejected by 15 journals, but I do remember her being jeered by many in the audience when she presented her plenary talk at the 1972 AIBS meeting at Minnesota—my first national meeting as a graduate student.) Variations on this theme, responsible for each of the algal divisions, including secondary endosymbiosis in red algal lineages, are the focus of three additional units. Case study examples are given for the phyla Cyanobacteria, Rhodophyta, Chlorophyta, Euglenozoa, Cryptophyta, Bacillariophyta, and classes Dinophyceae, Phaeophyceae, and Chrysophyceae.

The section on morphology illustrates the megadiversity within each of five different algal body plans: unicellular, colonial, multicellular, siphonocladous, and siphonous. Of special interest are cell wall composition and coverings, specialized cells, and flagellar types. The distinction between siphonocladous and siphonous is unclear, both having multinucleate cells resulting from repeated mitoses without cytokinesis.

This problem is exacerbated on p. 80 where in the first column the author states “the siphon is not a cell” (because the protoplast is not compartmentalized) yet in the second column “the plant consists of a giant, highly differentiated single cell...” The section ends with nine case study examples.

Life History is the shortest section, but Phillips does a good job of explaining the salient features of the characteristic life cycles of various groups. Ecology is the largest section, befitting a group that grows in nearly every habitat on earth. Unlike typical zoocentric textbooks, Phillips emphasizes the importance of algae to the ecology of coral reefs, giving recognition to the fact that algae can make up to 85% of the biomass of so-called coral reefs, 20% of which are the dinoflagellate algal zooanthellae, symbiotic in the bodies of corals and many other reef animals. Of course, kelp forests and floating sargassum are well-known ecosystems to most of the general public, and we hear more and more about toxic algal blooms in both fresh and marine waters. I was not aware of the number of algal predators to be found among the dinoflagellates and even some terrestrial green algae.

The final section, Algae & Humans, links back to many of the examples used earlier in the book, but now focusing on human impacts, such as the increasing occurrence of toxic algal blooms with climate change. One of the stories I found most interesting was the role of English botanist, Dr. Kathleen Drew, who, in 1949, discovered how to mass-propagate nori from spores. This enabled development of the commercial Japanese nori industry, today worth US\$850 million annually. Less well known is the use of algae in production of a variety of pharmaceuticals and nutraceuticals.

The major strength of the book are the quality and quantity of photos and photomicrographs with informative figure legends. Unfortunately, there was no scale indication on any of the images. Another strength was the up-to-date nomenclature (along with common names) and systematics. A summary table of key characteristics used to define major algal phyla and groups is at the back of the book, along with a useful glossary and index. I was disappointed that instead of even a minimal bibliography of references mentioned in the text, only a list of nine “further readings” is added to the last glossary page. This book

would be a good “further reading” for the diversity section of an introductory biology course or an undergraduate plant kingdom course.

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



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Address Editorial Matters (only) to:

Mackenzie Taylor, Editor
Department of Biology
Creighton University
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Omaha, NE 68178
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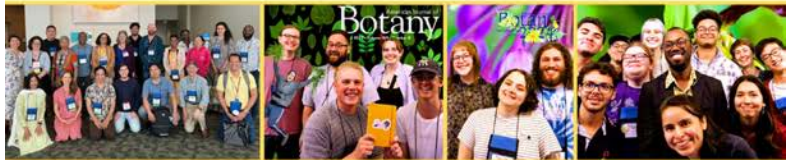
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