PLANT SCIENCE BULLETIN

FALL 2015 VOLUME 61 NUMBER 4

A PUBLICATION OF THE BOTANICAL SOCIETY OF AMERICA

BSA President Richard Olmstead on Increased International Cooperation in Botany

In This Issue...

From the Editor

With this December 2015 issue, I am delighted to unveil a new look and a new logo for the *Plant Science Bulletin*. Botany is a dynamic, evolving science and it is fitting for the *Plant Science Bulletin* to continually grow and change together with the field and with its readers. The BSA staff and I have been working hard to develop a new layout to fit within a larger 7 x 10-inch format. It is our hope that this new format will be attractive, improve readability of the popular print version of the *PSB*, and facilitate digital access of *PSB* content.

To accompany this new layout for the print *PSB*, we will be redesigning the *Plant Science Bulletin* webpage (http://cms.botany.org/home/publications/plant-science-bulletin.html), where you can easily access the most recent issue of the *PSB*, the *PSB* archives, as well as recent BSA news items and books currently available for review. Rob Brandt and the BSA team will be adding additional web features in the coming months. Check the *PSB* page often for updates and for newly available books!

Within this issue, I would like to draw your attention to valuable resources for both professional and student members. You will find an in-depth article (page 131) about the policies and procedures at the National Science Foundation with tips for preparing grant proposals. In the Student Section (page 151), the student representatives present an extensive list of grants and awards, as well as outreach, training, and professional opportunities aimed primarily at students. Finally, the Botanical Society of America is calling for nominations and applications for several awards that are relevant to members in all stages of their careers (page 130). I hope that you consider applying for these awards or nominating your worthy colleagues.

Mackenzie

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(Note: The video and slides from this lecture from the Botany 2015 conference can be found on the BSA's Botany Conference YouTube channel at https://www.youtube.com/watch?v=hrlA43io0CQ.)

I had an epiphany of sorts one rainy night in 2009 during a long treacherous microbus ride while conducting fieldwork in the Peruvian Andes. A British woman seated next to me explained why she had spent the last six months volunteering and traveling in rural Peru by saying that it wasn't the immediate experience that was most important to her, but rather the lasting impact on her life of experiencing the culture of a foreign country, about which she would never feel the same again. Months later, I realized just how true this is. Ostensibly the reason for my travel was to collect plants for my research, but after the passage of time, the memories that stayed with me were of people and places. Ironically, my personal history of international travel began in Peru 41 years earlier as an exchange student living in Lima and taking advantage of the opportunity to travel and learn about the country.

Botany 2015 Presidential Address: Richard Olmstead: The International Botanist

As my career as an academic botanist developed, that interest in travel served me well as research interests in plant phylogenetics led me to visit far-flung parts of the world and to interact with scientists from around the world. I would like to relate two of those experiences, because I think they are illustrative of the tremendous advantages that international cooperation can yield.

International Research Collaboration on Verbenaceae

Over the past 13 years, I have been involved in research on the verbena family. This work has taken me and/or my students to more than a dozen countries. Botanists in each country helped negotiate legal and cultural barriers. In return, field trips with host country botanists resulted in the collection of hundreds of plant specimens for their herbaria and ours. But equally importantly, the personal connections that enhance the outcomes of the research afford a marvelous opportunity for cultural education of everyone involved. The tangible, scientific outcomes of this project, which is still ongoing, include collaboration among 18 scientists from five countries in research publications; Ph.D. degrees to six students from five countries, whose research benefited from

the collaboration; international research exchange opportunities for three grad students; numerous undergraduate participants; and presentations at four international conferences (as well as our Botany meetings). I benefitted from their expertise and knowledge of the local plants, while my collaborators benefitted from the opportunity to participate in high-impact publications (including several in the *American Journal of Botany*) that emerged from the collaboration (Figure 1).

Figure 1. *Dick Olmstead with Pedro Estrada, María Múlgura, and Alejandrina Alaria in Jujuy, Argentina.*

University of Washington – Sichuan University Undergraduate Exchange in Environmental Sciences

With support from the NSF and the University of Washington, in 2000, we initiated an exchange program for undergraduates in the environmental sciences. Involving students in research was central to this program. Today, nearly 500 students have participated in the exchange. My active participation was only in the first few years, during which time a botanist also was active on the Sichuan University side.

Two students stand out in my mind from among many who have gone on to professional careers in science. Yuan Yao-Wu was among the first cohort of Chinese students to enter the program (Figure 2). After spending his exchange year working in my lab in Seattle, he returned to China to complete his senior thesis at the Institute of Botany in Beijing before coming back to the University of Washington for his Ph.D. (the first of many in that cohort to complete a Ph.D.). Yuan was an invited speaker in the BSA Presidents' symposium at Botany 2013 and is now Assistant Professor at the University of Connecticut.

Figure 2. *Yuan Yao-Wu in Sichuan, China (2002).*

Rachel Meyer was in the second cohort of UW students to study in Sichuan and participated in a student-led ethnobotanical study of the ethnic minority Nuosu people in a remote village in southern Sichuan (Figure 3). She returned to Seattle to participate in research in my lab before completing a Ph.D. degree at

the New York Botanical Garden on the origin of domestication of eggplant. As a grad student, Rachel was a student representative on the BSA Board of Directors. She continued research on the genetics of domestication as a postdoc and is now an AAAS Fellow working as an intern at the National Science Foundation. Both Yao-Wu and Rachel attribute their choice of career track and initial successes to the opportunities made available to them through this international exchange program. For both of them, participation in, and support from, the BSA also helped launch their careers.

Figure 3. *Rachel Meyer with Nuoso woman in Sichuan, China (2003).*

As I considered what mark I might be able to make as President of the BSA, I wondered how representative my experiences were among BSA members and if there was anything the Society could do to advance international collaboration in science and education. In an effort to quantify this, with the help of Membership Director Heather Cacanindin, I asked members to fill out short, five-question surveys about their experiences with international collaboration. With background information from the membership directory, I devised three questionnaires: one for professional botanists living in the United States, one for students, and one for international members. The surveys also provided an opportunity for members to comment individually. I will present the results of the surveys here and have forwarded the results, along with the many comments, to the BSA Committee on International Affairs.

For a little background, I sorted the membership lists to see what our international membership looks like. While our membership base is still mostly from the U.S., 27% of our members are from other countries. Our neighbors to the north [Canada] account for another 4%, leaving 23% from outside of North America (Figure 4). Most of the remaining are from Europe, Asia, and South America.

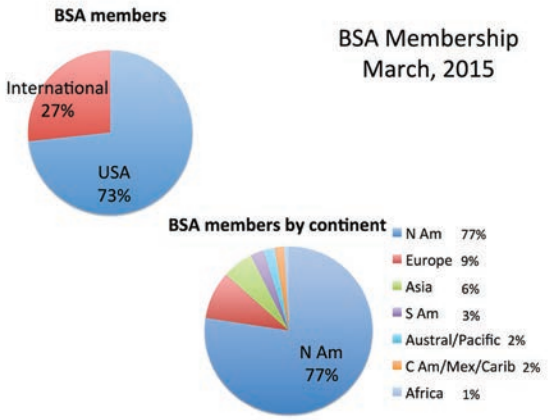


Figure 4. *BSA international membership.*

A total of 234 BSA members answered the survey, including 152 U.S. professionals, 48 foreign members, and 34 students. In each survey, most questions asked about interactions that had occurred in the last few years (2012-2015), in order to keep the answers

from respondents of different ages comparable. Bear in mind that, while many members responded, this is not a scientific survey and there may be biases inherent in whether members responded or not and in how they interpreted the questions.

The first questions in each survey asked about frequency of travel. Over 75% of professional members from the U.S. had traveled to a foreign country for research purposes in that interval, with a mode of two to five trips in the designated time period (Figure 5). Of those trips, approximately 75% involved collaboration with host country scientists. In contrast, fewer than 40% of foreign members had traveled to the U.S. to participate in research (Figure 6). Nearly 60% of our student members had traveled to a foreign country for a research visit. I am impressed with the level of international collaboration among society members in the U.S., but perhaps we could do more to encourage our foreign members to visit our labs as part of our international collaborations.

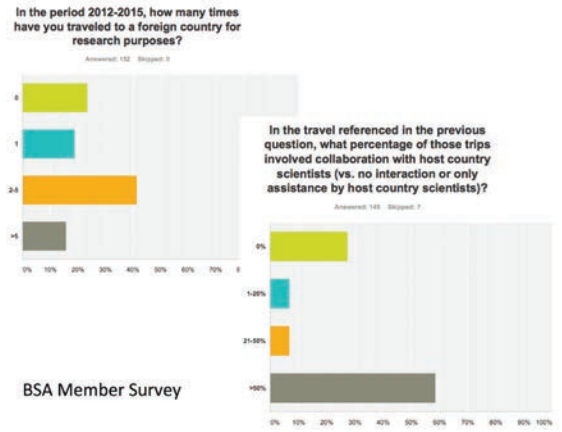


Figure 5. *International collaboration of BSA members as measured by the number of times traveled to a foreign country for research purposes (0, 1, 2-5, or >5) and the percentage of trips that involved collaboration with scientists from the host country (0%, 1-20%, 21-50%, >50%).*

Our U.S. professional members also actively engage foreign collaborators in their research publications, with nearly 80% publishing with co-authors from outside the U.S. during the last 3 years (Figure 7). Nearly one third of these members shared authorship with foreign scientists on half or more of their papers!

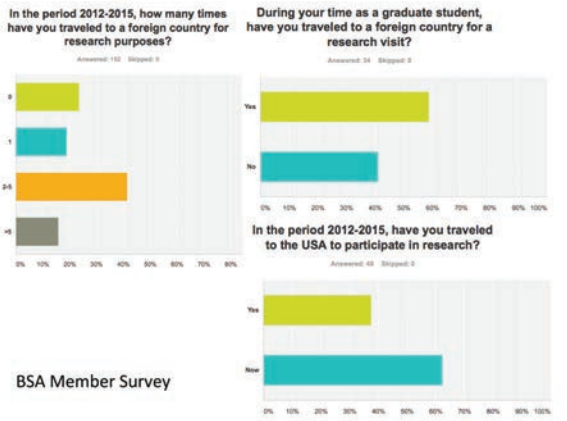


Figure 6. *BSA members' collaborative travel history.*

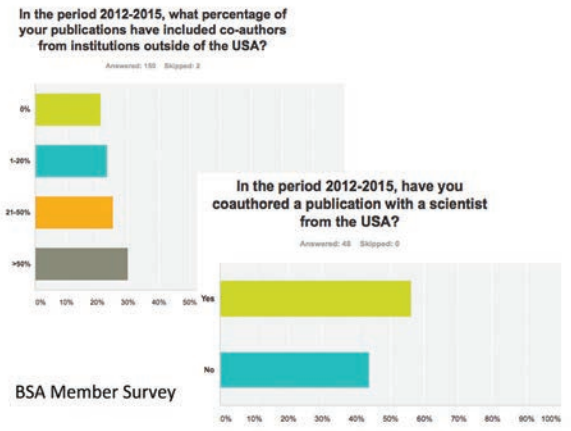


Figure 7. *BSA members' collaborative publications publications measured by the percentage of publications with international co-authors (0%, 1-20%, 21-50% or >50%) and occurrence of international co-authors (yes or no).*

Slightly over half of our foreign members have published with scientists from the U.S. during

that same interval. One of the frequent comments from foreign members was that they joined the BSA to take advantage of opportunities for collaboration with scientists in the U.S. However, in response to the survey, over 60% of foreign members said that BSA membership has not helped them to become involved in international collaboration (Figure 8). I believe the BSA can do more to foster these interactions

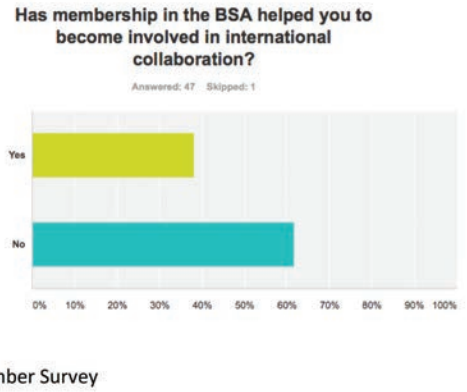


Figure 8. *BSA membership's ability to help in international collaboration.*

With many members thinking about attending the International Botanical Congress (2017 in Shenzhen, China), I was interested in members' participation in international conferences outside of the U.S. Approximately 70% of U.S. professional members have attended one or more international conferences in the past 3 years and more than half of foreign members have traveled to the U.S. to attend a conference during that time (Figure 9). I was impressed to see that nearly half of our student members had attended a conference in a foreign country during their time as a grad student.

The value of international research exchanges is undeniable. A brief visit can be valuable

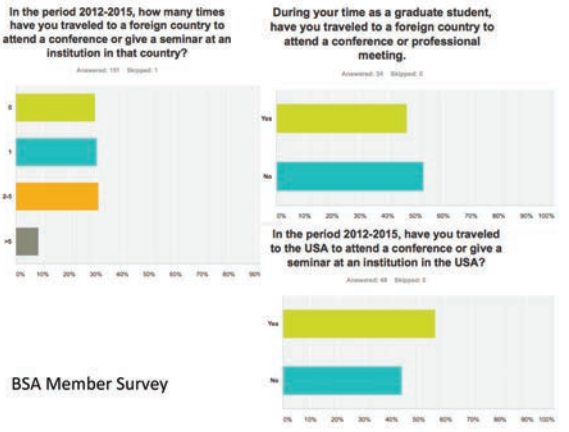


Figure 9. *International travel to conferences by BSA members including times traveled (0, 1, 2-5, >5) and occurrence of travel by U.S. professional members and foreign members (yes or no).*

for establishing contacts and emerging collaborations, but having time to work together is often essential for collaborations to fully develop. In our survey, nearly two thirds of all U.S. professionals report that they, or someone in their lab, has participated in a research exchange, either hosting a foreign scientist or being hosted in a foreign institution (Figure 10). More than half of international members report participation in similar exchange with a U.S. institution. Unfortunately, fewer than 15% of our students have had that opportunity.

Having the opportunity for international collaboration is a particularly valuable part of graduate student development. There is no better way to understand the impact of international collaboration than to experience it oneself. I was pleased by the response to the student survey to learn that two thirds of the respondents have been encouraged by their advisors to take advantage of opportunities for international collaboration (Figure 11). In addition to research exchanges, opportunities for foreign travel for special training or educational opportunities are available for students (e.g., Organization for Tropical Studies cours-

es). Nearly 40% of student respondents have taken advantage of such opportunities.

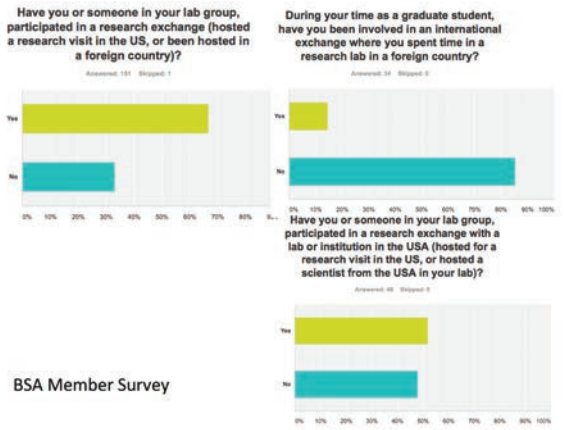


Figure 10. *BSA members' experience with research exchanges, including participation of U.S professional members (yes or no), graduate students (yes or no) and foreign members (yes or no).*

Increasingly, science is an international enterprise in which the network of connections throughout the world can, if we choose to take advantage of it, enhance everything that we do as individual scientists. International collaboration in science and education seemed to come naturally to me, but I realize that not everyone has had the same opportunities that I have had or has been encouraged to take advantage of them when they do occur. This is where I think there is a role that the BSA can play to help promote and facilitate international cooperation in research and education.

What can the BSA do? In keeping with the rapid globalization of botanical research, the Society should do more to embrace a leadership role in botanical research and education worldwide. I think there are several things we can do to achieve this:

- Actively grow our international membership
- Partner with botanical societies in other countries
- Provide a clearinghouse for information on opportunities in research and education
- Promote international exchange and training programs for students
- Facilitate contacts among botanists with common interests
- Encourage member participation in international conferences

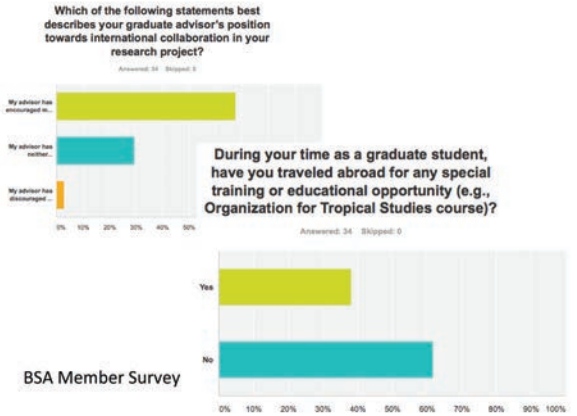


Figure 11. *BSA members' levels of encouragement for international collaborations.*

I was struck by the survey comments from international members indicating that they hoped membership in the BSA would lead to research connections, but also by the results that show membership has fostered such collaboration for relatively few of them. If we can help our members to connect and build their own international networks, we can make a difference in our science and in the careers of those who practice it.

Reflecting back on that long microbus ride in the Peruvian Andes, I realize that the personal friendships I have made and the connection to places and their histories have created empathy for the issues confronting countries and cultures around the world. The experiences have not just made me a better international botanist, but a better international citizen.

Public Policy Notes

The BSA Public Policy Quarterly

This year the BSA Public Policy Committee has been hard at work trying to bring policy awareness and engagement to the BSA membership. We surveyed members of the BSA during Spring 2015 to understand how to better provide our membership with the policy updates they need. We received responses from 195 BSA members!

As a result, we found that a majority of you want to be more involved in Public Policy, but are unsure what our committee does and/or how to become more engaged (Figure 1). As a follow-up to your survey responses, we've summarized our findings in this edition of the *Plant Science Bulletin*. Here, we provide information about the Public Policy Committee, how to become more involved, and a sneak peek at upcoming changes we have proposed, including a new funding opportunity!

As for all BSA committees, the mission of the BSA Public Policy Committee is outlined under section XII of the society policies. The

By Marian Chau *(Lyon Arboretum University of Hawai'i at Manoa) and* ***Morgan Gostel*** *(George Mason University),*
Public Policy Committee Co-Chairs

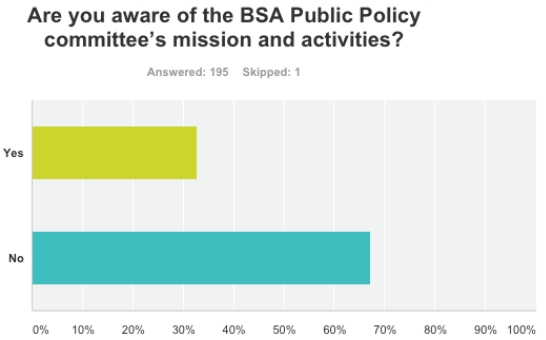


Figure 1. *Awareness of the BSA Public Policy Committee.*

Public Policy Committee is broadly defined, but generally charged with "addressing issues… to effect change, educate and influence decision makers, and provide input from the BSA perspective on public policy documents, strategic plan documents from federal agencies, and reports requesting input from plant biologists." We work closely with other societies regarding policy, advise the BSA Board, encourage members to present botany to the public (including legislators and the general public), and provide policy impact resources for new activities to the BSA Board.

In order to make our impact more visible to membership, we have taken the results from our survey to heart and correspondingly updated our activities.

How Often Would You Like to Be Informed About BSA Public Polic Activities?

A majority of you indicated that you would like to be contacted either monthly (35%) or quarterly (45%) regarding updates from the Public Policy Committee, and we'd like to ex-

plain how to get the best of both worlds: by reading this quarterly column in the *PSB* and signing up for bimonthly AIBS Public Policy Reports at http://www.aibs.org/public-policy-reports/ (Figure 2)! The BSA Public Policy Committee works closely with AIBS and, as a result, our policy actions are often linked to updates in the AIBS reports.

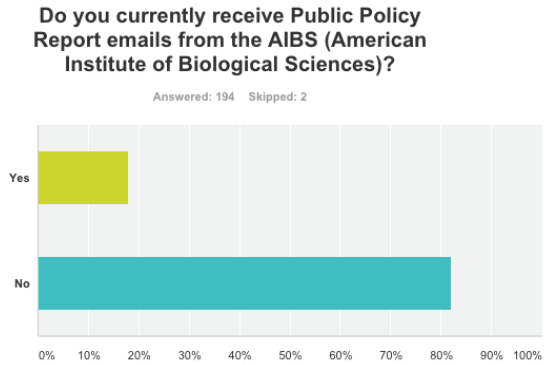


Figure 2. *BSA members receiving AIBS updates.*

In addition to the survey results we've presented here, we received a huge number of recommendations from members regarding activities we can pursue, and we're working on bringing more things into the fold as we speak (Figure 3).

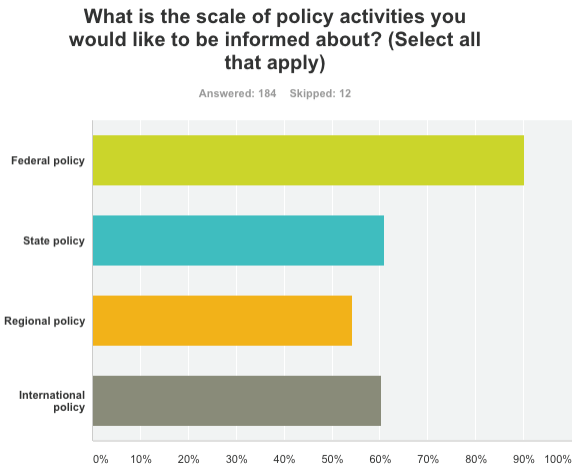


Figure 3. *Policy activities of interest to BSA members.*

Do You Have Any Recommendations for BSA Public Policy Committee Activities?

Your top five responses included:

- Federal funding for basic botanical research
- Cultivate ties with other groups
- Promote botany through STEM education
- Threatened and endangered species listing and conservation
- Loss of university botany departments and/or herbaria

In response to these comments, some projects that are in progress include developing a Policy website, helping to draft collaborative work with other groups to inform conservation legislation that will go up for a vote in Congress, showcasing Public Policy activities from our membership, and the introduction of a new public policy award.

We received contact information from 20 BSA members (>10% of respondents!), and we are contacting these individuals for Public Policy Quarterly guest columns to showcase their policy activities. If you are interested in preparing a guest column, please contact us (see below)!

In the meantime, be sure to apply for the fourth annual BSA Public Policy Award to attend Congressional Visits Day in Washington, DC (include link when the application form is complete), due January 25, 2016!

As always, we welcome any news, questions, or information regarding public policy news in botany. Please contact either Marian (mmchau@hawaii.edu) or Morgan (gostelm@gmail.com).

Economic Botany Notes

Extended Economic Botany Avenues at the BSA

Economic botany is a broadening section of the BSA, encompassing a myriad of disciplines, and often providing an important link between basic and applied research. At this year's Botany conference in Edmonton, the Economic Botany section co-sponsored* a well-attended multidisciplinary symposium, "Underutilized Crops for Secure and Green Futures," organized by section members Nyree Zerega, Rachel Meyer, and Allison Miller. Along with ten section talks and six posters, the presenters explained the utility of botanical resources to improve livelihoods, serve as innovation platforms, impact ecology, and recast our understanding of humans that may all influence policy or genetic resource development.

Following an introduction by Dr. Zerega highlighting the importance of underutilized crops as an important—but largely untapped—source of plant genetic resources and the need for more basic research on these species, attendees heard six talks spanning the range of disciplines represented by the BSA. Early morning talks covered a study combining forest ecology with ethnobotany to investigate the impact of pre-Columbian management on ecosystems, an analysis of the increasing homogeneity of the global food supply and proposals for increasing crop diversity and food security, and an investigation into crop wild relatives at the intersection of economic botany, plant breeding, and systematics.

Late-morning talks included phylogenomics and pollination biology of an underutilized tree crop genus with a discussion of how basic research can be leveraged to promote the development of underutilized crops, an overview of the African Orphan Crops Consortium and the ambitious collaboration aiming to develop genomic resources for 100 crops and train African crop breeders to use them, and finally an exploration of local adaptation in amaranths, which contain both underutilized crops and weeds, using phylogenetic and population genomic tools.

Section posters ranged from showcasing appealing traditional plant uses for health and for food packaging [Nepenthes can be a wrapper for sticky rice! (Schwallier et al.)] to temperature tolerance phenotyping of crops and phytochemical medicinal activity. Oral presentations included developmental, nutritional, and ecological impact analyses of new and underutilized foods and fodders. Fieldwork and collection analyses of rice and chickpea helped to reset ideas of adaptation trends.

* *Support of the symposium was given by Northwestern University, ASPT/BSA Systematics Section, and BSA Genetics, Tropical Biology, and Economic Botany sections.*

By Elliot Gardner *(Northwestern University and Chicago Botanic Garden) and* ***Rachel S. Meyer*** *(New York University)*

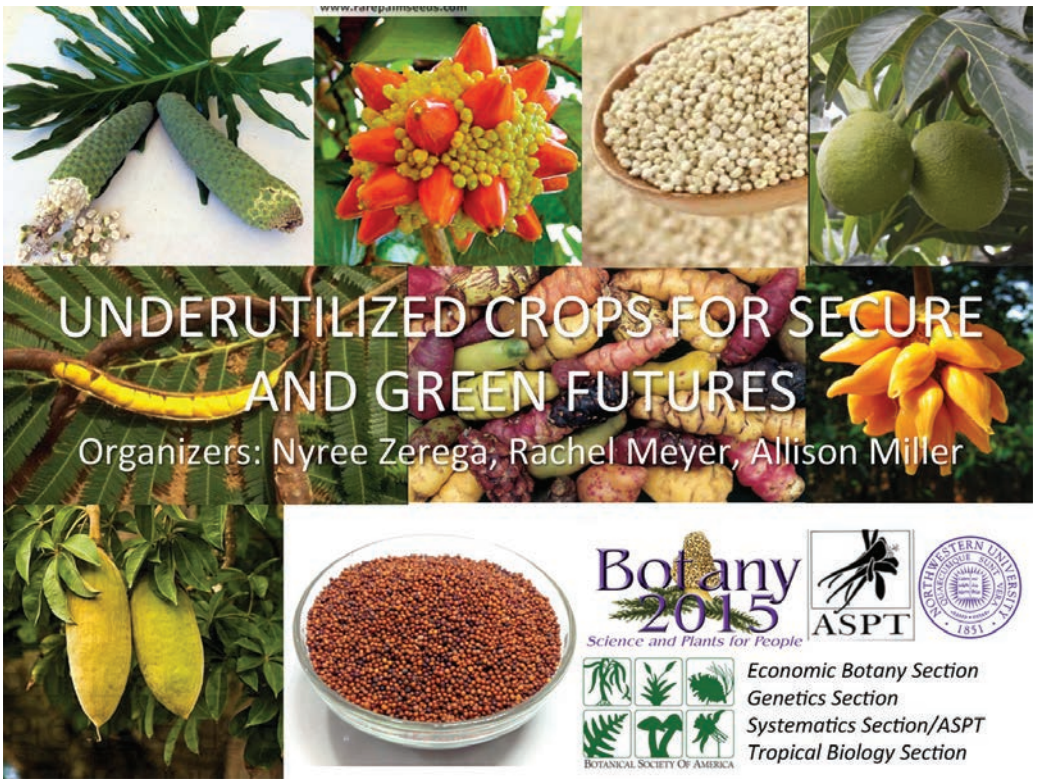
New morphometric methods enabled inference of functional diversity. Geospatial collection assessment was used to set priority collection areas for major crops. Extensive tribal ethnobotanical databases were compared to assess completeness.

Although the Economic Botany section is small, its scope is great, bringing together researchers from a wide variety of disciplines—including systematics, genomics, phytochemistry, ecology, ethnobotany, population genetics, and policy—united by the study of economically important plants. To address the growing need to connect our section with various disciplines and agencies, we have created a new Community Relations Officer. We have kept our section dues flat to encourage broad participation in our section. We also encourage students doing multiple- or inter-disciplinary science to apply for Economic Botany section travel awards and present at the next meeting.

For more information, please contact either Elliot (egardner@u.northwestern.edu) or Rachel (rm181@nyu.edu).

References

Schwallier, Rachel, et al. 2015. Traps as treats: a traditional sticky rice snack persisting in rapidly changing Asian kitchens. Poster from Botany 2015. http://2015.botanyconference.org/engine/search/index.php?func=detail&aid=70.



Upcoming Award Deadlines

The BSA has entered the awards season! Please visit http://cms.botany.org/home/awards.html for further information about the following awards as well as more information about BSA awards.

February 1st

- BSA Awards - General
- Darbaker Prize
- BSA Public Policy Award

March 1st

- BSA Student Travel Awards
- PLANTS Grants

March 15th

BSA Awards - General

- Distinguished Fellow of the Botanical Society of America
- BSA Emerging Leader Award
- Charles Edwin Bessey Teaching Award
- BSA Corresponding Members
- Grady L. Webster Structural Botany Publication Award
- BSA Awards - Students
- BSA Young Botanist Awards
- BSA Graduate Student Research Awards
- BSA Undergraduate Student Research Awards
- Genetics Section Graduate Student Research Awards

April 1st

- BSA Awards - General
- Jeanette Siron Pelton Award

April 10th

- Pteridological Section & American Fern Society Student Travel Awards
- TRIARCH "Botanical Images" Student Travel Award
- Vernon I. Cheadle Student Travel Awards | Developmental & Structural Section Student Travel Awards
- Ecological Section Student Travel Awards Economic Botany Section Student Travel Award
- Genetics Section Student Travel Awards

BOTANICAL SOCIETY OF AMERICA
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Information about NSF Programs, Policies, and Proposals: What, Where, Why, How?

The scientific community always has many questions about the National Science Foundation (NSF); its programs, funding applications, and proposal and review process; and how things work in general. While these items are covered in various places on the NSF website (http://www.nsf.gov), finding them can be challenging, and searching requires some knowledge of what terms to use. The NSF website is constantly being updated and new functions often appear to help you in your searches.

To keep researchers informed, NSF offers "NSF Days" (http://www.nsf.gov/about/congress/nsfdays/index.jsp) in various sites around the country each year. In addition, Program Directors (or Program Officers as used in the Proposal and Award Policies and Procedures Guide [PAPPG]) provide information sessions at many professional society meetings, as did the three authors at Botany 2015. We hope this short orientation based on our information session this past July will help researchers obtain the information they need more easily.

By Judith E. Skog
Sedimentary Geology and Paleobiology, Earth Systems GEO
Roland P. Roberts
Biological Infrastructure, BIO
Joe T. Miller
Environmental Biology, BIO
National Science Foundation, Arlington, VA

About NSF (The "What")

The NSF is a federal agency, and as such, its budget and many of the priorities for the agency are determined by the U.S. Congress, the Office of Science and Technology Policy (OSTP), and the President's budget request through the Office of Management and Budget (OMB). For the most part, the distribution of budget funds within NSF has been determined by the NSF Director's Office and senior management (Assistant Directors who are the heads of the various Directorates at NSF). They discuss the various policies and priorities to be addressed with funding streams, but in recent times, the U.S. Congress has put some limitations on how funds are to be distributed inside NSF. For example, Congress has determined funds for the Major Research Instrumentation Program. You can find the NSF

budget requests and final budgets at http://nsf.gov/about/budget/.

We point this out because program directors typically are not the ones determining where resources go, so arguing your case for spending priorities at their level might not be the place to direct this issue. If a program director notes that he or she can't make this decision, please believe him or her! It should also be noted that OSTP will often form Interagency Working Groups to address issues that span government agencies (one was formed on plant genome issues and one was addressing Scientific Collections). At times, the response to these working group findings could be new programs or initiatives at NSF (e.g., the Plant Genome Research Program and the Advancing Digitization of Biological Collections program). In addition, the National Academy of Sciences (NAS) often forms special committees to examine research issues, or the scientific community will hold workshops that result in reports on special areas of research needing attention. NSF may use these reports as priorities for the foundation are considered. Many professional societies (e.g. AIBS, AAAS, as well as BSA) have public policy offices or committees, and they can be valuable resources to help one understand how the science funding policies are determined.

Researchers often think they can only look to their "home directorate" for support, but it is important for everyone to peruse programs across NSF.

It is also important to understand that NSF is overseen by the National Science Board (NSB), and that body determines policies for NSF. The NSB, for example, recently released a report on reducing the workload for Principal Investigators (http://www.nsf.gov/pubs/2014/nsb1418/nsb1418.pdf) in which preliminary proposals were recommended as a mechanism that should be tested. The "About NSF" web page (http://www.nsf.gov/about/) provides a lot of information, including NSF's current priorities, strategic plan, and the composition of the NSB. Being familiar with these items can help you understand the goals of many of the programs within NSF and to whom you should address concerns about opportunities for support.

Science and engineering research and education support at NSF is organized into seven directorates under the Office of the Director:

- Biological Sciences
- Geosciences
- Computer and Information Science and Engineering
- Engineering
- Social, Behavioral and Economic Science
- Education and Human Resources
- Mathematical and Physical Sciences.

Within directorates, organization varies; some are divided further into divisions, clusters or sections, offices, virtual activities, special activities, or other units that make sense for their size and activities. This structure may seem to be narrowly divided; however, there is opportunity for exchange of ideas, co-reviewing, and collaboration among the entities.

Be assured, the scientists working at NSF recognize the collaborative nature of research and strive to provide the best reviews of the science within each program and across what may appear to be a restrictive and narrow focus of the various programs. We note this

because researchers often think they can only look to their "home directorate" for support, but it is important for everyone to peruse programs across the foundation. For example, the Major Research Instrumentation program is managed through the Office for Integrative Activities (http://www.nsf.gov/dir/index.jsp?org=OIA) under the Office of the Director, and some international activities are supported through the Office of International Science and Engineering (http://www.nsf.gov/div/index.jsp?div=OISE).

Although the science is overseen by the various directorates/programs, the actual financial part is overseen by the Office of Budget, Finance, and Award Management. The division of this office you will most likely deal with is the Division of Grants and Agreements (DGA), since DGA actually makes the awards recommended by the science divisions. Your sponsored research office (SRO) is probably in close contact with DGA and its policies, and you should consult your SRO about budget issues when preparing proposals or you should consult your grants officer if you have questions about an award. Program directors will answer questions about the science for proposals and awards.

A program director will typically be your primary point of contact at NSF, and it is worthwhile to know there are various ways program directors are employed at NSF. There are program directors who are permanent employees whose only job is at NSF. Then there are categories of temporary staff who serve shorter terms at NSF. Rotating program directors may come for 1 to 3 years through (1) the Intergovernmental Personnel Act (IPA), where these people retain their institution employment and NSF pays the institution for their services, (2) Visiting Scientists who take leave from their university and are paid by NSF, and (3)

A program director will typically be your primary point of contact at NSF, and it is worthwhile to know there are various ways program directors are employed at NSF.

temporary federal employees who resign other jobs and are full time for a limit of 3 years at NSF. There are also "experts" hired for special tasks (e.g., to fill in short-term within programs on a part-time basis). Rotator positions are an opportunity for others to learn more about NSF and to bring their special scientific expertise to the foundation. Announcements appear regularly for these openings, and they are posted on the NSF website on the directorates' web pages and on USAJOBS.

Information on Programs (The "Where")

Most likely, many of you as plant biologists will be considering funding opportunities through programs managed by the Directorate for Biological Sciences (BIO, http://www.nsf.gov/dir/index.jsp?org=BIO), so we will provide a brief overview of this directorate. There are four divisions in the directorate: Biological Infrastructure (DBI), Environmental Biology (DEB), Integrative Organismal Systems (IOS), and Molecular and Cellular Biology (MCB). As you can see, the divisions address research at the level of the cell and below, the organism level, above the organism level, and any research or program that provides infrastructure required for biological research, including education from undergraduate to postdoctoral researchers.

We do not describe individual programs here, because the goals, the criteria, and the emphasis can change from year to year. You can find a list of upcoming funding opportunities for BIO on nsf.gov (http://go.usa.gov/3WZsy) and on the main BIO blog, BIO Buzz (https://nsfbiobuzz.wordpress.com/programs/). You should read the program description and solicitation that are the most recent versions before you begin work on any proposal. When a solicitation has been replaced by a newer version, there should be a note at the top of the solicitation giving the newest number or noting that it has been replaced. Be sure to check for any indication of revision.

Some programs within BIO are collaborative with other directorates or other agencies or have other groups setting priorities. The Plant Genome Research Program located in IOS, for example, is developed based on plans produced every five years by a working group of several governmental agencies (who were part of the OSTP Interagency Working Group for Plant Genomics mentioned above), and this program's priorities may change depending on that plan. As another example, the BIO postdoc program often partners with other directorates to address a need for new researchers to be trained as interdisciplinary scientists. If there are no external partners in the postdoc program, a group of program directors from all the divisions within the BIO directorate considers areas of need for new expertise in a specific biological area of research and recommend this as an emphasis for the postdoc program. These areas of emphasis generally continue for five years.

Some additional items of note regarding BIO programs: There are special programs that have their own deadlines and requirements, such as CAREER, OPUS, Genealogy of Life, LTREB, Ecology of Infectious Diseases, Research Coordination Networks, and Dimensions of Biodiversity. These do not fall under the same deadlines or requirements as the core programs, even though they are funded out of the same money as the core programs (for a complete list of BIO active funding opportunities, visit http://www.nsf.gov/funding/pgm_list.jsp?org=BIO&ord=date). Note that DEB also has a small grant category that is labeled at the preproposal stage as a project whose budget is capped at 150K; this is for projects that are smaller in scope and size. So far, the funding rate for these DEB small grants is slightly higher than for the rest of the core grants. You can find further information about small grants in the program solicitation and information about the funding rates for the small grants on the DEB blog (http://www.nsf.gov/div/index.jsp?div=DEB).

To gather additional information and advice on BIO programs, we recommend you read the blogs from the BIO divisions for analyses of programs and funding rates, news items about research, statistics on awards, staff profiles, and advice on various programs:

- **DEB blog (DEBrief): http://nsfdeb.wordpress.com**
- **IOS blog (IOS InFocus): http://nsfiosinfocus.wordpress.com**
- **MCB blog: https://nsfmcb.wordpress.com/mcb-blog/**

Also remember that programs are not static and the emphasis may change or there may

be programs with defined limits to their existence based on budgets or new government emphases. Once a special program reaches its set duration, the research may be included within core programs, the special program may be redefined, or additional buy-in from across NSF or other agencies may continue the program with a different format or emphasis.

To gather additional information and advice on BIO programs, we recommend you read the blogs from the BIO divisions. The division blogs are where you can find analyses of programs and funding rates, news items about research, statistics on awards, staff profiles, and advice on various programs such as CAREER:

- DEB blog (DEBrief): http://nsfdeb.wordpress.com
- IOS blog (IOS InFocus): http://nsfiosinfocus.wordpress.com
- MCB blog: https://nsfmcb.wordpress.com/mcb-blog/

While most botanists seek funding from the BIO directorate, as we said above, you should look for funding opportunities throughout the foundation. If you are developing computer informatics that are of general use, check out programs under the Computer and Information Science and Engineering (CISE) directorate (http://www.nsf.gov/dir/index.jsp?org=CISE). The Geosciences (GEO) directorate (http://www.nsf.gov/dir/index.jsp?org=GEO) also includes programs that could be useful to consider; if you are doing research in the polar regions, check out Polar Programs (http://www.nsf.gov/div/index.jsp?div=PLR); or if you are studying fossils, read about the Sedimentary Geology and Paleobiology program (http://www.nsf.gov/div/index.jsp?div=EAR). For Education activities, such as REU sites, new undergraduate efforts, graduate student programs and education research, the Education and Human Resources (EHR) directorate (http://www.nsf.gov/dir/index.jsp?org=EHR) is the place to look. If you are unsure about where your specific research fits best, use the NSF awards database to search for keywords that describe your research. You may discover programs that you had not considered previously.

Process and Policies (The "Why")

Program Directors are often asked why certain programs have different requirements or review methods (e.g., panels, ad hoc reviewers, a combination of these two, or no reviews for certain categories). We call your attention to a document that was produced after a Merit Review Working Group analyzed a number of issues at NSF with respect to workload, the burden on the community, and the burden on Principal Investigators: http://www.nsf.gov/oirm/bocomm/meetings/nov_2011/Merit_review.pdf. In this document, there are a number of charts and graphs illustrating the merit review challenges occurring in the past decade. Of particular interest will be the last two pages (pp. 25-26) where numerous suggestions are made for ways to improve the review process. Several of these are being tested across NSF to see if they are effective.

For example, programs within DBI and MCB have a single deadline per year, whereas DEB and IOS require preproposals and then those investigators who are invited to do so may submit full proposals. Some GEO programs are testing, having no deadlines, with proposals being accepted anytime. Other programs limit the number of proposals that may be submitted by a PI in a given time frame. Be sure to visit the various directorate and division web pages and the program pages and solicitations to understand the deadlines, the

Often, at the end of a solicitation, there is a section called "Additional Review Criteria." Be sure to read solicitations thoroughly, as we find this section is often missed.

goals and priorities, and the various required documents for each program. You also need to review carefully the PAPPG, which is the general information source for policies and procedures for all submissions to NSF in general.

Proposal Information (The "How")

Okay, you are now informed on how to tackle programs and find the information you need about them. Now we'll discuss the proposal process. Many good proposals are submitted to programs, but what is a "good proposal"? A good proposal is a good idea, well expressed, with a clear indication of methods for pursuing the idea, evaluating the findings, and making them known to reviewers and others who need to know.

However, just writing a good proposal does not make it competitive within a particular program. A competitive proposal is a good proposal and it is appropriate for the program and responsive to the specific requirements of the program solicitation or announcement (program summary). It also conveys some excitement and innovation in the field of study; therefore, you should always read and consider all information about the program carefully before you begin to write a proposal.

When reading a program summary and solicitation, focus on the goals of the program, eligibility requirements, and other special requirements and review criteria. Keep the review criteria in mind as you think about writing a proposal. Intellectual merit refers to the ways in which the proposed activity will advance science and engineering through research and education. Broader impacts are the broader scientific and societal impacts of the project and its potential results. In addition to these two overall criteria, look for special review criteria for the program as described in the announcement or solicitation. Often, at the end of a solicitation, there is a section called "Additional Review Criteria." Be sure to read solicitations thoroughly, as we find this section is often missed. Every page of a solicitation provides important information for preparing a competitive proposal. You may want to ask someone for a copy of their successful proposal—but remember that some program announcements are reissued yearly or on a regular cycle, so the emphasis can change. The award abstracts database (http://nsf.gov/awardsearch/) is a good place to find recently funded awards for a program to see what the emphasis has been in recent years. On the program web page, you will find a link at the bottom for "Recent Awards in this Program" that will quickly take you to the most recent awards and save you from searching all of the NSF awards database.

Identify your best research ideas for which you have some preliminary data. Be sure you have developed clear hypotheses and experimental procedures before you take the next steps. Consider feasibility in a 36- to 60-month window and what assistance you will need, given teaching and other time commitments. Think carefully about the budget request and how you would justify that request based on the

Commandments for a Competitive NSF Proposal

- ***Thou shalt start early!*** Give yourself enough time to check all the items and consider the proposal for all the criteria. Think carefully about the budget and that it is well justified by the research program.

- ***Thou shalt address the NSF review criteria thoroughly!*** Both intellectual merit and broader impacts should be addressed and related to the project. This is especially important when considering the broader impacts, since there should be some direct relevance for the research in a societal context. To simply say you will participate in an ongoing activity at your institution is not enough; explain why your project is important for that activity and why that activity is important for your project. Be as specific about the broader impacts of the project as you are about the intellectual merit.

- ***Thou shalt read the PAPPG and the program announcement and solicitation!*** Follow all instructions in these documents.

- ***Thou shalt get feedback on your proposal from your colleagues!*** Proposals should be cogent, appropriate, and justified. Study the reviews carefully if you receive them—for both awards and declines. Anticipate criticisms and invite criticism before you submit. Do not ask only the people close to your field of research, but ask someone who is not familiar with what you are doing to provide comment. If that person says something like "It was OK," don't submit that proposal. If that person says, "Wow, I had no idea your work was so interesting," send in the proposal. Remember that when this project is read in a panel, you will have at least three people reading it and comparing it to the other proposals within that panel. If the two people who are outside the specific area of your research don't like it because they don't see the rationale or the excitement of this research, their reviews won't be enthusiastic either. And you need to convince a wide audience of people that your work is important. Which brings up the next commandment….

- ***Thou shalt not irritate the reviewers!*** Be clear and concise and make it easy for reviewers to understand all parts of the project. Think like a reviewer before you submit the final draft. And, by the way, do submit the final draft—not the one with the comments inserted into the text that say "This paragraph needs work!" Yes, we have seen those.

- ***Finally, thou shalt contact your program director!*** If questions remain about items within the proposal, we are here to help. We realize that not all the items in the documents we provide are clear to everyone, and there are ways of interpreting program announcements that require some clarification. Don't be afraid to write with specific questions or to request a phone conversation; it's always best to prepare your PD prior to a phone call. We can't anticipate all questions, and some answers require a bit of research and discussion. You will speed up the process by asking the question or outlining the problem and requesting time for a conversation if the answer cannot be provided through e-mail. Obviously, e-mail is preferred, so we all have a record of the question and the answer, and to maintain consistency with decisions made within the program.

proposed activities. Communicate with a program director who can assist in determining the project's relevance for the program and answer your questions.

Writing a Proposal

Read the PAPPG (http://www.nsf.gov/publications/pub_summ.jsp?ods_key=papp) for guidance and instructions on proposal preparation and submission, and all criteria for the proposal to be accepted by the system. The guide describes the process for declinations, returns, withdrawals, awards, and significant items for grant administration. The requirements in this guide apply to all proposals submitted to NSF, but remember, there may be additional requirements or more restrictive requirements found within a program's solicitation or announcement. So, when composing your proposal, first follow the PAPPG and then apply any changes or additional content described for the program solicitation to which you are responding.

Anticipate some frustration along the way. If your proposal is declined and the reviews and panel summary do not make clear why, first look to see if there is a program director ("PO") comment on your proposal. If not, or if this still does not address your concerns, contact the program director once you have thought carefully about the reviews and the questions they raise. If awarded, follow up on reporting and stay in touch with the program about your accomplishments and publications. NSF is always eager to share PI research and education outcomes on their website and via social media.

A Note about Preproposals

Does our advice apply to preproposals where these are required? Mainly, yes. Programs will provide instructions for preproposals in the announcement and there will be information about preproposal submission. Typically, similar instructions are included for preproposals and proposals; however, since preproposals are shorter, it is important to understand what makes a good preproposal. In a preproposal, reviewers look for excitement, significance, rationale for the main idea, and a justification that the methods proposed will answer the question posed. The conceptual framework of the main objectives and the specific aims for the project must be clearly stated. And, as with full proposals, the broader impacts should be relevant for the project.

Final Bit of Advice

Stay up to date on NSF programs, deadlines, jobs, and events by subscribing to the NSF news feed, which you can find under the News web page (http://www.nsf.gov/news/). At the top of the page is a link to receive news by email. When you subscribe, you can choose how to receive news items, how often, and which items you want to receive so you will not be flooded with information not relevant to you. In addition, you may want to read the BIO blogs and follow NSF and BIO on Twitter and Facebook (see http://www.nsf.gov/social/). Being informed about critical dates, changes in programs, new programs, or changes in requirements or policies is the best way to prepare and submit proposals that are appropriate for a program at NSF.

Nisku Prairie: An Aspen Parkland Remnant in Central Alberta, Canada: Conservation Challenges

In the Interior Plains of North America, aspen parkland extends as an arc some 200 to 250 km wide from the foothills of the Rocky Mountains across the Canadian Provinces of Alberta, Saskatchewan, and Manitoba. It is a vegetation zone unique both to North America and the world, bounded in Alberta by the boreal forest to the north and the grasslands region to the south. It is so named because it naturally consists of a mosaic of groves of trembling aspen (*Populus tremuloides*) and open grassland, dotted with wetlands in low-lying areas. Its flat or undulating topography is a legacy of glacial debris deposited at the end of the last glaciation; silt from glacial lakes, till from in situ glacier melting, windblown sand dunes or glacial outwash from meltwater channels. Grasslands developed in the drier sites, woodlands in the wetter ones. Aspen parkland proved ideal for European settlement with its fertile soils. Today only 6% of its original prairie is left, the rest consumed by agriculture, the oil and gas industry and, most recently, urban and suburban development. Most of its remaining grasslands are small, isolated, and few and far between.

by Patsy Cotterill
Cotterill is an Edmonton botanist. She is a steward of three protected areas in the aspen parkland and boreal regions of Alberta, Canada, and also volunteers with City of Edmonton natural areas and parks.

Figure 1. *Nisku Prairie landscape in October 2015, showing aspen groves and interspersed grassland. (Photo credit: Charles Richmond)*

Nisku Prairie is one such remnant (Figure 1). Twenty-three acres in extent, it is an L-shaped parcel of largely native grassland bordered and intruded by aspen groves. It is situated on the west-facing, gently terraced slope of the Gwynne Outlet Channel, which is incised about 20 m into the surrounding plain. This broad, shallow valley was eroded when Glacial Lake Edmonton discharged through it some 10,000 years ago. On the other three sides, Nisku Prairie is bordered by a road and acreage residences. The municipality of Leduc County has preserved it as a municipal reserve, allowable under the Municipal Government Act of Alberta, which requires that 10% must be set aside as public land when private land is subdivided for development.

In 1993 a local acreage owner "discovered" the prairie with its rich assemblage of native flora. Ecologists from the Government of Alberta and the University of Alberta testified to its ecological value as a rare remnant, and Leduc County was persuaded to beef up its protec-

tion of the reserve. With the approval of local residents, the County staked out the boundaries more carefully and erected a fence along all but the western perimeter, along with a horse gate for access, and appropriate signage. This arrangement has been successful in keeping out all-terrain vehicles, a major recreational menace in rural areas, including supposedly protected natural areas and reserves. On the public side, a volunteer management committee was established. This cooperation was later formalized in a Stewardship and Management Agreement co-signed by Leduc County and the Native Plant Council of Alberta, whose local members contribute to the pool of volunteer stewards.

A Diverse Grassland Flora

Small differences in topography, including boulder outcrops, in soil type and moisture, such as in shallow draws and west-facing slopes, contribute to a diverse flora of over 180 species (including woodland species). The dominant grass of the grassland component of aspen parkland is plains rough fescue (*Festuca hallii*), one of three rough fescue species that comprise what was formerly considered a single entity, the *Festuca scabrella* complex, now recognized as the provincial grass emblem because of its ecological importance and cultural significance as the basis of the ranching industry in Alberta. Nisku Prairie's large cover of rough fescue grass (*F. hallii*) indicates conclusively that it is an original grassland remnant, as this grass does not regenerate once land has been plowed. Somewhat enigmatically, which seems to be true of many of the prairie remnants in our area, Kentucky bluegrass (*Poa pratensis*), considered to be an introduced species, is also a major component. Nisku Prairie's soils belong to the Chernozemic and Solonetzic orders, the former releasing Ca^{2+} ions from weathering of the glacial sediments, the latter Na^{+} ions, with consequences for soil structure and vegetation. Large patches of intermediate oat grass (*Danthonia intermedia*) and mat muhly (*Muhlenbergia richardsonis*) indicate solonetzic soils; in small spots where the solonetz develops into hard pans lacking vegetation, thickspike wheatgrass (*Elymus lanceolatus* subsp. *lanceolatus*) is present. (Many of our northern prairie remnants occur on solonetzic soils because they were difficult to cultivate; this protection does not unfortunately apply to rapid urbanization.)

Our most prized grass is Canadian ricegrass (*Piptatheropsis canadensis*), a relative rarity in Alberta. Among the eight species of sedge (*Carex*) recorded, woolly sedge (*Carex pellita*) and graceful sedge (*C. praegracilis*) appear to be the most prominent, especially in the moist solonetzic areas. Dudley's rush (*Juncus dudleyi*) is common throughout the grassland (Figure 2).

Figure 2. Plains rough fescue and three-flowered avens. (Photo credit: Patsy Cotterill)

Among our typical herbaceous species of the grassland are prairie crocus (*Anemone patens*),

much esteemed as a harbinger of spring when it blooms in early May, three-flowered avens (*Geum triflorum*), two buttercups, prairie (*Ranunculus rhomboideus*) and heart-leaved (*R. cardiophyllus*), and heart-leaved alexanders (*Zizia aptera*). A succession of flowers occurs throughout June and July, including two species of *Arnica*, slender blue beardtongue (*Penstemon procerus*), golden-bean (*Thermopsis rhombifolia*), field mouse-ear chickweed (*Cerastium arvense*), northern bedstraw (*Galium boreale*), and veiny meadow-rue (*Thalictrum venulosum*). Richardson's alumroot (*Heuchera richardsonii*) and the white and graceful cinquefoils (*Drymocallis arguta* and *P. gracilis*) are also common, as is bastard toadflax (*Comandra umbellata*). Petaloid monocots include prairie onion (*Allium textile*), common blue-eyed grass (*Sisyrinchium montanum*) and wood lily (*Lilium philadelphicum*). In wet years we see a few specimens of the beautiful calciphile white camas (*Anticlea elegans*). Mid- to late-season blooms consist mostly of Aster family members: five asters (*Canadanthus* and *Symphyotrichum* species), five goldenrods (*Solidago* species), two sunflowers (*Helianthus* spp.), meadow blazingstar (*Liatris ligulistylis*), and narrow-leaved hawkweed (*Hieracium umbellatum*). Three Artemisias are the latest representatives of the family to flower. Two other late bloomers of note are the annuals felwort (*Gentianella amarella*) and the hemi-parasite yellow owl's-clover (*Orthocarpus luteus*) (Figure 3). Shrubs are well represented in the moist soils of Nisku Prairie. With the exception of a few willows, all are of low stature. They include swamp gooseberry (*Ribes hirtellum*), saskatoon (*Amelanchier alnifolia*) and common wild rose (*Rosa woodsii*). Narrow-leaved meadowsweet (*Spiraea alba*) forms extensive patches in the wetter areas and is at its western limit at the longitude of Leduc. Western snowberry (*Symphoricarpos occidentalis*), a major colonizer of poorer-quality grasslands in aspen parkland, forms occasional patches, especially on moist, west-facing slopes.

Figure 3. *Grassland in midsummer, with a variety of forbs, including meadow blazingstar and stiff goldenrod. (Photo credit: Patsy Cotterill.)*

The Challenges of Managing a Prairie

Before European settlement of the aspen parkland, grazing by bison, and fire (caused by lightning or by aboriginal hunters), maintained grassland at the expense of suckering aspen. Both these management methods are difficult for small steward groups to employ and the agricultural departments of municipalities often have other priorities than their natural areas, as well as little expertise in burning for ecological purposes. Haying has been employed by Leduc County in the past and we hope to start a program of haying with litter removal again next year. We have also established two sets of experimental plots to determine the effect of litter removal on plant growth.

Even after 20 years of intervention in the Prairie, weed control continues to be a major management requirement. The great bane of natural areas throughout Alberta is the introduced forage grass, smooth brome (*Bromus inermis*), an aggressive colonizer of disturbed open areas that can also happily coexist as understo-

ry in aspen woodland. Attempts at control of brome colonies in the grassland have consisted mostly of herbiciding with glyphosate. The resulting patches of dead litter require repeated herbicide applications pending regeneration with natives from surrounding grassland or with transplants. Over the last half-dozen years meadow foxtail (*Alopecurus pratensis*) has become well established, likely getting its start in the wet bottomlands of the Gwynne Outlet and spreading up into the grasslands. We are cutting and herbiciding it.

A heavily disturbed area near the gate where rocks excavated from nearby fields were dumped and then removed has been the focus of volunteer efforts for the last few years. The soil here is now so disturbed that we essentially have a "garden," with a seemingly inexhaustible seed bank supply of annual and perennial weeds such as stinkweed (*Thlaspi arvense*), hemp-nettle (*Galeopsis tetrahit*), Canada thistle (*Cirsium arvense*), and sow-thistle (*Sonchus arvensis*), along with smooth brome. We have transplanted here seedlings and plugs grown by volunteers from seed collected on site or from the general area. The transplants resemble those of the intact prairie community neither in composition nor form. We grow species that germinate easily and are robust in habit, with the objective of creating as much native ground cover as quickly as we can: three-flowered avens, Richardson's alumroot, slender blue beardtongue, asters and goldenrods, and various grasses. Natural succession would eventually take care of the annuals, and indeed patches of the perennial colonizer *Solidago canadensis* complex are extensive, but we assume that thistle and brome would persist indefinitely among the natives if we did not remove them. We have not planted plains rough fescue, despite the dominance of this grass in mature prairies as its seedlings are unthrifty and uncompetitive in early successional situations. Moreover, our Nisku populations have not flowered significantly in four years, and other sources of seed are few and far between (Figure 4).

We are concerned that a number of native species appear to have disappeared over the years, usually those that were present originally in small numbers. Examples include leathery grape fern (*Botrychium multifidum*), Hooker's oatgrass (*Avenula hookeri*), long-leaved bluets (*Houstonia longifolia*), and Drummond's thistle (*Cirsium drummondii*). All of our grassland species are wide-ranging in North America, so their loss is only of local significance. Of perhaps even greater concern is our suspicion that numbers of commoner species are declining, which raises the question of whether this is due to natural attrition, or our amateurish and inconsistent management activities!

Our plans are to pay more attention to grassland health in the coming years, and to develop a more scientific basis for assessing changes in plant diversity. (A single-year inventory is not sufficient. This year we had no appreciable rain until late July, and several species did not flower or flowered only in small numbers as a result.)

Figure 4. *View of the disturbed rockpile area near the gate, currently being transplanted with native plugs. (Photo credit: Trudy Haracsi)*

Conservation of Grasslands

In many ways, the challenges of managing Nisku Prairie are typical of those of small natural areas on publicly owned, provincial, or municipal land. While the government can prevail upon private industry to restore disturbances caused by pipelines and other industrial activities, public money is not available for natural remnants whose purpose is conservation or nature-oriented recreation. The priority of urban municipalities is the maintenance of parks and urban forests; for rural ones it is agriculture and rural subdivisions. Consequently, much of the stewardship work falls on volunteers, who have their own limitations: lack of equipment, appropriate contacts and networks, expertise, time, and availability. A somewhat brighter conservation and management picture is that of the newly thriving land trusts, although even they depend to a considerable extent upon volunteers for management (Figure 5).

The connectivity of small remnants to larger natural landscapes is now recognized as of supreme importance for the long-term viability of vegetation communities. Geographically, Nisku Prairie is "connected" to the Gwynne Outlet, which extends south into a deeper valley supporting natural grassland communities. However, most of the acreage owners have extended their properties, often used for grazing horses, right down to the Channel edge, severing an ecological connection. We must likely accept that Nisku Prairie can make no significant long-term contribution to the conservation of grasslands in the aspen parkland zone or in Alberta as a whole. Perhaps its most important role then is anthropocentric rather than ecocentric: to serve as a "living museum" for public education and appreciation and for scientific study and experiment, likely involving students from our various post-secondary institutions. The continued engagement of volunteers, especially younger ones, is also vital, and we should be making greater efforts at outreach.

Older people with farming backgrounds have nostalgic ties to iconic species such as prairie crocus, associations that can only lessen in predominantly urban-raised populations. Our stewardship goal should be to maintain the health of the Nisku Prairie ecosystem for as long as possible so that succeeding generations can appreciate our ancestral landscapes. Such appreciation is basic to fostering attitudinal changes that could mean that conservation of both small and large landscapes will eventually be given the focus and the funding it deserves.

Figure 5. *Volunteers "wicking" smooth brome and reed canarygrass with glyphosate in a disturbed area. (Photographer unknown.)*

Announcements

In Memoriam

Fred Sack (1947-2015)

Long-time BSA member Fred D. Sack died on June 30, 2015, after a brief illness. He had served as a Professor in the Department of Botany at the University of British Columbia from 2006 to his retirement in 2014 and as Head of the department from 2006 to 2011.

Fred was born on May 22, 1947 in New York City, the only child of Irving and Matilda Sack. He graduated from Stuyvesant High School in 1964 and Antioch University in 1969, with a degree in Sociology. While working in New York City and living in Brooklyn, Fred encountered the Brooklyn Botanic Garden and developed an interest in plants that eventually led him to Cornell University for graduate school.

Fred received his Ph.D. from Cornell in 1982 for his research on stomatal development and ultrastructure in the moss *Funaria hygrometrica*. A portion of Fred's thesis appeared in the *American Journal of Botany* in 1983, the first of numerous *AJB* papers over his career. After two years as a postdoctoral researcher at the Boyce Thompson Institute, Fred was hired as an Assistant Professor in the Department of Botany at The Ohio State University in 1984. He progressed through the ranks, and remained there for 22 years. Fred's research interests in plants were broad and diverse and included developmental anatomy, cell biology, structure-function relationships, molecular genetics, the cytoskeleton, and gravitational biology.

Fred's interests in gravitational and space biology led to extensive involvement with NASA advisory boards, grants panels, and working groups. He served on the National Academy of Sciences Committee on Space Biology and Medicine, the Space Studies Board, and the National Research Council. From 1991 to 1993, Fred served on the Board of Directors of the American Society for Gravitational and Space Biology; in 2004, he was awarded the NASA Public Service Medal, and in 2005 he was appointed a Fellow of the American Academy for the Advancement of Science. Fred served as an Associate Editor for the *AJB* from 2005 to 2013.

Over the course of his scholarly career, Fred published over 110 papers and supervised scores of graduate students and postdocs. He was known for his enthusiasm, incisive thinking, quick wit, and collegial nature. Fred is survived by his wife, Dian Clare, her three sons and four grandchildren, and his twelve cousins. In memory of Fred's love of gardens and his scientific interests, the Fred Sack Memorial Fund at the University of British Columbia will support the creation of a moss garden around the Biological Sciences Building.

- Judy Jernstedt, University of California, Davis

Personalia

Dr. Edward L. Schneider Named President and Executive Director of The Botanical Research Institute of Texas

The Board of Directors of the Botanical Research Institute of Texas (BRIT®) is delighted to announce that Edward L. Schneider, Ph.D., has been named President and Executive Director, effective December 15, 2015. Dr. Schneider brings more than 30 years of botanical executive administrative experience to BRIT and will lead the organization into the next phase of its mission of conservation and education.

"On behalf of the Board of Directors of BRIT, I am excited to welcome Ed Schneider as the new Executive Director," said Board Chairman, Harry Bartel. "Dr. Schneider's leadership and fundraising skills are perfect for building upon BRIT's mission-based research and education programs and extending the Institute's capabilities into each."

BRIT's search for a new executive director began in June 2014 after long-time director Dr. S. H. Sohmer announced his retirement. The selection was made after an exhaustive national search and selection process.

Louisiana State University Names Its Herbarium for Shirley C. Tucker

Boyd Professor Emerita Dr. Shirley C. Tucker has given $2 million to the LSU Herbarium and plant systematics program in the College of Science Department of Biological Sciences. Her gift, supplemented with an additional $960,000 from the Louisiana Board of Regents, creates a $2.96 million endowment to support the Dr. Shirley C. Tucker Chair in Plant Systematics, supports four superior graduate student scholarships, and provides endowed support for the LSU Herbarium.

In recognition of her distinguished career and contributions to plant sciences at LSU and beyond, the LSU Herbarium was named the Shirley C. Tucker Herbarium during a ribbon cutting ceremony held on October 15, 2015. The ceremony was followed by a symposium featuring guest speakers Irwin M. Brodo, emeritus scientist at the Canadian Museum of Nature in Ottawa and principle author of Lichens of North America, and Chelsea D. Specht, associate professor and curator of

monocots at the University of California, Berkeley.

"I am grateful for the many enjoyable years I spent as a faculty member at LSU. It is a pleasure to be able to show my appreciation with this gift and to support a strong program in plant systematics at LSU that will continue for years to come," said Tucker.

A renowned lichenologist and leading authority on floral development in legumes and other groups of flowering plants, Tucker was one of the first women to receive LSU's highest faculty rank of Boyd Professor. She has written more than 150 publications on floral development, plant systematics and lichen studies. She is also credited for building LSU's herbarium lichen collection, which contains 44,000 specimens, one of the largest such collections in the Southeast.

The Shirley C. Tucker Chair in Plant Systematics will provide perpetual support for an outstanding faculty member in plant systematics in the Biological Sciences Department and additional funding for superior graduate student scholarships to recruit top-performing graduate students in plant systematics to LSU. Tucker's gift will also provide continuous and reliable support to maintain and grow LSU's Herbarium collections.

"Dr. Tucker is a trailblazer in her field and role model for aspiring botanists and women in science. We are very excited to be a part of

Ribbon-cutting ceremony to celebrate the naming of the Shirley C. Tucker Herbarium at LSU. (L to R) Shirley C. Tucker Herbarium Director Lowell Urbatsch, Senior Development Director for the College of Science Emi Gilbert, College of Science Dean Cynthia Peterson, LSU Boyd Professor Emerita Shirley C. Tucker, LSU President F. King Alexander, and LSU Foundation Vice President for Development Ann Marie Marmande. Photo by Jim Zietz, LSU Strategic Communication.

her legacy of achievement," said Cynthia Peterson, dean and Seola Arnaud and Richard Vernon Edwards Jr. Professor. "Shirley Tucker has maintained a decades-long commitment to the LSU Herbarium and her gift will allow us to sustain this important facility and attract additional talented faculty and students to the plant systematics program."

The LSU Herbarium is a testament to the geographical breadth and taxonomic depth of Tucker's lichen studies. Her interest in lichens began in the 1950s as a student in the Botany Department at the University of Minnesota. She began focusing on lichens in the Gulf Coast region circa 1970 after reviewing LSU's historic Louisiana lichen collections of A.B. Langlois from the late 1800s. Her research collections also include vascular plants, bryophytes, algae and fungi.

"Shirley C. Tucker's generous, substantial donation of funds for supporting the plant systematics program and the herbarium at Louisiana State University is gratifying beyond words. Since day one of my arrival at LSU in 1975, Shirley has been a resourceful, helpful and personable colleague for me, for graduate students, and for many scientists worldwide. Knowing that all of her fine attributes will be embodied forever in this fine gift will be a source of inspiration for all of those who will benefit from her generosity," said Lowell Urbatsch, director and curator, Shirley C. Tucker Herbarium.

Tucker retired from LSU in 1995 and continues a very active research program at the University of California, Santa Barbara, the Santa Barbara Botanic Garden and the Louisiana State University Herbarium. In 2006, she was inducted into the LSU College of Science Hall of Distinction. She has also held a number of prestigious leadership positions including president of the American Society of Plant Taxonomists and the Botanical Society of America.

From the *PSB* Archives

60 years ago:

"The Weed Society of America was founded at Fargo, North Dakota, in December 1954. All persons who join this society during 1955 will be listed as charter members. Annual dues are $6.00; this includes a subscription to the journal Weeds." *PSB* 1(4): 3

Egbert H. Walker of the Smithsonian Institution reports on his experience as the Botanical Society of America's delegate to the 1951 meeting of the Botanical Society of Japan: "The outstanding impression gained from the contacts at this convention is that the Japanese botanists are eager for closer contacts and exchange with American botanists. The language barriers and the traditions of Japan, and likewise of America, are obstacles that can be and are being slowly dissolved. I trust that my appointment as delegate from the Botanical Society of America and the Pacific Science Board has helped accelerate a greater accord between the botanists of these two countries." *PSB* 1(4) 4-5.

50 years ago:

C. A. Arnold reports on the death of Rudolf Florin (1894-1965): "The death of Professor Rudolf Florin, Swedish paleobotanist, has terminated one of the most remarkable and productive botanical research careers of modern times." *PSB* 11(3): 11.

SCIENCE EDUCATION

PlantingScience Awarded $2.9M National Science Foundation Grant

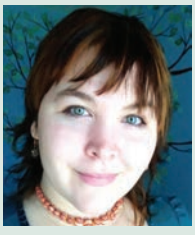
We are extremely excited to announce that BSA was awarded a $2.9 million NSF grant to develop and study a new model of professional development for teachers and early career scientists. The grant funding will go toward developing a sequence of in-person workshops and online learning platforms targeted toward high school teachers new to PlantingScience and their students, as well as graduate students and postdocs. High school biology teachers and early career scientists will work collaboratively and learn from each other while they co-mentor students on student-led plant science projects through the PlantingScience online mentoring platform. Our co-PIs at the Biological Sciences Curriculum Study (BSCS) will be conducting a rigorous cohort-comparison study to measure impacts of the new model on the students, teachers, and scientist participants.

This is fantastic news for the program, since it will allow us to move to a new platform where we can support a larger number of student teams, and it will help us to evaluate, improve, publicize, and grow this powerful program. We'll make use of our 10-year history and the strong existing PlantingScience community as we create new online training and professional development resources. Many of these resources will be available to the entire PlantingScience community and will help improve the quality of projects overall and give targeted guidance to students, mentors, and teachers as they need it.

The grant will help us to provide leadership opportunities for existing PlantingScience scientist mentors, Master Plant Science Team members, and teachers to focus their acquired expertise towards training future program participants. We will be in touch by e-mail as opportunities arise.

This new professional development grant means we will soon be expanding our reach, but other factors are involved with this growth. Our expansion in Canada, thanks to increased partnership with the Canadian Botanical Association, and development of a new agriculture module in partnership with the American Society of Agronomy will be very important in moving forward. In order to handle the larger number of student teams we're anticipating, we'll need more scientist mentors willing to volunteer their time and share their passion for plants and science.

Please consider joining us next fall!



By Catrina Adams, Education Director

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

Seeking new PlantingScience mentors and middle and high school teachers for Fall 2016. PlantingScience is growing, and we need your help!

If you have not yet mentored with the program, please consider joining us next fall. If you are a current mentor, please consider recruiting your colleagues to give mentoring a try next year.

If you have or know a student in grades 6-12, please consider sending their biology teacher an invitation to check out our website PlantingScience.org and what we offer (free of charge) to teachers. PlantingScience is a great way for middle and high school students and their teachers to learn more about what plant science is like and to meet and interact with scientists from around the world.

Learn more at:
www.plantingscience.org

plantingscience

USA Science & Engineering Festival, BSA Seeking Local D.C. Area Booth Volunteers

This April the BSA will be participating in the USA Science and Engineering Festival held in Washington D.C., sharing booth space with partnering organizations as part of a joint "Plant Presence." By partnering, we are able to make a bigger impact for plant science among a sea of biomedical and engineering exhibits at the Festival. Over 350,000 attendees are expected, and we expect that over 10,000 people will visit our Plant Presence booth each day. This is a great way to capture the public interest in plants and to increase their appreciation of how important plants are to our daily lives.

We are seeking local BSA members to help us share simple booth activities with D.C. area schoolchildren and families at this 3-day event held April 15 -17 at the Walter E. Washington Convention Center.

If you are in the area and would like to share your passion for plants with the public, please consider volunteering for a shift at the booth. Please contact Catrina Adams (cadams@botany.org) if you are interested in learning more about the opportunity.

What Is QUBES? And What Can It Do for You?

A message from Carrie Eaton and the QUBES team

QUBES stands for Quantitative Undergraduate Biology Education and Synthesis.

- If you are an educator in biology that is on the lookout for ways to explain or incorporate quantitative concepts into your classes – this is for you.
- If you are an educator in statistics, mathematics, or computational science that wants more relevant biology motivating examples or data to incorporate into your classes – this is for you.
- If you are an educator somewhere in the interface of mathematics and biology – this is for you.

What is QUBES?

- We are a leadership team working with a large network of institutions and professional societies in all areas related to resources for professional development in teaching quantitative biology (broadly inclusive).
- Our Hub website (https://qubeshub.org/) is a collaborative space for sharing teaching ideas.
- You may have already seen us advertise FMNs (Faculty Mentoring Networks), which are cohorts of educators with the same mission and motivation. They work together to share quantitative biology education ideas and curriculum in the same course, like introductory biology, the same tool, like NetLogo or anything else that brings them together.

What else can QUBES do for you? Just let us know! What can you do for QUBES? Join the conversation! https://qubeshub.org/

Next-Generation Careers: Innovations in Environmental Biology Education

The BSA is one of six professional societies participating in a newly awarded NSF RCN-UBE incubator headed by the Ecological Society of America and the Society for Conservation Biology. The incubator is based around discovering skill sets necessary for career advancement in the evolving field of environmental biology, and how faculty, instructors, and professional societies can help prepare students for next-generation careers by helping to address these skills.

As part of this project, the BSA will be helping to distribute faculty surveys and hosting a small focus group as part of the BOTANY 2016 meeting. A report and publication on the findings of the project is planned for January 2017.

Stay tuned! Many workshops and discussion sessions regarding the topic of nontraditional scientific careers are planned for our BOTANY 2016 meeting in Savannah.

Round-up of Opportunities for Students

With the year coming to a close, you may be thinking about what you want to do in 2016—so here are some ideas! Gathered here are upcoming opportunities for you to enrich your CV, studies, and research. We have four categories for easy browsing: Grants and Awards, Broader Impacts, Short Courses & Workshop, and Job Hunting.

Grants and Awards

Grants and awards can fund your research, travel for training or field work, and even stipend. Grant/award applications are also a great opportunity to plan and articulate your research. Besides this list, remember to check if your department or university has grants suitable for application.

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

*By **Angela McDonnell and Becky Povilus**, BSA Student Representatives*

BSA Student Travel Awards	
Variable, up to $500	Botanical Society of America
Travel (conference)	Several awards support student travel to the annual BOTANY conference: - Cheadle Student Travel Awards - Triarch "Botanical Images" Student Travel Award - BSA Section awards
Deadline: early-April, variable	
More info:	www.botany.org/Awards
Cross-Disciplinary Training Grant	
up to $3,500	microMORPH
Travel (research)	Foster cross-disciplinary training and interaction by allowing graduate students to visit labs/gardens with the intent to enrich their research on plant evo-devo, as related to questions or processes of microevolution.
Deadline: Spring and Fall	
More info:	projects.iq.harvard.edu/micromorph
EDEN Research Exchange	
up to $3,000	EDEN: Eco-Devo-Evo Network
Travel (research)	Allow graduate students to develop and disseminate experimental techniques, community resources, and novel collaborations involving research on new and emerging model organisms.
Deadline: April 30 and October 31	
More info:	www.edenrcn.com
NSF Graduate Research Fellowship Program	
$32k/yr + tuition aid	National Science Foundation
Stipend & Tuition	Support outstanding graduate students in NSF-supported disciplines who are pursuing research-based Master's and doctoral degrees at accredited U.S. institutions.
Deadline: October	
More info:	www.nsfgrfp.org
NSF Doctorial Dissertation Improvement Grant	
up to $13,000	National Science Foundation
Research Funds	Provide partial support of doctoral dissertation research for improvement beyond the already existing project (check that your project falls within the scope of associated Divisions).
Deadline: October	
More info:	Click the "Funding" tab at http://www.nsf.gov
Torrey Botanical Society Fellowships and Awards	
up to $2,500	Torrey Botanical Society
Research Funds & Travel	Support research/education of graduate student society members (fund field work, recognize research in conservation of local floral/ecosystems, fund course attendance at a biological field station).
Deadline: mid-January	
More info:	http://www.torreybotanical.org
Prairie Biotic Research Small Grants	
up to $1,000	Prairie Biotic Research, Inc.
Research Funds	Support the study of any species in U.S. prairies and savannas.
Deadline: late-December	
More info:	http://www.prairiebioticresearch.org

Botany In Action Fellowship	
$5,000	Phipps Conservatory and Botanical Gardens
Research Funds	Develop new, science-based plant knowledge and chronicle traditional knowledge of plants. BIA promotes interactive scientific education about the importance of plants, biodiversity, and sustainable landscapes.
Deadline: mid-January	
More info:	www.phippsbotanyinaction.org
The Lewis and Clark Fund for Field Research	
up to $5,000	American Philosophical Society
Research Funds	Encourage exploratory field studies for the collection of specimens and data and to provide the imaginative stimulus that accompanies direct observation.
Deadline: early February	
More info:	www.amphilsoc.org/grants/lewisandclark
ASPT Graduate Student Research Grants	
up to $1,000	American Society of Plant Taxonomists
Research Funds	Support students (both Master's and doctoral levels) conducting field work, herbarium travel, and/or laboratory research in any area of plant systematics.
Deadline: early March	
More info:	www.aspt.net/award
Richard Evans Schultes Research Award	
up to $2,500	The Society for Economic Botany
Research Funds	Help defray the costs of field work on a topic related to economic botany, for students who are members of the Society for Economic Botany.
More info:	www.econbot.org
Sigma Xi Grants-in-Aid of Research	
up to $1,000	Sigma Xi
Research Funds	By encouraging close working relationships between students and mentors, this program promotes scientific excellence and achievement through hands-on learning.
Deadline: mid-March and October	
More info:	www.sigmaxi.org/programs/grants-in-aid
Young Explorers Grant	
up to $5,000	National Geographic Foundation
Research Funds	Support research, conservation, and exploration-related projects consistent with National Geographic's existing grant programs. In addition, this program provides increased funding opportunities for fieldwork in 18 Northeast and Southeast Asian countries.
Deadline: mid-March and October	
More info:	www.nationalgeographic.com/explorers/grants-programs/young-explorers
Systematics Research Fund	
up to $5,000	The Systematics Association & The Linnean Society
Research Funds	Besides research focused on systematics, projects of a more general or educational nature will also be considered, provided that they include a strong systematics component.
More info:	www.systass.org/awards

The Exploration Fund Grant	
up to $5,000	The Exploration Fund Grant
Research Funds	Provides grants in support of exploration and field research for those who are just beginning their research careers.
Deadline: late October	
More info:	www.explorers.org/expeditions/funding/expedition_grants
CIC Smithsonian Institution Fellowship	
$32,700 for one year	CIC & the Smithsonian Institution
Stipend	One-year fellowships to support research in residence at Smithsonian Institution facilities. All fields of study that are actively pursued by the museums and research organizations of the Smithsonian Institution are eligible.
Deadline: early-December	
More info:	www.cic.net/students/smithsonian-fellowship
Ford Foundation Fellowship Programs	
$24k-45k, for 1-3 yrs	Ford Foundation
Stipend	Three fellowship types are offered: Predoctoral, Dissertation, and Postdoctoral. The Ford Foundation seeks to increase the diversity of the nation's college and university faculties.
Deadline: late-November	
More info:	http://sites.nationalacademies.org/pga/fordfellowships/index.htm
The Arnold Arboretum Awards for Student Research	
$2,000-10,000	The Arnold Arboretum
Research Funds	Four awards are offered for graduate students, with topics that focus on Asian tropical forest biology and comparative biology of woody plants (including Chinese-American exchanges). Check website for full information on each award.
Deadline: late-November	
More info:	http://www.arboretum.harvard.edu/research/fellowships/
Garden Club of America Scholarships	
$2,500-8,000	Garden Club of America
Research or Training Funds	Many awards are offered to support botanical research, with foci ranging from public garden history/use, field botany, medicinal botany, and horticulture. Check website for full information on each award.
Deadline: January-February	
More info:	http://www.gcamerica.org/scholarships

Broader Impact Opportunities

It's not just for NSF grants! Sharing your passion for plants and science with a wide range of audiences will develop speaking skills and can help you re-connect with the reason you decided to go to grad school after all.

PlantingScience	
What it is:	A learning community where scientists provide online mentorship to student teams as they design and think through their own inquiry projects.
What you can do:	Interact with grade school-to-college students online, as they work on plant-focused learning modules in the classroom.
More info:	http://www.plantingscience.org/

Science Olympiad	
What it is:	Competitions are like academic track meets, consisting of a series of 23 team events in each division (middle school or high school). Each year, a portion of the events are rotated to reflect the ever-changing nature of genetics, earth science, chemistry, anatomy, physics, geology, mechanical engineering, and technology.
What you can do:	Mentor local students in person on a variety of science and engineering oriented topics and skills, help organize and run competitions
More info:	http://www.soinc.org/
Local Arboretums, Parks, and Museums	
What it is:	These institutions often depend on volunteers to donate their time and expertise to help people of all ages enjoy their collections and grounds. They may already have programs in place that allow you to lead tours or interact with visitors at special events, so that you can share your interests and passion.
What you can do:	Lead tours; help organize and run events
More info:	Look up local parks/arboretums/museums online, or inquire at visitors' centers.

Short Courses and Workshops

These are a great way to learn new skills to add to your research. Here are a few of many options available to grad students for part of a semester or summer.

Advanced Field Botany	
University of Idaho June or July	This two-week course is open to upper division undergraduates and early career graduate students. In the course, you'll gain valuable experience and botanical knowledge in the field. You'll also get acquainted with the flora of Idaho in the Inland Northwest. Interested students should look for an announcement in the spring.
More info:	http://www.webpages.uidaho.edu/dtank/AFB/Advanced_Field_Botany.html
Tropical Botany Summer Course	
University of Florida June 26 - July 21	This course highlights the biology and systematics of tropical plants, specifically the extensive holdings of tropical vascular plants at Fairchild Tropical Garden, The Kampong of the National Tropical Botanical Garden, and the Montgomery Botanical Center. Field trips will also be offered to the Everglades, the Florida Keys, and other adjacent natural areas. Be on the lookout for an announcement during the winter months.
More info:	http://www.flmnh.ufl.edu/herbarium/news/tropicalbotany.htm
OTS Courses in Tropical Field Biology	
Organization for Tropical Studies Variable dates	Courses through the Organization for Tropical Studies (OTS) are a well-renowned way to spend a summer or semester in the field, learning about the biology of tropical ecosystems in Costa Rica and South Africa. Course offerings include Tropical Plant Systematics, but check their website for the full list of offerings.
More info:	www.ots.ac.cr

microMORPH Short-Course in Organismic Plant Biology	
Arnold Arboretum of Harvard University	microMORPH summer short-courses give students a 2-week immersive learning experience amid the expansive living collections and the state-of-the-art microscopy facilities of the Arnold Arboretum. Topics in past years have included plant anatomy (with a focus on wood anatomy), and plant morphology; the topic for 2016 has not yet been decided. Applications will be solicited in the spring.
late June - early July	
More info:	http://projects.iq.harvard.edu/micromorph/courses-0
Molecular Evolution Workshop	
Marine Biological Library at Wood's Hole	This 10-day course features a series of lectures, discussions, and bioinformatics exercises. Included are sessions on phylogenetic analyses, population genetics analyses, databases and sequence matching, molecular evolution, and comparative genomics. Applications for participation are due on April 4, 2016.
July 17 - July 27	
More info:	molevol.mbl.edu/index.php/Main_Page
Bodega Bay Applied Phylogenetics Workshop	
UC Davis and the Bodega Marine Laboratory	This week-long course for will cover topics in statistical phylogenetics and gives students the opportunity to complete a project during the course. The schedule will likely include sessions on Bayesian inference, divergence-time estimation, MCMC diagnosis and model selection, biogeography, continuous and discrete trait evolution, species tree inference, and rates of lineage diversification.
March 5 -12	
More info:	www.treethinkers.org
The R Basics Workshop	
Missouri Botanical Garden	This workshop is one way to get exposure and experience working with R: a powerful statistical software package. No dates are currently set for the next three-day crash course, but it is likely that it will be taught again next May in St. Louis by scientists from the Center for Conservation and Sustainable Development. Look out for a formal announcement in December or January and watch their website.
May	
More info:	www.rbasicsworkshop.weebly.com
edX: Data Analysis for the Life Sciences	
online	edX, a free online course provider, offers a seven-part course on data analysis for the life sciences (PH525.1-7). These courses are a self-paced way to learn the using R for statistical analysis, starting with basic R use to dealing with genomic datasets. These courses combine video lectures, practical exercises, and a discussion board monitored by course developers.
Variable times	
More info:	search "PH525" on www.edx.org

What's Next: Looking for a Job in Botany

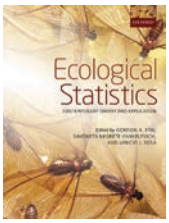
Before you have your degree, or if you are looking to switch jobs, it is important to consider your next step, whether it be finding a PI and lab to work in for continuing your education, finding a post-doctoral research opportunity, or finding a job that suits your goals and skills. Finding out about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

Masters/PhD/Post-Doctoral Opportunities	
These types of jobs are easily searchable on the "EvolDir" website under "PostDocs" and "GradStudentPositions." Click the icon, and listings will pop up in a list from the newest to the oldest. This site shows positions from across the biological sciences but is a great option for plant evolutionary biologists.	
EvolDir	http://www.evol.mcmaster.ca/brian/evoldir.html
Academic Teaching Positions	
Check the BSA website; click on the "Careers/Jobs" tab, and you can select "Post-doctoral, Fellowship, and Career Opportunities" link to see a current list of a variety of job postings. The BSA website is a great resource for one-stop-shopping for careers and other opportunities in a variety of botanical sciences. Another good resource for finding jobs (including postdoctoral opportunities) can be found through AAAS, at the Science Careers site.	
Botanical Society of America	jobs.botany.org
AAAS Science Careers	jobs.sciencecareers.org/jobs/botany-plant-science
Government Positions and Non-Academic Jobs	
Searches for government jobs can begin atusajobs.gov and americajobs.com. A good resource for non-academic jobs is the Conservation Job Board; this site allows you to search within various fields by state and is updated regularly. Networking sites like LinkedIn and ResearchGate will help you connect with and organize your professional contacts---be sure to keep your profile pages updated and polished!	
Government Positions	www.usajobs.gov
	www.americajobs.com
Conservation Job Board	www.conservationjobboard.com/category/botany-jobs
Use your University!	
Many academic institutions have offices that focus on helping alumni succeed after graduation. Check with your department or institution for resources on job announcements, workshops focused on personal development (such as CV/resume writing or getting a teaching certificate), and networking opportunities.	

BOOK REVIEWS

Ecological

Ecological Statistics: Contemporary Theory and Application



Gordon A. Fox, Simoneta Negrete-Yankelevich, and Vinicio J. Sosa, editors
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Paperback, £39.99. 416 pp.
Oxford University Press, Oxford, United Kingdom

Not so long ago, ecologists were free to frolic in flowered meadows and poetically report findings that "[could not] be merely accidental, because they so often tend in the same direction" (Bumpus, 1899). And although some, no doubt, yearn for a return to this descriptive way of science, it seems undeniable at this point that researchers entering or continuing on in the field must become fluent in the language of statistics. This task is especially difficult because our understanding of statistics has changed dramatically in the past decade and continues to change daily. Driven in part by access to ever-improving computing power, many of the statistical techniques used in contemporary work were little known a generation ago—if they existed at all. The question then becomes: how do we best *teach* statistics to our students and ourselves?

Ecological Statistics: Contemporary Theory and Application is one answer to this question—and it's a good one at that. Best suited as an overview for graduate students or researchers with standard mathematical backgrounds, the text begins with basic probability, but quickly turns to more specific relevant issues like the effects of ecological data constraints on analysis. *Ecological Statistics* excels at building a working conceptual understanding of statistics rather than treating each topic piecemeal as is common in other texts. The value of this conceptual understanding is especially relevant for those interested in working with the complex, imperfect, and sometimes unconventional nature of biological data.

The topics covered are diverse, including generalized linear models, structural equation modeling, and phylogenetic analysis. These chapters vary widely in technicality, but all employ straightforward writing and supporting illustrations. Chapters 1–3 are, most simply, a discussion of the concepts that follow in the successive chapters. The authors provide not only the basic tools you will use later in the book, but also a map of where those tools may come in handy. These tools include unbiased data collection, sample statistics and confidence intervals, likelihood, model selection,

and non-parametric methods, among others. The successive chapters use variations of these basic tools with sample data to more fully develop the ideas discussed. Chapter 4 talks specifically about the ever-present and often-confounding conundrum of what to do with missing data, while Chapter 5 talks more generally about deftly handling censored or truncated data. Chapter 6 is a particularly well-written chapter by Yvonne M. Buckley that discusses in depth the correct application of the generalized linear model, as well as many of the method's common pitfalls and complications. Chapter 8 discusses the process of combining simple models into more complex causal models, while Chapter 9 discusses combining models from different studies into informative and transparent meta-analyses. The final four chapters cover the correlation structure of data, with Chapter 10 focusing on spatial variation and linear modeling and Chapter 11 focusing on phylogenetically correlated data. Chapter 13 discusses using mixture models for overdispersed data, and Chapter 13—another exceedingly well-written section, this time by Benjamin M. Bolker—examines linear and generalized linear mixed models.

This broad treatment of the field has inevitably left some relevant topics out in the cold—notably, non-linear models, multivariate techniques, and time series—but in general, the book gives enough background to serve as a springboard for the reader to delve deeper into topics they find particularly relevant. Additionally, as a consequence of the text's conceptual nature, some readers may find a more succinct resource to be helpful later when they are looking to perform a certain task. The authors and editors have dutifully placed example R code for most chapters; however, these snippets are often isolated by substantial blocks of crucial explanatory text or supporting mathematical notation, making quick reference challenging. It also seems that further utility could be gained with additional problem sets for students to work through independently.

Despite these small gripes, *Ecological Statistics: Contemporary Theory and Application* is an amazing piece of work that deftly performs the unenviable task of presenting the "need to know" methods of a complex field. While the first six chapters alone make this text a worthy purchase, not every chapter may prove to be adequate for every course. However, the logical progression of the chapters may serve well as a structure for instructors to build on. This book would be a valuable addition to any course asking students to expand their statistical comfort zone, but also easily lends itself to self-study for those wishing to join the conversation of ecological statistics.

–Chase L. Nuñez, University Program in Ecology, Nicholas School of the Environment, Duke University, Durham, North Carolina, USA

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Systematics

Flora of North America: North of Mexico; Vol. 9: Magnoliophyta: Picramniaceae to Rosaceae

Flora of North America Editorial Committee

2015. ISBN-13: 978-0-19-534029-7
Hardcover, US$95.00. 752 pp.
Oxford University Press, New York, New York, USA

Volume 9 of the *Flora of North America* (FNA) covers only four families, Picramniaceae, Staphyleaceae, Crossosomataceae, and Rosaceae. However, at over 700 pages, it is one of the largest volumes published. Volume 9 is the 18th out of 30 to be published and represents 1.5% of the vascular families that will be covered. Treated within the volume are two species each of Picramniaceae and Staphyleaceae, seven of Crossosomataceae, and 680 of Rosaceae. The FNA is designed for both the botanist and nonbotanist and contains dichotomous keys for identifying North American species and detailed treatments of taxa. The Introduction, which is fairly verbatim among volumes, has a very detailed explanation on how to read and interpret the species' treatments.

While the FNA, by design, covers North America north of Mexico, the map of North America on the inside front and back covers depicts all of North America, Central America, and much of the Caribbean. Of this additional land area, only Mexico is fully delineated and labeled. I suspect this was intended to give reference to the area covered by the flora, but I think this gives the map an incomplete appearance. Likewise, the District of Columbia is listed on the legend for this map, but it is not labeled on the map itself. The smaller occurrence maps for each species only include the flora area. To be consistent within the volume, it might have been practical to drop the extra land area. On the other hand, this map design is entirely consistent with all previously published volumes of the FNA, with the exception of updates to Canadian territories.

Within the Basic Concepts section of the Introduction, it states that taxa treated in full include native species, as well as waifs or cultivated plants that are found frequently outside of cultivation. This is further elaborated later in the Introduction where it states that at least one specimen from each geographic unit record should have been seen by the authors. In practice, inclusion in this volume of the Flora seems generous. *Potentilla sterilis* has had its native status questioned and has one historical documentation from 1928. No current occurrences are known, and no voucher was seen (p. 132). Likewise, *Potentilla erecta* is questioned as being an extant naturalized species and is no longer known where it is historically reported (p. 136). *Acaena pallida* is known only from a single collection from California (p. 325). I think generous inclusion for the Flora is justifiable. Introductions of species will only continue so these species may appear on the landscape in the future.

In some previous volumes (2–4, 22, 24–26), the occurrence maps are range maps with shaded regions where the species occur. However, Volume 9 and other recently published volumes have a simplified dot occurrence map. Even though ranges have become fragmented, I think the range maps are more informative and better represent the species' geographic ranges rather than using political boundaries. For instance, one dot occurrence in Quebec could represent a geographic range larger than the combined region of all New England states with dot occurrences. This might suggest to the nonbotanist that a species is *only* found in Quebec versus being found *all over* New England. It is also difficult to detect dots on small political divisions on

the map, although this is not necessarily a concern because occurrences are listed in the species treatments as well.

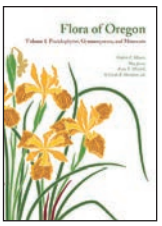
The illustrations in the volume are very nice. Twenty-eight percent of the species in the volume are illustrated, including species in each of the four families. Other published volumes have illustrations that are easily sized to one-half of a page, but in this volume they are smaller, closer to one-third of a page. This probably conserved space in this large volume, but there does not seem to be any loss of detail. In fact, the Rosaceae illustrations are quite detailed, enough so to highlight subtle differences between similar species, such as those within the genera *Rosa* or *Potentilla*, especially as there are scale bars for each species within an illustration—helpful to nonbotanists who may not have an eye for the difference between 1 and 2 mm. Illustrated species have a box code of "F" within their treatment, but unfortunately within the treatment there is no page number listed for the illustration. One must either flip some pages to search for it (e.g., *Geum triflorum* is treated on p. 62, but the illustration is on p. 52 within the *Rubus* treatments) or find the species in the index. The italicized page numbers in the index specify the page of the illustration, but the font used in the book does not allow italic numbers to be easily discerned.

The keys in this volume work well too. For the Rosaceae, there is an 18-couplet key to subfamilies and tribes; the keys for Picramniaceae, Staphyleaceae, and Crossosomataceae are simple and lead directly to genus or species. I collected three specimens on the walk to my office and had them keyed out and treatments fully read in short work—as the process is intended. It took nine couplets to arrive at *Chaenomeles speciosa, 11 for Duchesnea indica* var. *indica*, and 15 for *Rubus allegheniensis* (most likely a hybrid cultivar). The couplets are easy to navigate and, in addition to vegetative information, contain details for flowering and fruiting stages aimed at those frustrating times when one or the other is unavailable. There is no glossary of botanical terminology, however, which may make it more difficult for the nonbotanist. The Introduction refers to the book *Categorical Glossary for the Flora of North America Project* and lists a website for its online access. The link given no longer appears to work, but I found the website by searching online for the title.

This is a hefty book, so it's no good as a field guide. However, the FNA, including this volume, is also published online (www.fna.org). This makes it a useful tool in the lab or classroom, but the complete 30-volume set would be a splendid addition to any botanist's (or anyone's!) library.

– Adam Ramsey, Department of Biological Sciences, University of Memphis, Memphis, Tennessee, USA

Flora of Oregon, Vol. 1: Pteridophytes, Gymnosperms, and Monocots



Steven C. Meyers, Thea Jaster, Katie E. Mitchell, and Linda K. Hardison (editors)
2015. ISBN-13: 978-1-889878-46-1
Cloth, US$90.00. xiv + 591 pp.
Botanical Research Institute of Texas, Fort Worth, Texas, USA

My first thought on opening this book was, "How do I preserve the beautiful dustcover?" My second thought was, "There should be some special recognition of Tanya Harvey, for layout and design of this elegant volume." There is now a new standard of excellence for a state flora.

Cover 2 and its facing page are full-color illustrations of the eleven Oregon ecoregions: Cascades, Coast Range, Willamette Valley, etc. Cover 3 is the family index, and its facing page is an outline map of Oregon's counties, with the county seat of most counties indicated. The adopted family names mostly follow Angiosperm Phylogeny III.

The actual keys begin on page 65. That is to say, there are 64 pages of introduction, explanation of keys, and page after delightful page of Oregon's pioneer and contemporary botanists, including portraits and extensive biographical details. These pages also include extensive coverage of "Exploring Oregon's Botanical Diversity," replete with color photographs—these are national parks, national forest lands, etc. One of the sketches mentions *Luina serpentina* Cronquist, an Oregon endemic. I had never heard of this plant, so I turned to the index, to no avail. (Not surprisingly, it turns out it's in the *Asteraceae*, not covered in this volume.) As I subsequently discovered, nothing in these opening pages is included in the index to this volume. Alas, readers can only page through themselves, to discover these riches. (Sketches of the lives of the four editors are only included on the back flap of the dustcover.)

The arrangement of the accepted taxa is alphabetical throughout, with the running heads dictionary-like. This is yet another example of how much thought went into the book's design. All species are mapped; the maps include dots for actual specimens, plus shading to indicate their occurrence in Oregon's eleven ecoregions; furthermore, the names of the ecoregions (most abbreviated) are given at the end of each description, followed by the range outside of Oregon. A great many are illustrated with line drawings, which are far more useful than photographs. The descriptions are very ample. The authors of accepted taxa are given without abbreviation, although the authors of synonyms are conventionally abbreviated. None of the Latin is explained or translated, and no references to type descriptions are given. English names are given; I forbear to call them common names, because most of them appear to be mere translations of the Latin. "Long-bearded mariposa-lily" is scarcely plausible as a name that can come trippingly on the tongue.

Just before the index, there are five appendices. One of the most interesting is the fifth one, "Native taxa not collected in the past 50 years." If I were an Oregonian, I would adopt this list as an action plan for plant collecting. Table 1 of Appendix 1 lists taxa excluded from full treatment because they are known from a single Oregon population, or because they are mere waifs. Table 2 of Appendix 1 lists well over 100 species that have been credited to Oregon, but which turn out to be unvouchered (for the most part) or with misidentified vouchers. I cannot recollect ever having seen such lists in a flora before. Their inclusion speaks to the care with which the editors and taxon authors have approached their material. The appendices include the entire flora, not just the taxa treated in Volume 1. However, only the scientific names relevant to Volume 1 that appear in Appendix 1 are included in the index for Volume 1, but without reference to their occurrence in Appendix 1 itself.

There are to be three volumes, comprising the dicots. I learned by e-mail that the publishing target dates for Volumes 2 and 3 are autumn of 2017 and (late) 2019, respectively. The Oregon Flora Project is off to a splendid start, and I feel sure the next two volumes will be eagerly awaited.

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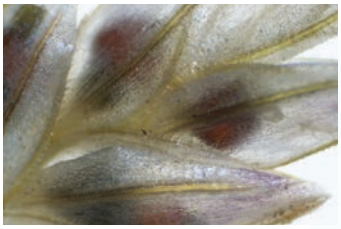
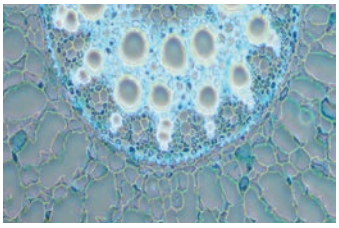
Plant Science Bulletin Featured Image

Spring branches of Arctostaphylos viscida (whiteleaf manzanita) draped in lichen (possibly in the genus Evernia). Smooth bark and a rich red to brown color are good indicators that trees or shrubs seen while hiking in Oregon and California belong to the Arbutoideae subfamily of the blueberry family, Ericaceae. The manzanitas, in the genus Arctostaphylos, can form dense thickets as a dominant or co-dominant member of chaparral plant communities. The manzanita seen here, Arctostaphylos viscida, produces seeds that can remain dormant in the soil for many years, until stimulated to germinate by fire, allowing this shrub to establish quickly after an area burns. The branches of this manzanita are draped in lichen, a separate organism that does not harm the plant, but does use the branches as habitat. While the productivity of a community is often thought to be driven by the photosynthesis performed by plants, cryptogams such as this lichen perform photosynthesis as well and may account for about %7 of the net primary productivity worldwide. Bacteria within the lichen can also obtain nitrogen from the air, processing it into a form that can be used by plants and animals which are unable to secure this important resource from the atmosphere.

Photo by Kevin Weitemier, Botany & Plant Pathology Department, Oregon State University.

See You In Savannah !





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