



Restructuring the LSU Herbaria After Doubling in Size

Jennifer Kluse, Christina Mozzicato, Genevieve G. Mount, and Laura P. Lagomarsino

Department of Biological Sciences, Louisiana State University in Baton Rouge, LA; contact: llagomarsino1@lsu.edu or jkluse@lsu.edu



Collections Acquisition

- In most cases, Memoranda of Understanding that outlined specific terms for each transfer were signed by both donor and recipient.
- Smaller collections were sent to LSU via post or hand delivered
- Larger collections transported in freight trucks, either by professional movers (NO) or herbarium staff (NLU).
- Specimens were freeze-treated before and after transfer.
- Large collections were stored in herbarium cabinets outside of the main LSU herbarium



The University of Louisiana at Monroe herbarium: A Case for Collaboration

In March 2017, ULM announced its decision to divest its herbarium of ca. 472,000 specimens. Too big to fit in LSU's infrastructure, this collection was transferred to the Botanical Institute of Texas in Ft. Worth in late 2017. Now known as the R. Dale Thomas collection, these specimens have been preserved and will be maintained in perpetuity. With funding from an NSF RAPID grant, BRIT staff pulled 60k specimens for repatriation to Louisiana at LSU. The majority of these specimens were delivered in December 2018. They increase LSU's representation of northern Louisiana parishes, adding value to the collection while leaving space to grow.



Between 2015 and 2018, the herbaria at Louisiana State University, comprising the Shirley C. Tucker Herbarium and the Bernard Lowy Mycological Herbarium, grew from from **ca. 200k to ca. 400k specimens**. The vast majority of this growth was via the acquisition of 7 collections.

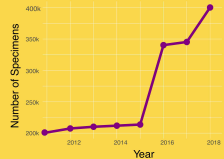


Figure 1. LSU's growth has been incredibly rapid in recent years. This graph displays the cumulative number of specimens in over the past seven years.

University of Louisiana at Monroe (NLU)

- Partial collection (ca. 13%) acquired via partnership with BRIT
- 60,000 specimens
- Vascular plants



LSU Shreveport (LSUS)

- Partial collection (ca. 60%)
- 6,000 specimens
- Vascular plants



Tulane University (NO)

- Entire collection
- 120,000 specimens
- Vascular plants, lichens, bryophytes, and algae (fungi incorporated into NY)

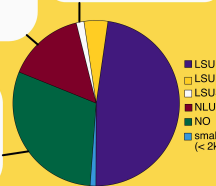


Figure 2. Composition of LSU Herbaria, including all consolidated collections.

Eglin Airforce Base

- Entire collection
- 1,737 specimens
- Vascular plants, lichens



McNeese State (MCN)

- Entire collection
- 1,223 specimens
- Vascular plants



Tall Timbers Research Station (TTRS)

- Partial collection
- 1,018 specimens
- Bryophytes



University of Louisiana at Lafayette (LAF)

- Partial collection
- 492 specimens
- Bryophytes



Physical Integration



- All herbaria will be integrated as a single collection in LSU's compacted infrastructure.
- All specimens will receive an LSU accession number, apart from Tulane. Pre-existing barcodes for the two large collections (NO and NLU) are retained, but smaller collections are given a new LSU barcode.
- Once fully digitized, specimens will be intercalated into the collection following LSU's filing scheme
- To date, all small collections and LSUS are fully physically integrated. It is anticipated that integration of NO and NLU will be complete by Fall 2021.

Challenges Associated with Integrating Multiple Collections

- Multiple filing systems (modified Cronquist, Dale Torre, alphabetical)
- Different geographic organization
- Time demand: Each specimen is handled multiple times.



Digital Integration

- Database Infrastructure:** During expansion, LSU amassed 14 datasets across two platforms (Specify and Symbiota). By 2020, we will have 5 Symbiota databases, one for each major taxonomic group.
- Digitization:** Each incorporated herbarium was incompletely digitized at time of transfer. Today, all LSU, LSUM, LSUS, MCN, TTRS, and Eglin specimens are at least partially databased and imaged, with plans to make NO, NLU, and LAF searchable by 2022.
- Datasharing:** LSU shares its data publicly via various Symbiota Portals (SERNEC, Mycoportal, and the Lichen, Bryophyte, and Macroalgal portals), as well as iDigBio and GBIF.
- Bioinformatics:** During digital integration, our custom SilverBiology software broke. To replace its functionality, we are currently modifying python scripts from the Consortium of Pacific Northwest Herbaria (<http://www.pnwherbaria.org/>), we will be freely available on GitHub.



Challenges Associated with Integrating Multiple Collections



- Multiple database structures and systems
- Various stages of completion
- Outdated proprietary software
- Large image files require significant storage space for backup

The Future of the LSU Herbaria

The LSU herbaria are in a good position. We have a supportive administration that recently hired two tenure-track/tenured botanists, a substantial endowment from Dr. Shirley Tucker, and recent growth that complements preexisting collections, including increased representation of northern and southwestern Louisiana. We are very active: specimens are deposited and/or studied by 6 labs at LSU, and we have a healthy loan program. With room to grow by 225k specimens, we can sustain this level of activity for many years.



The consolidated LSU herbarium represents an invaluable resource to the study of plant biology and ecology in Louisiana specifically, and across the Gulf South more broadly. With easy access to many ecosystems in the North American Coastal Plain biodiversity hotspot, we are poised to become a major hub for the study of southeastern plant diversity, ecology, and evolution.

Acknowledgements

This is a truly collaborative effort. Many individuals and institutions are crucial to our success, including: Jason Best, Ashley Borden, Peter Fritsch, and Tiana Rehman from BRIT; Denise Santamaría-Aguilar, Lyndon Croft, Eric Maxwell, Janet Mieseray, Laura Frost, Carrie Barker, Kyle Harms, Lowell Urbatsch, Meredith Blackwell, and Shirley Tucker from LSU; Barbara and Michael MacRoberts from LSUS; Anne Bradburn and Steve Darwin from NO; Ray Heyland (deceased) from MCN; Garrie Landry and Erin Sigel from LAF; Kevin Robertson from TTRS, and Brett Williams from Eglin AFB. A team of LSU undergraduates funded by work-study and the Shirley Tucker endowment is essential to our timely completion of this effort: Alexandra Clouette, Roderick Daniels, Hannah Dougal, Amber Griffin, Abby Hogan, Mike Le, Daniel Magann, Brandon Nguyen, P.J. Tassin, Olivia Taylor, and Arandilla Verma. The LSU Center for Computation and Technology provided funds to update our digital infrastructure. Herbarium integration is supported by the National Science Foundation under Grant No. DBI-1756469.