



The Vasculum

The Society of Herbarium Curators Newsletter
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The Society of Herbarium Curators (SHC) unites the world's herbarium professionals in discussion, training, action, and support for the benefit of herbaria, science, and society. SHC envisions a network of innovative, well-trained herbarium professionals, empowered to recognize and address local and global stakeholder needs with organizationally sustainable strategies that advance the well-being of herbaria, science, and society. For more information, please join us online:

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Message from the President



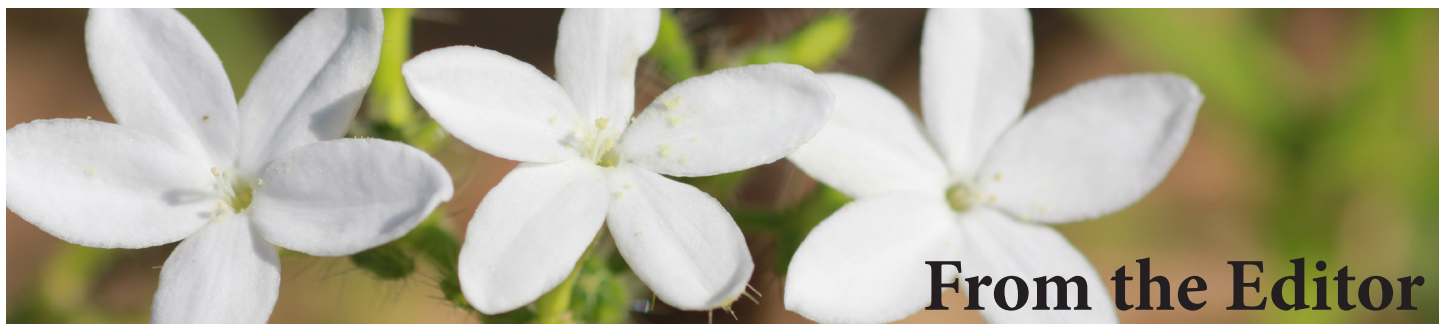
It is an honor to serve as the new President of the Society of Herbarium Curators, and I thank the leadership and membership for handing off a healthy and vibrant organization. In particular, I would like to thank Austin Mast (R. K. Godfrey Herbarium, Florida State University) for his superb service as President over the past two years, Lucinda McDade (Herbarium of Rancho Santa Ana Botanic Garden) who just completed her three-year term as Member-at-Large, and Andrea Weeks (Ted R. Bradley Herbarium, George Mason University) for her service as Past-President and Program Chair. Also, I would like to welcome our newest board member Maribeth Latvis (C. A. Taylor Herbarium, South Dakota State University), who was elected Member-at-Large.

The Society has been very active this past year, and as evidenced from Austin Mast's column in this issue of *The Vasculum* (page 4), the list of accomplishments is impressive. In the upcoming year, we plan to keep the momentum going. Priorities include rolling out the new Developing Country Membership category, making headway on establishing an endowment, and making various improvements to the SHC website, to name a few. As for more aspirational goals and building on the success of the post-Botany workshop and the SHC Strategic Planning for your Herbarium course, it would be beneficial for the Society to think about other educational activities that we might support to provide even more value-added service to the community. If you have suggestions, please let me know.

Over the next year, I also hope to see the Society and its members play an active role in discussions about the future of biodiversity collections. Over the past several years, hundreds of institutions around the world have been engaged in a monumental specimen digitization and mobilization effort. The digitization task has energized biodiversity collections and the wealth of data and images that have resulted from digitization activities has given collections a renewed relevance, enabling much new research. Now, there are discussions about what kinds of activities biodiversity collections should prioritize going forward with a developing emphasis on how to further promote digitized specimen data for research. As members of the herbarium collections community, I encourage you as individuals to play an active role in participating in these discussions at a national and international level.

I'm looking forward to sustaining the great momentum and direction of the Society. Thanks very much for your past and future support in these efforts. Please don't hesitate to contact me to offer your ideas on how to make the Society more successful. Finally, if you would like to nominate yourself for an elected position, contact the Nominating Committee Chair Austin Mast (amast@bio.fsu.edu), or me to be considered for a committee role.

Patrick Sweeney
Yale University Herbarium, Senior Curator



From the Editor

With the second issue of *The Vasculum* from our new editorial team, we continue to make modifications to the format and content in an effort to continue bringing articles of interest in an updated style. I would like to again thank the editorial committee, Abby Moore and Melanie Link-Perez, for all of their effort in bringing *The Vasculum* to you. The most significant change made with this issue was delaying the publication date from July to August. We decided to extend the summer publication date in order to cover the Botany and The Society of Herbarium Curators annual meetings. The winter issue will continue to be published at its normal time in January.

The Society of Herbarium Curators has had many exciting changes over the last few years, and we hope that this excitement is reflected in the pages of *The Vasculum*. As you will read on page 6, we are happy to report the adoption of complementary membership to our colleagues in developing countries. Not only will this new program broaden the representation of the SHC worldwide, but it will further enhance our entire community by giving us a unified, diverse, and resounding voice in promoting and strengthening the vital roles of herbaria in science and society.

In this issue, we are excited to showcase the tremendous success our members have had in funding herbarium-based research and digitization projects. We highlight three such projects in the current issue: The Index Herbariorum upgrade (see page 7), the Southern Rocky Mountain project (see page 9), and the Capturing California's Flowers project (see page 19). It is exciting to see our colleagues have such great success, especially as their success will do much to advance the use of herbaria.

Our featured herbarium this issue is Tarleton State University Herbarium (TAC), from Stephenville, Texas, U.S.A. The TAC collection has a history that is familiar to many of the smaller collections (and even some larger ones), where collections were made primarily for teaching, but then obtained remarkable growth and importance to research because of a few professors who understood the importance of herbarium collections. As our community well understands, these smaller collections are of tremendous importance and value to our understanding of local and regional biodiversity.

Once again, the Editorial Committee would like to announce a call for papers for the January issue. We have such a vibrant and creative community, and we would like to hear more about your successes. Please contact us with article ideas.

John J. Schenk
Georgia Southern University Herbarium Curator

Letter from the Past President

I will start by welcoming Patrick Sweeney (Yale University Herbarium, Y/YU) as the Society of Herbarium Curator's ninth President. I have had the pleasure of working with Patrick in his term as President-Elect for the last year, and the Society is in good hands. Patrick and I decided to both write for the Letter from the President column this issue, with my passage representing a reflection on the final six months of my time in the role and his representing his thoughts on our Society's future.

The Society's Executive Board (EB), members of standing, and ad hoc committees have been very busy in the first-half of 2018. I'll mention some of the highlights below, but there are certainly others, including our annual funding of student research and the creation of an ad hoc Endowment Committee.

I thank the other members of the ad hoc Branding Committee (President-Elect Sweeney and Past-President Andrea Weeks) for working with me to produce a revised Mission, Vision, and Tagline for the society that the EB later approved with minor edits. In my opinion, these nicely distill the essence of the Society. Our new mission statement is: The Society of Herbarium Curators unites the world's herbarium professionals in discussion, training, action, and support for the benefit of herbaria, science, and society. Our new vision statement is: The Society of Herbarium Curators envisions a network of innovative, well-trained herbarium professionals, empowering them to recognize and address local and global stakeholder needs with organizationally sustainable strategies that advance the well-being of herbaria, science, and society. Our new tagline is: Promoting and strengthening the vital roles that herbaria play in science and society. These can now be seen on the website and will proliferate over other materials (the newsletter, promotional materials, etc.) over the next year.

A healthy 51% of eligible voters participated in voting this year. I welcome Maribeth Latvis (South Dakota State University Herbarium) as the new Member-at-Large for the society and the founding leadership cohort for the Early Career Section, including Katelin Pearson (Robert K. Godfrey Herbarium at Florida State University) as Section President, Sophie Winitzky (Rancho Santa Ana Botanic Garden) as Section President-Elect, Chris Tyrrell (Milwaukee Public Museum) as Section Secretary, Charles Zimmerman (New York Botanical Garden) as Section Professional Development Officer, and Abigail Moore (Robert Bebb Herbarium at University of Oklahoma) as Section Member-at-Large.

The Developing Country Membership category proposal passed by a huge margin (136 Approve, 1 Reject, 6 Abstain). During the EB meeting at Botany 2018, a list of Developing Countries was approved that includes the 81 countries recognized by the World Bank as low-income or lower-middle-income economies. With this transformative move the Society is better positioned to engage all members of the world's community of herbarium professionals, and I look forward to a successful roll-out of this new membership category for 2019.

The proposed amendments to the Constitution and Bylaws also passed (132 Approve, 0 Reject, 11 Abstain). These amendments were designed to reinvigorate the process of establishing affiliations with other organizations, bring greater precision to the language, make the curation of membership information easier, clarify the responsibility for the Society's social media platforms, and do a few other minor things. Affiliate organizations are now recognized by the EB for two-year periods, which requires the EB to regularly discuss the potential opportunities that affiliations represent, and prevents non-productive affiliations from accumulating without reconsideration. At this year's EB meeting, the Society initiated affiliate relationships with the American Society of Plant Taxonomists, Botanical Society of America, and the Society for the Preservation of Natural History Collections for 2018–2020.

Other important decisions made by the EB at its meeting this year included the approval of the Botany 2020 Conference as our Society's meeting location for that year and the acceptance of a balanced budget for 2019. The latter represents a first for the Society: acceptance of a proposed budget, rather than EB approval of each expense as it comes up. Thank you to our treasurer, Mare Nazaire, for her work to make this happen.

I also thank David Jennings (Project Manager, iDigBio) for co-organizing the seven-week Strategic Planning for Your Herbarium course with me again this year. Very strong interest in the topic remains (51 applicants this year), and we ended up making the difficult admission decisions based on a mix of considerations, including diversity of career stages and herbaria, urgency for the herbarium, and the herbarium's concrete plans to leverage the strategic planning in the near future (e.g., for funding). This year's 18 course participants represented 17 herbaria from the US, Canada, Argentina, and Denmark. As organizers, we could not have asked for a more creative, engaged, and committed group. We were pleased that all respondents to the end-of-course survey gave the course an A- (1), A (4), or A+ (7 respondents), and all respondents strongly agreed with the statement "I would recommend this course to others if offered in the future." If the topic interests you, watch for it to be offered again next year. It aligns well with the Society's vision of a network of herbarium professionals empowered "to recognize and address local and global stakeholder needs with organizationally sustainable strategies that advance the well-being of herbaria, science, and society."

Finally, thank you for being a part of this society. We are 291 members strong (as of June 15, 2018) with an energetic EB and a growing portfolio of offerings to our community. Now, as Past President, I chair the Society's Nominating Committee. I encourage you to contact me to stand for office in 2019, should you be interested in joining the leadership team. Ideally, our EB will capture as much of the diversity of our membership's perspectives as possible. We will elect a new President-Elect, Secretary, and Member-at-Large in early 2019, and it could be you in one of those roles.

It has been an honor to serve you and support the herbarium community these past two years. Thank you for the opportunity!

Austin Mast
Robert K. Godfrey Herbarium Director
Florida State University

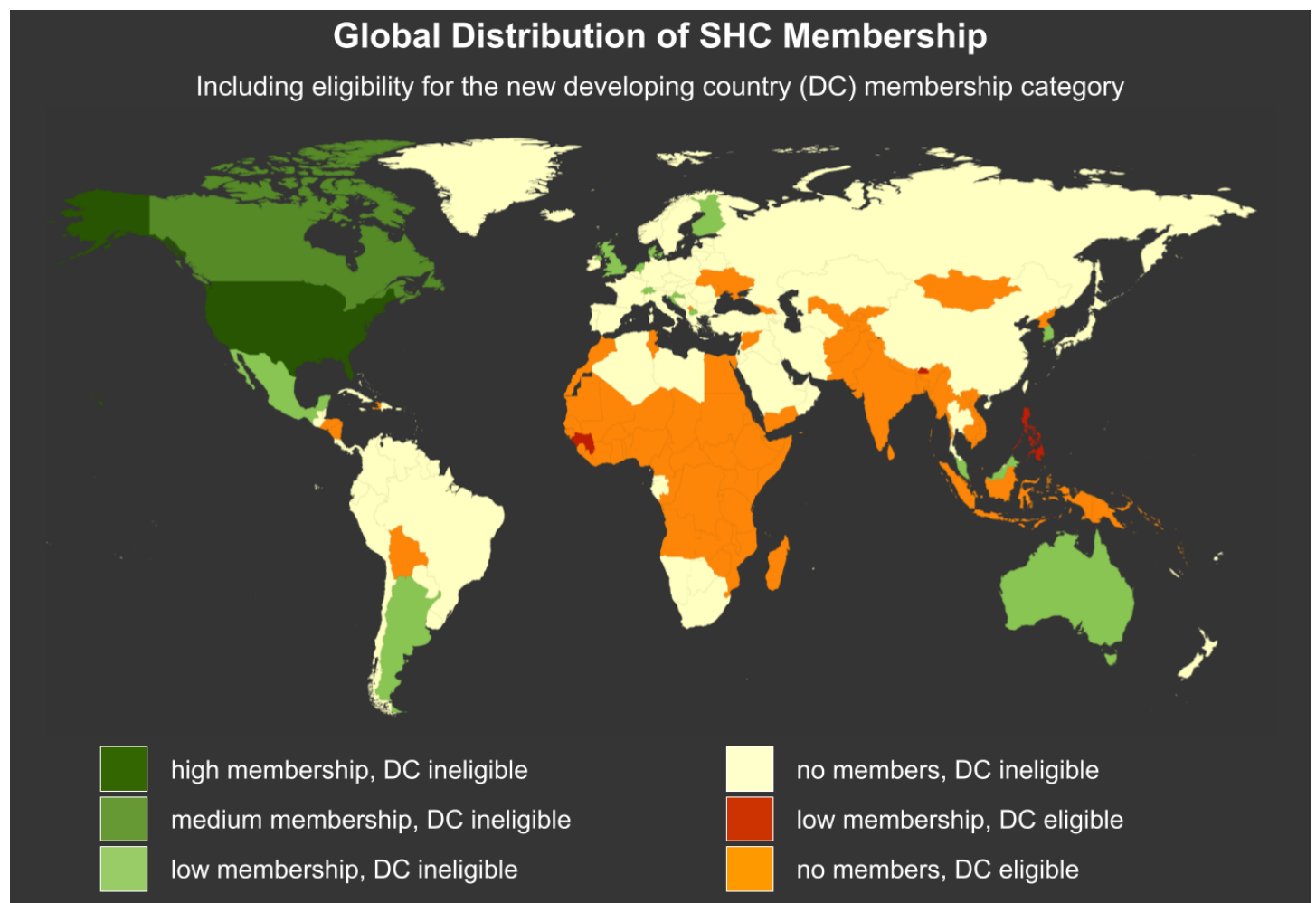


News from the Society

Introducing the New Developing Country Membership Category!

Last spring we voted to approve a new membership category for the Society of Herbarium Curators based on the economic development status of a member's resident country. The Developing Country Membership category will be complimentary, allowing our society to be more inclusive and to broaden the international diversity of our membership. To get to know our growing community better, the SHC Membership Committee will be profiling new developing country members in future editions of *The Vasculum*.

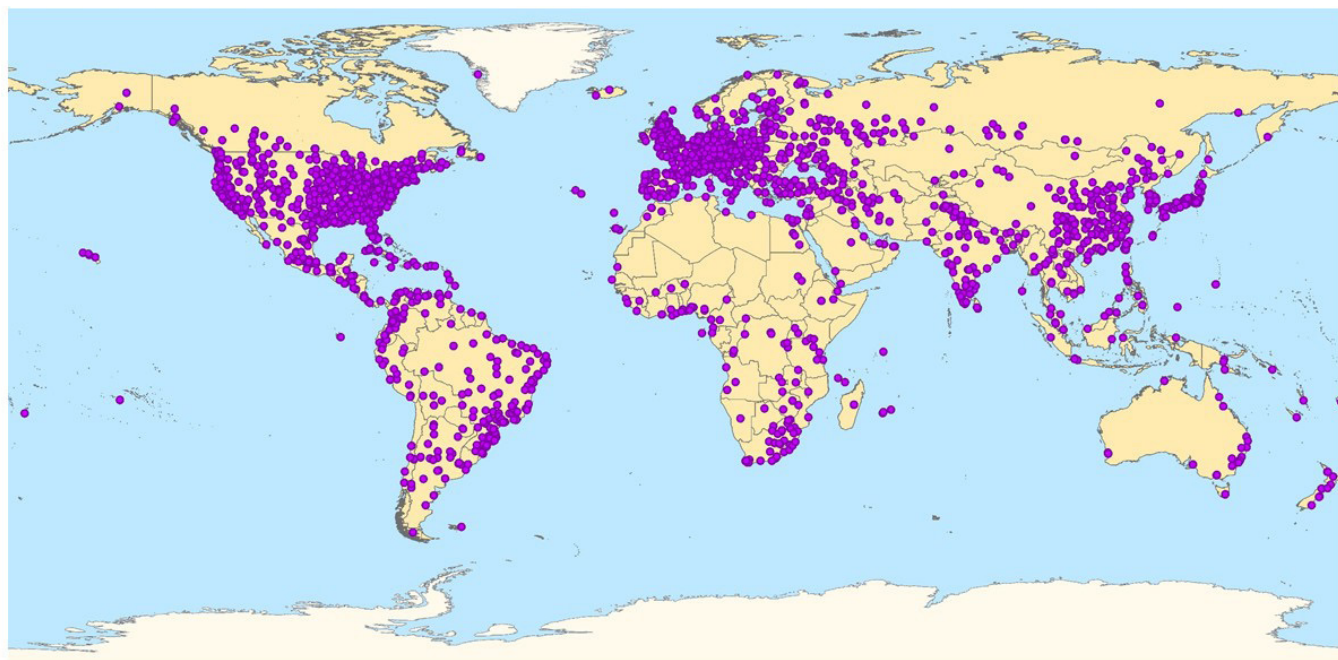
Look for our first member profile in the winter issue, and in the meantime, help spread the word to your colleagues living and working in eligible countries! This no-cost membership category will be available beginning in 2019, and eligible countries include those categorized by the World Bank as low- or lower-middle income (updated annually, see current list at: <https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups>).



Index Herbariorum Gets an Upgrade

For the past 83 years, Index Herbariorum (IH) has been providing information about the world's herbaria. The entry for each herbarium in the IH includes its physical location, web address, contents, and history, as well as the names, birth dates, contact information, and expertise of associated staff. Each institution in the index has a four to eight letter code that serves as its unique identifier, a practice that dates from the founding of the index. The International Association for Plant Taxonomy started IH and oversaw the publication of the first six editions. Responsibility for maintaining the index then shifted to The New York Botanical Garden. Dr. Patricia Holmgren, former Director of the NYBG Herbarium, served as co-editor of edition 6, and subsequently oversaw the compilation of volumes 7 and 8, the last published in hard copy. Dr. Noel Holmgren converted the index to an electronic database, which became available on-line in 1997. We replaced the original web portal in 2003 when we incorporated IH into the NYBG Virtual Herbarium. I took over the editorship of IH in September 2008.

A grant from the U.S. National Science Foundation (DBI grant # 1600051) has recently funded some much-needed upgrades to Index Herbariorum. With this funding, we were able to modify the structure of the database to include more information about the contents of herbaria (e.g., numbers of total specimens for the major groups of organisms stored in herbaria), the status of collections digitization, and the URLs of data portals through which the data can be accessed. We have created an API (<https://github.com/nybgvh/IH-API/wiki>) to facilitate the inclusion of Index Herbariorum data in other applications. We also modified the IH website so that herbaria can update their own information and new herbaria and staff members can self-register. All updates and new registrations are provisional until reviewed and accepted by the Editor. Since the self-update procedure went live in January 2018, there have been more than 500 updates to IH, including 48 new herbaria and 133 new staff members. Instruc-



Location of the world's herbaria

tions about how to use the self-update portal, including an FAQ, are available on the IH opening web page (<http://sweetgum.nybg.org/science/ih/>).

Prior to going live with the new portal, interns Schuyler Borden and Roslyn Rivas attempted to update as much of the existing IH data as possible by contacting correspondents and consulting institutional webpages, publications and, in some cases, neighboring herbaria. They focused their sleuthing on herbaria whose IH contact information was no longer functional and for those herbaria that had not provided any updates to their entries in more than a decade. Through their efforts, we were able to cut the number of outdated or unreachable herbaria in half. The list of herbaria with outdated information is still quite long, though —if interested, you can download the list from the Index Herbariorum website opening page. If you can provide information about any herbaria in the list, we will be very grateful!

The data updates have made it possible to offer a (reasonably) accurate annual summary of the contents of the world's herbaria. Reports entitled, "The World's Herbaria" for 2016 and 2017 are available for download on the IH website. These reports provide an annual snapshot of IH data to facilitate tracking changes in the number of herbaria and the specimens they hold over time. Participating institutions can use these data to put their own collection in a global perspective and to understand how they contribute to the worldwide effort to document plant and fungal biodiversity. Hopefully the report will also prompt herbaria to update their information regularly. We will post new reports in early January of each year. The 2018 version reports 3001 active herbaria in 176 countries that collectively contain 387,007,790 specimens. Linked to these herbaria are 12,174 staff members and associates. During 2017, 73 new herbaria were added to Index Herbariorum, and 35 herbaria were reported as discontinued.

New York Botanical Garden staff member Melissa Tulig (Director of Biodiversity Informatics) oversaw the changes to the IH database and Joel Ramirez (Web Developer for Biodiversity Informatics) created the self-updating website. They, along with Schuyler and Roslyn, have made this project a pleasure to direct. Herbaria have long had a tradition of communication and cooperation, and Index Herbariorum benefits greatly from this tradition. I thank the hundreds of contributors each year who alert me to changes in their own herbaria and to changes in other herbaria.

Barbara M. Thiers
Director of the William and Lynda Steere Herbarium
Editor, Index Herbariorum
The New York Botanical Garden, Bronx, New York



Advancing Digitization in the Southern Rocky Mountain Region

Natural history collections around the world contain an estimated 2.5–3 billion specimens (Chapman 2005). Index Herbariorum lists approximately 3,000 herbaria that collectively house over 387 million plant specimens worldwide (Thiers 2018). Despite the efforts of many collections and the relatively recent focus on digitization, we collectively have a long way to go to complete digitization efforts. One of the catalysts for digitization is the formation and funding of consortia of likeminded collections, often focused on a narrow geographic region, to advance these efforts. While many states or regions have accomplished the goal of creating consortia (Consortium of California Herbaria, Consortium of Pacific Northwest Herbaria, SEINet, SERNEC, Intermountain Herbaria, Consortium of Northeastern Herbaria [Thiers 2018; Barkworth & Murrell 2012]), there was a conspicuous digitization gap in the Southern Rocky Mountains of Colorado and Wyoming.

For over a decade there have been several unsuccessful attempts to secure funding for a Consortium of Southern Rocky Mountain Herbaria (SoRo). Regardless, several collections forged ahead with digitization without consortium-level funding, leaving collections in the region in vastly different states of completion, ranging from not having a database or online presence to having invested years of time in the databasing process. The University of Colorado spearheaded an Advancing Digitization of Biodiversity Collections (ADBC) grant to make this consortium a reality by bringing together 38 institutions from within the greater Southern Rocky Mountains and including several collections from outside of the area that house significant SoRo collections. The project's focus was on aggregating specimens from throughout the SoRo region encompassing both historic and contemporary collections. For this reason it was important to involve large East Coast herbaria that house historic collections from the region alongside the collections of herbaria within the SoRo (Fig. 1). Digitization TCN: Collaborative Research: Using Herbarium Data To Document Plant Niches In The High Peaks And High Plains Of The Southern Rockies – Past, Present, And Future was funded through iDigBio's ADBC in the spring of 2017 with the primary goals of (1) mobilizing approximately 1.7 million herbarium specimens across the 38 institutions to describe and document plant niches in the greater Southern Rocky Mountain area and (2) building a formalized Consortium of Southern Rocky Mountain Herbaria. The project is slated to last four years, but in the first nine months of the project the 19 institutions that are digitizing new material have added approximately 200,000 new images and over 50,000 new database records

In the process of formulating this project, our goal was to build a data set designed to capture vascular plant distributions across the Rocky Mountains and High Plains to facilitate ecological niche modeling. In many ways, this area is an ideal model for such research due to its rapid changes in elevation over relatively small geographic areas, the number of species filling narrow niches, and elevational gradients extending across both latitude and longitude. Boulder County, where the University of Colorado is located, boasts an almost 10,000 foot elevation gradient in a single county.

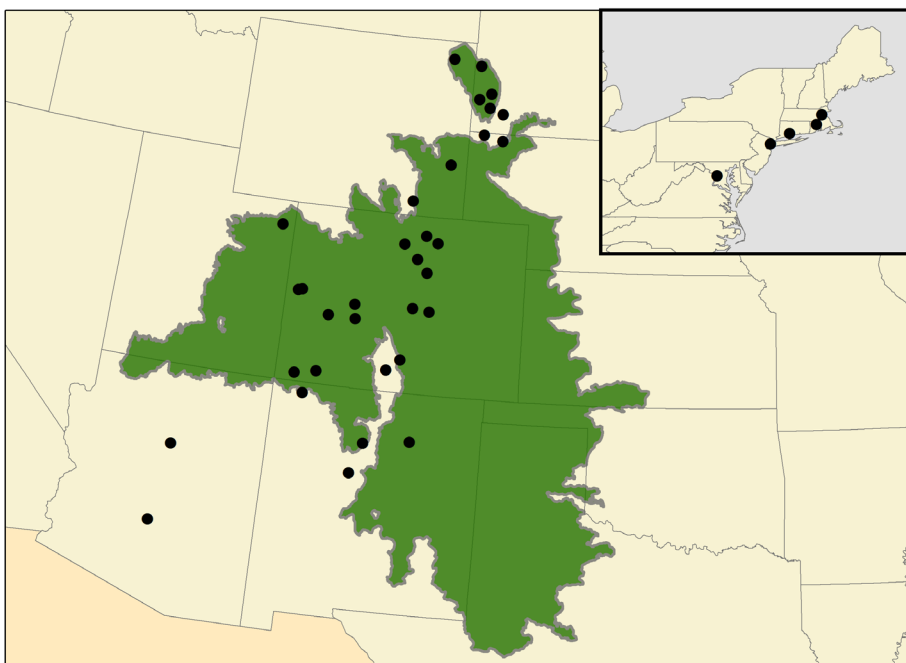


Fig. 1. Map of the 38 institutions providing data to the SoRo project. Collections are primarily based in the 10-state SoRo-region, but significant collections, especially ones housing historic records, are included from eastern North America (inset).

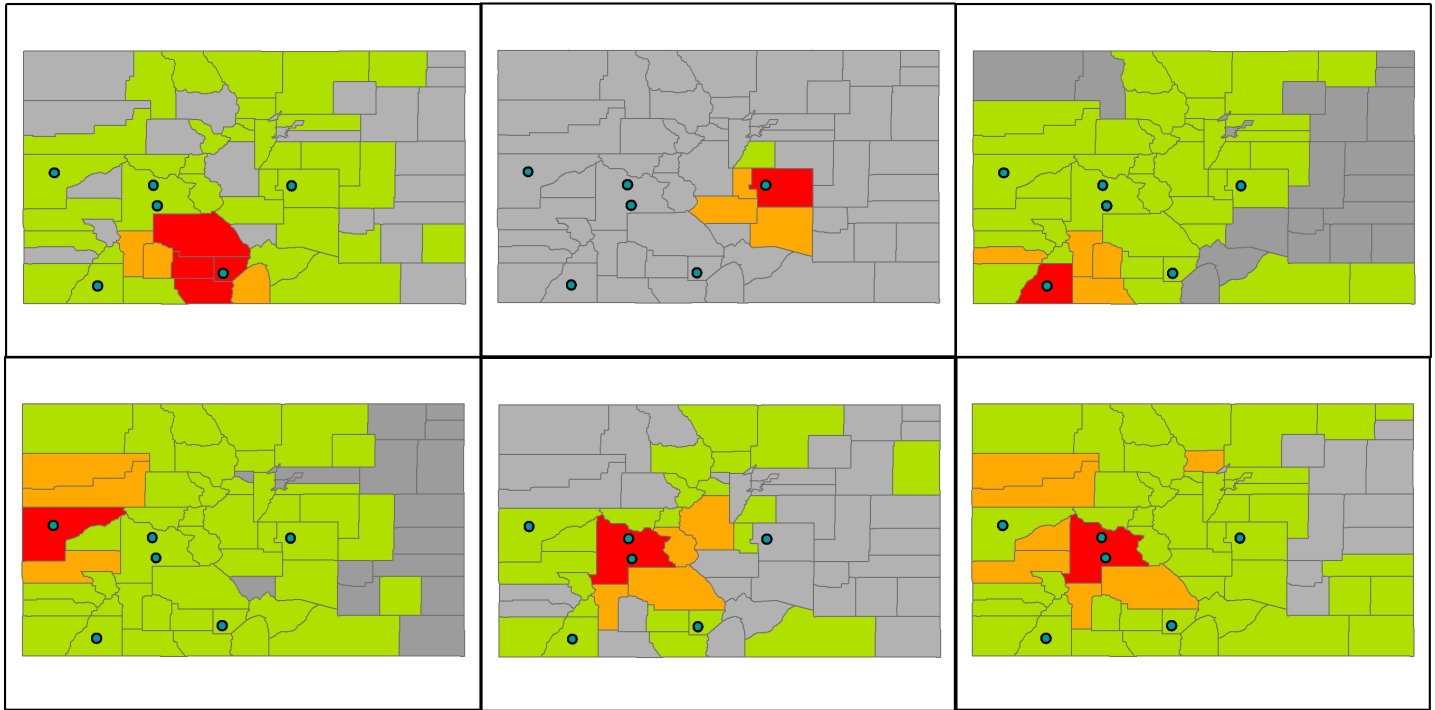


Fig. 2. Heat map showing the distribution of collections (left to right top to bottom) for small Colorado collections (ALAM, COCO, FLD, MESA, RMBL, and WSC) based on the Jenks Natural Breaks method, modified by setting the first category to zero to account for counties that did not contain any collections (grey). In all cases the county or counties surrounding the institution contains the highest number of collections.

To date, the digitization community has done an amazing job mobilizing larger herbaria; roughly 240 United States herbaria have received funding through ADBC to digitize vascular plants, lichens, bryophytes, fungi, and algae, with many collections receiving funding across multiple projects (iDigBio 2018). Unfortunately, many of the smaller herbarium collections have not been involved with ADBC projects. These collections may be specimen-for-specimen more important than larger collections because they often contain unique material not distributed through exchanges. Small collections can provide an important piece of the spatial and temporal puzzle being used to build biodiversity data sets. One of the difficulties with including these collections is just locating them and making contacts. These collections often have limited funding, are frequently run on volunteer hours, and may not be easy to track down. During the formation of our project we contacted several collections using Index Herbariorum data without receiving any return communication.

Currently, 160 collections provide specimen data for the state of Colorado in SEINet for a total of 584,482 specimens (SEINet 2018). These collections range from several collections contributing a single specimen up to the largest collection at the Rocky Mountain Herbarium (RM) with 209,970 specimens. While a significant portion of these records come from the largest herbaria in the region (RM, COLO, CS, and KHD), roughly 30% of the records come from smaller or out-of-state collections (SEINet 2018). This proportion should increase significantly as more local collections come online (GREE, DMNS, CIBO, etc.) and larger collections start to focus on digitizing records from outside their immediate region. For example, COLO has had its Colorado vascular plant collection in a database for over 10 years, but we are now focusing on the surrounding states and will add records to the digital collection from outside of Colorado at a faster rate than from within the state. Digitization of out-of-state records should outpace accessioning of new Colorado material for the immediate future. It is difficult to determine exactly what digitization work has been completed in a collection or what the focus has been just by looking at the data available online. For this reason, it is important to maintain up-to-date metadata when submitting records to aggregators like SEINet, iDigBio, and GBIF.

Table 1 shows the relevance of several of the smaller collections included in the SoRo grant. In many cases, these collections provide more data about specific counties than the two largest herbaria in the SoRo region (COLO and RM) and represent over 20% of the county-level specimen data currently available in SEINet. These collections do not have the same geographic reach as larger collections, but they do provide very focused and relevant datasets helping to flesh out our collective spatial and temporal understanding of biodiversity. These metrics should be a source of pride and are something smaller collections should be aware of, especially when many of these collections are faced with shrinking budgets. They should also serve as validation for including smaller collections in larger digitization efforts. The smaller herbaria of the SoRo region generally represent extremely focused collections from the vicinity surrounding each institution. Similar patterns have been documented in other areas where species richness appears to be at its maximum in counties where universities are located, a phenomenon branded as the “botanist effect” (Moreman and Estabrook 2006). For each of these smaller SoRo herbaria, between 81.6 and 99% of their collections are from Colorado, emphasizing their regional specificity. The two collections with somewhat lower Colorado holdings are located on the western and southwestern Colorado border. Their regional focus jumps into the mid 90% by adding their holdings from neighboring states. By comparison, only ~30% of the University of Colorado’s vascular plant collection is from Colorado. Heat maps (Fig. 2, page 10) show the concentration of the specimens at the six Colorado SoRo collections with fewer than 15,000 specimens based on the Jenks Natural Breaks Method, modified by setting the first category to zero to account for counties without any collections (SEINet 2018). From these maps, we can see that collection intensity also appears to be focused in the area proximate to each of our smaller partners.

Table 1. Contribution of the Colorado herbaria with fewer than 15,000 specimens to the overall available data within SEINet. *% of the collection from the Four Corners states: Colorado, Arizona, New Mexico and Utah.

Collection	Collection size	% from Colorado	County	SEINet rank	% SEINet records for home county
ALAM	5,161	95.10%	Rio Grande	2nd	20.71% of Rio Grande
ALAM	5,161	95.10%	Alamosa	3rd	23.40% of Alamosa
COCO	11,362	98.90%	El Paso	1st	41.10% of El Paso
COCO	11,362	98.90%	Teller	1st	27.85% of Teller
FLD	13,525	81.6% (93.8%)*	La Plata	1st	28.30% of La Plata
MESA	6,143	88.8% (94.3%)*	Mesa	3rd	13.40% of Mesa
RMBL	7,729	99.00%	Gunnison	2nd	15.40% of Gunnison
WSC	7,522	97.50%	Gunnison	4th	8.50% of Gunnison

This spring, the University of Colorado Herbarium (COLO) facilitated the addition of the City of Boulder Open Space and Mountain Parks Herbarium (CIBO) to the Index Herbariorum. When added to SEINet later this year, CIBO will be the third largest contributor of data for Boulder County despite being a collection of fewer than 3,000 specimens. We suspect that most large collections are already represented in Index Herbariorum, but smaller unlisted collections like CIBO may be common and may provide a valuable resource.

The SoRo project is continuing to uncover relevant collections that may have been missed in the initial proposal

and would encourage these collections to contact us. The Denver Museum of Nature and Science and the City of Boulder Open Space and Mountain Parks Herbaria are in the process of being added to SEINet external to the SoRo project. There are also opportunities through the ADBC program to join previously-funded TCN projects as a Partner in an Existing Network (PEN); small collections interested in digitization should contact relevant TCNs to see if they are currently considering funded PEN projects. Most of our partners were located using Index Herbariorum, and if you currently maintain (or know of) a collection not listed there we would encourage you to register. Registering a previously-unregistered collection could be the pathway to funding through a larger project. One of the current goals of iDigBio and the ADBC is to uncover “dark data,” or data housed in collections that have not been digitized and are “essentially inaccessible to most biologists, ecologists, policy-makers, the general public, and other scientists” (Nelson 2017). The darkest of these data are housed in collections not previously registered in larger taxonomic networks; if the people working on digitization cannot find your collection they do not know how to include it in future projects. Expanding these resources not only provides a local inventory of the collections digitized but also gives the scientific community more access to specimens to answer questions about taxonomic relationships and species distributions through time and can provide access to DNA for a greater range of specimens. Curated collections housed in smaller colleges and universities, community colleges, teaching collections, unregistered natural history collections, and even personal collections may be our best chance at filling spatial, and especially temporal, gaps in our collective knowledge of natural history.

Acknowledgments

The author acknowledges Dina Clark, Tim Hogan, Erin Tripp, and Rick Williams. Collaborative Research: Using Herbarium Data to Document Plant Niches in the High Peaks and High Plains of the Southern Rockies - Past, Present, and Future, NSF Award # 1702516.

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J. Ryan Allen, Project Coordinator Southern Rocky Mountain (SoRo) TCN
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How to Prepare an Herbarium Specimen from a Coconut Seedling and its Attached Fruit (*Cocos nucifera*, Arecaceae)



Fig. 1. A photograph of Eileen Watkins and the herbarium specimen discussed herein. The visible expanded portions of the seedling include four expanded leaves and many roots.

of the seedling (primarily those parts derived from epicotyl, but also the root system) expand outward through the seed coat and fruit wall. Most of the single cotyledon remains confined within, and enlarges to fill, the seed. The confined portion of the cotyledon stays connected—via the basal portion of the cotyledon—with the expanded distal sector of the seedling. Because of that connection, the expanded distal sector is effectively bound to, and difficult to separate from, the fruit and its contents (Fig. 1).

Herbarium curators have two objectives that can be at odds with one another: processing and storing specimens efficiently and attempting to accurately depict them as observed in nature. Herein, I discuss how three coworkers and I prepared a coconut seedling and the attached fruit into an herbarium specimen (Fig. 1). We undertook this project at the Herbarium of Southwestern Florida (SWF), a collection of ca. 41,000 plant specimens housed at the Naples Botanical Garden (NBG).

Before describing our methodology, I'll summarize previously known morphological aspects of the fruit, seed, and seed germination of *Cocos nucifera* (Arecaceae) to add perspective about the present work. The reader may consult Foster and Gifford (1974) and Troll (1937) for additional detail about those aspects.

Relevant morphological aspects

At anthesis, the ovary of *C. nucifera* is trilocular and triovulate, but two of the locules become compressed during fruit expansion; hence, the mature fruit (coconut) is effectively unilocular and contains one seed. The seed remains confined within the persistent, non-dehiscent fruit wall. Germination is hypogeal and only certain parts

Methods

On December 22, 2017, I collected a wild seedling of *C. nucifera*, together with the attached coconut, near Marco Island (Collier County), Florida, U.S.A. Problematical were fire ants living within, and swarming out from, the coconut; however, I am unaware whether presence of the ants was typical.

Once the specimen was brought back to the herbarium, I placed it directly onto a table (i.e., with no intervening absorbent surface) and weighted solely the laminae of the expanded leaves.

The coconut, being remote from the laminae, did not interfere with pressing. Because the laminae were plicate and, therefore, resistant to pressing (the typical condition of palm laminae), I utilized many pounds of weights (large, sealed, water-containers that were flat beneath). At our relatively low herbarium temperatures, drying required approximately two months.

We mounted the entire specimen onto a white Corflute® (Corex Plastics Pty. Ltd, Dandenong, VIC, Australia) sheet that was 3 mm thick. This polypropylene material is flexible, yet firm; has smooth surfaces; and is corrugated internally for support. Eileen Watkins (assistant at SWF and a volunteer at NBG) glued the expanded laminae of the seedling onto the sheet, using Elmer's® (Elmer's Products, Inc., Westerville, OH) Multi-Purpose Glue that was diluted with tap water. She affixed the fruit surface to the sheet using Titebond® III Ultimate Wood Glue (Franklin International Co., Columbus, OH), a product that provides especially strong adhesion (on June 6, 2018, a representative of the manufacturer told me that this glue functions "for a long time" and "longer than the wood") but is acidic and, therefore, lacks archival quality.

Thereafter, William Pattison (Carpenter at NBG) trimmed the sheet to a length and width of 48 ½ x 24 inches. He attached the sheet to a rigid, thicker, sheet of PVC-plastic using screws that he inserted along the perimeters of the two sheets. Afterward, for maximal support, he drove an additional 2 ½-inch screw into the coconut fruit from behind the underlying material.

We attached a herbarium label onto the bottom-right corner of the upper sheet, stamped it with a collection number, and entered the label-data into our digital herbarium database. Currently, the specimen is on display on a wall in the herbarium. Permanent storage will be in a large metal cabinet.

I hope that others find this methodology, or a modification thereof, applicable to diverse kinds of bulky or heavy plant specimens, e.g., large fruits, inflorescences, or infructescences of other taxa; thick foliage-leaf-bearing stems; or shoots with large basal rosettes.

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SHC Annual Meeting

The 2018 Society of Herbarium Curators meeting was held concurrently with Botany 2018 at the Mayo Civic Center in Rochester, Minnesota, U.S.A. (Fig. 1). The SHC Executive Board meeting occurred on Tuesday, July 24th (Fig. 2; please see page 4 for Past President Austin Mast's discussion of the important policies that were discussed and voted on). The SHC business meeting was held on the same day, where annual reports were presented. The meeting marked the beginning of incoming President Patrick Sweeney's two year term as President, and Past President Austin Mast beginning his two year term. We are happy to report a peaceful transition as the handing off of the presidential vasculum occurred without incident (Fig. 3). We thank Austin for all of the amazing initiatives that he proposed during his term that have gone a long way to strengthen the SHC; we are a better Society because of his time in office. We also thank our outgoing Past President Andrea Weeks for all that she has done to promote and strengthen our Society.



At the conference, Past-President Andrea Weeks organized the SHC workshop, titled: Leveraging Digital Specimen Data and Derivatives for Herbarium Curation and Collections' Management (Fig. 4). The workshop was offered on Thursday morning, July 26th, following the Botany meeting. (continues on middle of page 16)



Fig. 1. Mayo Clinic Conference Center in Rochester, Minnesota, U.S.A.



Fig. 2. Executive Board Members (from left to right): Patrick Sweeney, Lucinda McDade, Mary Ann Feist, Andrea Weeks, John Schenk, and Austin Mast.

(Continued from page 15) Talks were given by leaders in the field of digital specimen data, including Sylvia Orli, Jason Best, Katie Pearson, Mary Barkworth, and Patrick Sweeney (Figs. 5 & 6). The well-attended, half-day workshop provided rich content on how herbarium curators are discovering new opportunities and challenges in keeping pace with the speed, scope and scale of how specimens are being used in their online digitized collections (Fig. 7).

We hope that you will join us during next-year's meeting in Tucson, Arizona.



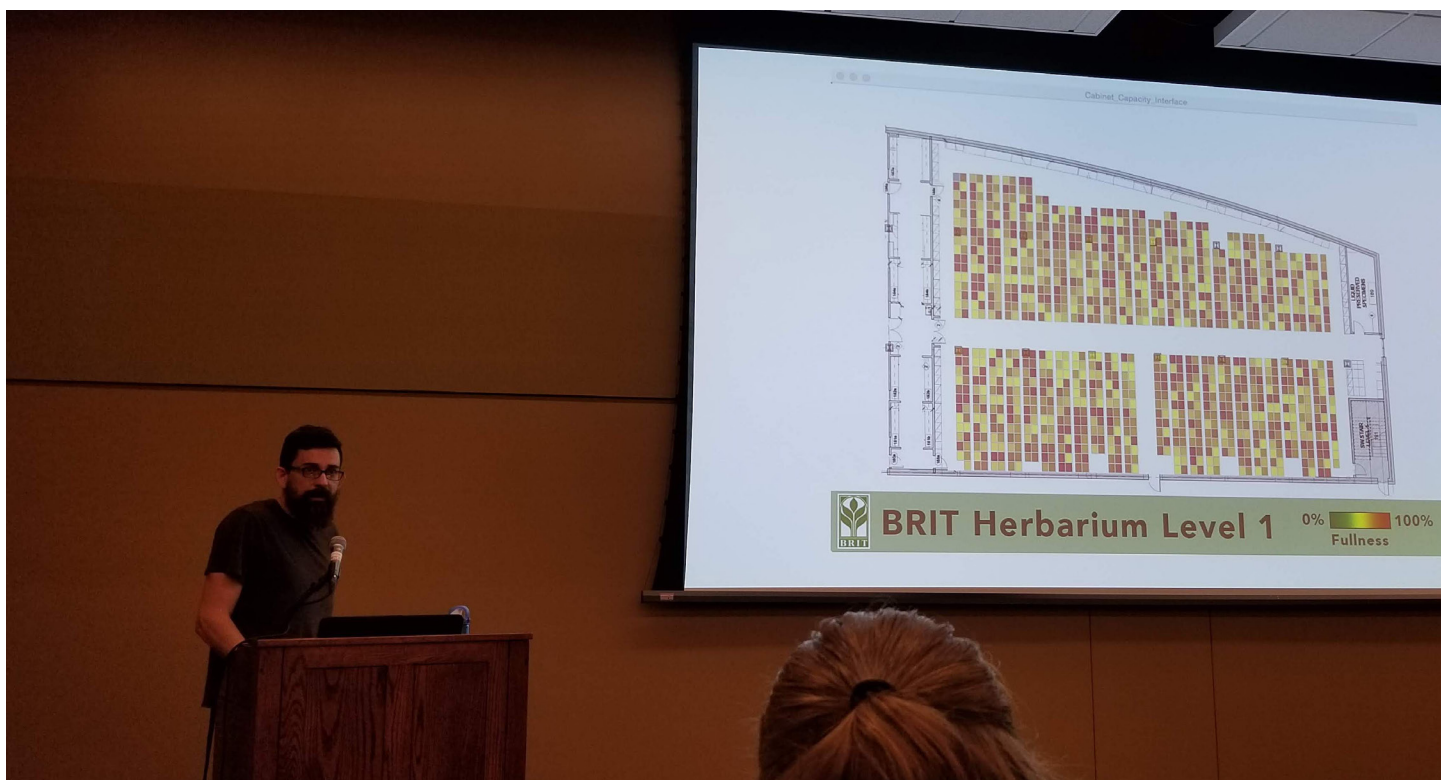
Fig. 3. The traditional handing off of the presidential SHC vasculum between incoming President Patrick Sweeney and Past President Austin Mast.



Fig. 4 (left). Past President Andrea Weeks introducing the SHC workshop she organized: Leveraging Digital Specimen Data and Derivatives for Herbarium Curation and Collections' Management.

Fig. 5 (top). Mary Barkworth presenting updates to Symbiota.

Fig. 6 (below). Jason Best presenting his research on digitization of herbarium cabinet space.



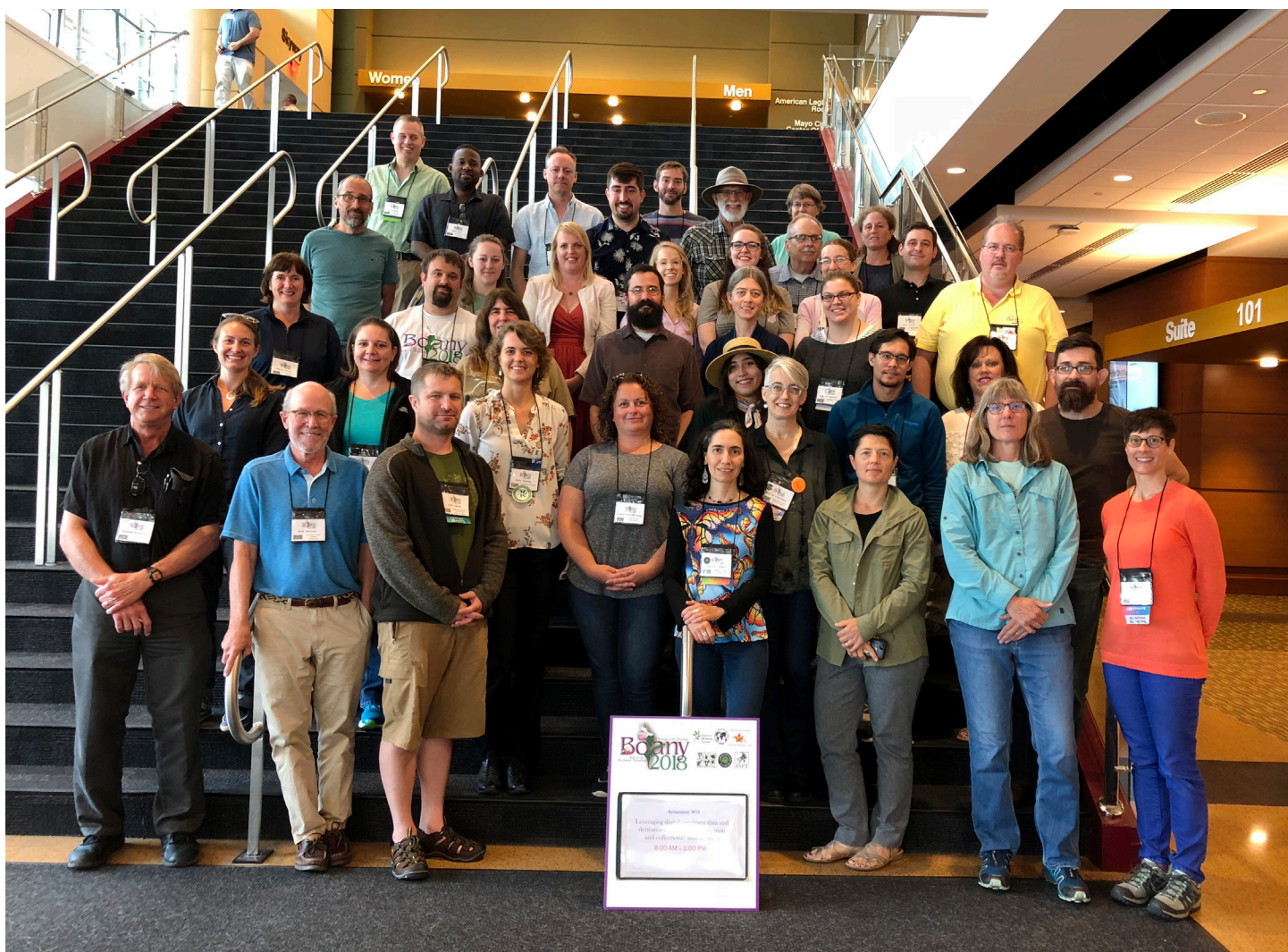


Fig. 7. Presentors and participants in the Leveraging Digital Specimen Data and Derivatives for Herbarium Curation and Collections' Management workshop.





Capturing California's Flowers

Digitization of herbarium specimens—capturing images and label data in digital formats—remains an enormous task for the world's herbaria. For 22 institutions in the U.S. state of California, this job has become easier with a new four-year, \$1.8 million National Science Foundation grant (Award # 1802301) to establish a new Thematic Collections Network (TCN), Capturing California's Flowers (CCF). Spearheaded by Dr. Jenn Yost, Director of the Hoover Herbarium at the California Polytechnic State University, this new network aims to image over 900,000 herbarium specimens from the oldest records, the most diverse families, and most threatened families in California. California is a biodiversity hotspot and home to more than one third of all U.S. plant species, emphasizing the need to understand this diverse and changing flora through herbarium records. The region's herbaria already have a strong history of collaboration in the Consortium

of California Herbaria, and this project aims to strengthen and expand the capabilities of this community of universities, research stations, natural history museums, and botanical gardens.

The project is trailblazing not only in its ambitious digitization goals and cast of collaborating institutions, but also in its research aim: To better understand flowering time shifts by recording flowering (i.e., phenological) data for each specimen digitized over the course of the grant. Flowering time is an important biological phenomenon for science, society, and biodiversity, and herbarium specimens can provide rich data on how flowering times vary across time and space. This project builds upon recent advancements in standardization and sharing of phenological data, including the Plant Phenology Ontology and data standards developed in collaboration with the New England Vascular Plants TCN, to capture phenological data. Furthermore, the project will digitize specimens of 250 taxa currently monitored by the California Phenology Project and National Phenology Network, empowering future cross-comparisons of specimen-based and observational phenological data. The institutions involved in this project will explore several workflows for capturing phenological data: from specimen sheets during imaging, from label text using a new Attribute Mining tool, and from images using crowd-sourced Notes from Nature expeditions that engage a broad audience of citizen scientists, students, and volunteers to produce phenological scorings. With the efforts of this community of California herbaria, the project hopes to build a strong foundation for the future of capturing phenological data from herbarium specimens.

All specimen images and records produced in this project will be publically available for research, education, and outreach via the Symbiota portal, an open-source, web-accessible database platform widely used by other collections and TCNs. The project will also develop new tools in Symbiota to mine, explore, and store phenological data,

and all data will be aggregated and available through the iDigBio portal.

The project runs from 2018–2022. Jason Alexander from UC Berkeley is the Data Manager and Katie Pearson, recent MS graduate from Florida State University, is the Program Manager. The tools, techniques, and data generated as part of this project will expand the value of herbarium specimens in addressing society's problems. More information can be found by e-mailing jyost@calpoly.edu.

Herbaria making up this Thematic Collections Network: CSU Chico (CHSC); CSU Los Angeles (CSLA); UC Davis (DAV); CSU Fresno (FSC); CSU Humboldt (HSC); UC Irvine (IRVC); UC Los Angeles (LA); CSU Long Beach (LOB); CSU Fullerton (MACF); California Polytechnic State University, San Luis Obispo (OBI); Rancho Santa Ana Botanic Garden (RSA); CSU San Bernardino (CSUSB); Colorado Desert District, California Dept. of Parks and Recreation (BSCA); Santa Barbara Botanic Garden (SBBG); San Diego Natural History Museum (SD); San Diego State University (SDSU); CSU Northridge (SFV); San Jose State University (SJSU); UC Berkeley (UC/JEPS); UC Santa Cruz (UCSC); UC Santa Barbara (UCSB); and UC Riverside (UCR).



Photo: Jenn Yost

Featured Herbarium

Tarleton State University, located in Stephenville, Texas, U.S.A., was first established in 1899 under the name John Tarleton College. Its namesake, John Tarleton, was a wealthy businessman in Stephenville, Texas, who provided the endowment to support a college in his will. The school opened its doors to 145 students, offering preparatory and junior collegiate level classes led by four faculty members. With time, the college grew and became Tarleton Agricultural College. By 1973, the college was incorporated into the Texas A&M system. Its curriculum expanded to include four-year programs, and the college was reorganized under its current name Tarleton State University (TSU). TSU has come a long way from first opening its doors and now maintains six locations, over 13,000 enrolled students, and offers 94 degrees from associate to doctorate (David and Young, 2010).



The Tarleton State University Herbarium, originally named Tarleton Agricultural College Herbarium, was established in 1921 and is a north-central Texas regional collection. Initially, the primary function of the collection was to provide and house teaching specimens, but now it consists of over 7,000 specimens representing over 850 taxa. TSU is located in the lower portion of the West Cross Timbers, a sub-ecoregion of the Cross Timbers and Prairies, and plants from this ecoregion are well-represented in the TSU Herbarium. However, the collection does not consist strictly of vegetation from the West Cross Timbers and varies geographically with specimens collected from throughout Texas and fourteen other states. It is a member of the Texas Oklahoma Regional Consortium of Herbaria (TORCH), which is a member of SEINet Regional Net-

Fig. 1. Tarleton State University Herbarium space, 2018.

works of North America databases. The Herbarium is currently digitizing its collection to fully participate in the TORCH and SEINet databases, but limited staffing over the years has slowed the project. Currently, roughly a third of the collection's information is available online and digitizing the collection remains a priority. The herbarium is housed in the Lamar Johanson Science Building on the TSU main campus and functions as a teaching resource for the Department of Biological Sciences. The current herbarium director is Dr. Allan Nelson, who also has actively added to the collection since starting at TSU in 1997. Nelson balances his duties as herbarium director with his responsibilities as department head for biological sciences and teaching courses in plant sciences.

The herbarium's more prominent collections include voucher specimens from floristic projects of the Padre Island National Seashore (PINS) and the Lula C. Gough Collection. Vegetative surveys conducted in 1996 and 1997 in three regions of PINS resulted in the seashore's first checklist for vascular plants as well as a more focused



Fig. 2. *Lupinus texensis*, widespread Texas endemic, collected by Lula Gough.



Fig. 3. Dr. Allan Nelson collecting on Colorado River at Johanson Ranch, 2003.

vegetative analysis of the Big Ball Hill region of PINS. Nelson and his students Irma Negrete, Victor French, Mary Johnson, LaShea Macke, Travis Wilburn, Angela Day, as well as a faculty member from Laredo College, Dr. Jim Goetze, were members of a research team that conducted the surveys for the Big Ball Hill vegetative investigation and island flora (Nelson et al. 2000; Nelson, Goetze, and Lucksinger, 2001; Negrete, Galloway, and Nelson, 2002). The Lula C. Gough collection is the voucher specimens for the first flora for Erath County, the county in which Tarleton State University is located. The floristic survey was conducted in 1920–1921 as Gough's master thesis out of University of Texas at Austin. Gough eventually joined TSU as an associate professor of Biology in 1921 and it was her collection that prompted the establishment of the TSU Herbarium. The flora for Erath County was published in 1922 and served as the first and only flora for the area until Nelson and students, including Sara Harsley, Paige Cowley, Turner Cotton, Carter Rosson, and Sarah Brown, completed an updated checklist of all the plants known from Erath County in 2018. The project added 330 species to Gough's original list, which is to be expected after nearly a century.

The TSU Herbarium's history is primarily a mystery. It persisted through a changing, growing campus as well as a monumental move when the Lamar Johansson Science Building was constructed in 2001, but the move left the herbarium with little to no records providing any comprehensive description of its past. What has persisted are the specimens that provide information on the people involved with the TSU Herbarium. Individuals are most influential through their specimens and some of the most prominent developers of the TSU Herbarium have been Nelson, Gough, and Clarence Mertins. Nelson, the current herbarium director (Fig. 3), is the most prolific contributor in the collection's history. Under his direction beginning in 1997, the collection has expanded an estimated five times its size with the majority of specimens coming from his own projects. Nelson actively uses the TSU herbarium as a teaching tool for plant taxonomy and is consistently adding project voucher specimens to the general collection. Though other developers have contributed, no others compare to the sheer numbers compiled by his research teams.

Mertins, instructor of biology (1960–1965), provided a substantial amount of specimens to the herbarium, but it was the timing of his contributions that was most impactful. Prior to Mertins, the collections had hit a proverbial dry spell with no substantial acquisitions between 1930 and 1960, and it was the efforts of Mertins that revived the functionality of the herbarium. Mertins' specimens varied far from Erath County to include material from the Davis Mountains in the far west, the northern reaches of the panhandle, and to the Sam Houston National Forest at the base of the Piney Woods in the east. In 1963, Mertins was awarded an NSF research fellowship



Fig. 4. Lula Gough, Associate Professor in Biology, Tarleton State University yearbook photo 1921.

to work with Dr. U.T. Waterfall out of Oklahoma State University and returned with several Oklahoma specimens for the collection (Gresham, 1963). Mertins left TSU in 1965, but his efforts set the trend and contributed to make the 1960s the second most productive decade in terms of growth for the herbarium.

Gough, associate professor of biology (1921–1950), was the first to publish a flora for Erath County, Texas. Her vouchers, which are housed in the TSU Herbarium, provided the first material to establish TSU herbarium, but Gough is also the most prolific female contributor to the herbarium. She was a well-respected professor during her tenure at the University and spent almost 23 years as the sole female professor in the Biology Department. Gough taught courses in botany for 30 years and used the herbarium frequently for her courses to engage her students in topics of taxonomy and general plant science (Summers, 1950).

People play vital roles in any natural history collection, but in smaller, regional collections, such as at Tarleton State University, a single individual can leave lasting influences and truly shape a herbarium. Thus, the TSU Herbarium has acted as an archive for ecological, botanical, and anthropological data due to its dedicated collectors for decades. Those of us involved in the herbarium hope for more decades of growth and development with help from professors and students alike.

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