



The Arizona  
Native Plant  
Society

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# The Plant Press

THE ARIZONA NATIVE PLANT SOCIETY

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Specimen sheets from the ASU Herbarium.

## The Herbarium

### *A Priceless Resource for Botanical Documentation, Research, and Understanding*

by Douglas Ripley, Arizona Native Plant Society

#### Introduction

An herbarium (plural: *herbaria*) is a collection of dried preserved specimens that documents the identity of true plants (Kingdom Plantae), ranging from the higher vascular plants to the nonvascular plants such as the bryophytes. But herbaria can also serve as repositories for other groups of “plant-like” organisms such as the algae (Kingdom Protista), the fungi (Kingdom Fungi), and lichens (composite organisms formed by a symbiotic relationship between an alga and a fungus). The herbarium is a place of special wonder and excitement for those who love plants and wish to know more about their occurrence, distribution, and variation. This issue of *The Plant Press* is devoted to a brief discussion of the importance of the herbarium and its history, followed by individual articles describing the major, and some of the smaller, Arizona herbaria.

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# President's Note

by Douglas Ripley [jdougripley@gmail.com](mailto:jdougripley@gmail.com)

Having just perused the latest issue of our quarterly newsletter *Happenings*, I am once again pleased to reflect on the scope and range of the many activities and initiatives our Society continues to sponsor. Those activities include interesting monthly chapter meetings, hands-on botanical training through the Plant Atlas Project of Arizona (PAPAZ) initiative and the Science, Technology, Engineering and Mathematics (STEM) program for middle-school students, field trips to many fascinating locales, and native plant restoration projects. Also, several Chapters sponsor and fund important publication and research grant programs which make a significant contribution to our understanding of native plants. In February the Society was pleased to host the annual Arizona Botany Meeting 2014 in cooperation with the Arizona Sonora Desert Museum. That event was a great success thanks to the many outstanding presenters and field trip leaders. We are now making initial plans for next year's meeting which we anticipate will be held in mid-February 2015 at the Desert Botanical Garden. I would also like to alert you to the Society's annual three day field trip/workshop to be held at the Southwestern Research Station in the Chiricahua Mountains on 5-7 September 2014. Registration information is available through the AZNPS website. I believe that all of these worthwhile activities and projects reflect extremely well on the AZNPS and its members who have contributed so much of their time and energy to make them happen.

This issue of *The Plant Press* is devoted to the subject of herbaria and provides a general discussion of the history and importance of herbaria, followed by individual articles that describe the major, and some of the smaller, herbaria in Arizona. Anyone interested in native plants should be aware of the invaluable resources represented by our State's herbaria. We hope that these articles will provide our members with the information they will need to begin using their local herbarium to support and reinforce their interest in native plants.



above Luca Ghini's Bound Herbarium Specimens. Courtesy University of Florence, Museum of Natural History, Botany Section.

## The Herbarium *continued*

### The Importance of Herbaria

The estimated 350,000,000 specimens housed in the world's approximately 3,400 herbaria represent a priceless record of botanical history that continues to help inform our understanding of biogeography, evolution, and ecology and serve as source material for many other disciplines such as cytogeography, biochemical systematics, palynology, and genecology. (Thiers [continuously updated]). In addition to their enormous value and usefulness as repositories for plant diversity, many herbaria sponsor events ranging from extensive symposia to more informal seminar programs. Almost all herbaria solicit the assistance of volunteers to help with the never-ending tasks associated with herbarium maintenance. As such they not only provide both the professional scientist and general plant enthusiast with a source of invaluable information on specific research projects but they also offer an intellectually stimulating place to learn more about botany and to meet and associate with other like-minded people.

### History

The earliest record of formally pressing and drying plant specimens and organizing them into an herbarium is attributed to the Italian physician and botanist Luca Ghini (1490-1556) who is also credited with establishing the first European botanical garden (Mayr 1982). Unlike the current practice of mounting specimens on separate sheets of heavy paper and storing them horizontally in cabinets, the earliest herbarium practice involved binding individual specimen sheets into volumes. Linnaeus is credited with introducing the current mounting and storage practices although the bound volume technique persisted in some herbaria into the 19th Century (Stearn 1957). In recent decades, many significant innovations have improved the storage and management of herbarium specimens, such as compacting herbarium cases that greatly reduce the amount of aisle space required between cases and the introduction of new and significantly less dangerous

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# Arizona Western College Herbarium (AWC) Yuma

by Dr. Megan Lahti, Science Department Head, and Valerie Morrill, Yuma Chapter, Arizona Native Plant Society

The Arizona Western College (AWC) Herbarium is located in the new Agricultural and Science Building on the college campus. Recently rededicated in 2010, it features state-of-the-art facilities for storage and collection management. The Herbarium houses over 1,000 specimens representing the regional vascular flora, primarily limited to southwestern Arizona. Many of the specimens were collected by AWC students and faculty. Local agencies such as the Yuma office of the Bureau of Land Management and U.S. Army Yuma Proving Ground have also donated their collections to the Herbarium. Currently, access to the collection is limited to staff, students, and upon request. The Herbarium intends to make the collection virtually available to the public via the SEINET website in

the near future: [swbiodiversity.org/seinet/collections/index.php?catid=2](http://swbiodiversity.org/seinet/collections/index.php?catid=2). Please contact Marie Stubbs, the Science Division Administrative Secretary at 928.344.7656 for more information, or visit: [www.azwestern.edu/academic\\_services/instruction/science](http://www.azwestern.edu/academic_services/instruction/science).



above The AWC Herbarium is located in the College's new Agricultural and Sciences Building.

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## The Herbarium *continued*

measures to control herbarium insect pests. Digital technology now allows for the scanning of herbarium specimens through which specimen images can be accessed on line or transmitted electronically anywhere in the world. And, of course, the power of modern computer technology is now used to search and manage huge herbarium collections in a way that was previously difficult and enormously time consuming.

### Major Herbaria

The Muséum national d'histoire naturelle (National Museum of Natural History, France), which was established in 1635 is the largest herbarium in the world with approximately 9.5 million specimens. Other major European herbaria include the Komarov Botanical Institute of the Russian Academy of Sciences (7.1 million specimens) and the Royal Botanic Garden Kew (7 million specimens). In North America, the largest herbaria include the New York Botanical Garden (7.2 million specimens), Missouri Botanical Garden (6.3 million specimens), Harvard University Herbaria (5 million specimens), United States National Herbarium, Smithsonian Institution (4.3 million specimens), Universidad Nacional Autónoma de México (National Autonomous University of Mexico) (1.2 million

specimens), and the Royal Ontario Museum (860,000 specimens) (Thiers [continuously updated]).

### Arizona Herbaria

The remaining articles in this issue of *The Plant Press* provide information on the major Arizona herbaria as well as several smaller herbaria. All are priceless resources for Arizona's professional and amateur botanists seeking information on plant identification, research, and understanding.



### References

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# Arizona State University Herbarium (ASU) Tempe

by Elizabeth Makings, Collection Manager, Les Landrum, Curator, and Walter Fertig, Lichen and Digital Data Collections Manager

## Introduction

An herbarium is a collection of pressed, dried plants referenced in space and time, and systematically arranged. Herbaria can be thought of as ‘libraries of the plant world’ — unique and important repositories of public information for reference and study. An institution’s program for managing and caring for its collection exists within the context of its resources and goals. Like most herbaria, Arizona State University (ASU) seeks to document the ecological and geographical distribution of the regional flora, facilitate research, support teaching, and promote conservation.

Each herbarium also has individual strengths and idiosyncrasies. For example, the ASU herbarium is particularly strong in Cactaceae cytological vouchers. Floristics has also been an emphasis of study for graduate students at ASU, and the Herbarium is embellished with comprehensive collections from botanical inventories all over the state.

## Importance of Herbaria

Herbaria deepen our knowledge of the plant world and are critical to understanding the value plants bring to life. ASU, being a large university herbarium, serves the diverse botanical community of academics, government agency scientists, non-governmental groups, and the general public. Physical specimens and their associated data are powerful tools for validating species-level investigations, and herbaria have been used in a variety of ways to address important academic, fundamental, and applied topics — some broad categories are listed below.

### Biogeographical

- \* Biodiversity assessments past and present
- \* Plant distributions, population trends, patterns in endemism, etc.
- \* Records of alien plant occurrences, abundance, and dispersal
- \* Source of information on species rarity

### Environmental

- \* Identifying pollution trends, pests, and diseases threatening human health or agricultural activities
- \* Identifying cycles in climate and phenology

### Fundamental and/or Applied research

- \* Basic materials for taxonomic revisions and monographs
- \* Index of the variability within species including morphological changes over time

- \* Tissue banks for molecular phylogenetic and morphological studies
- \* Planning and implementation of restoration projects
- \* Elucidation of land-use history and management
- \* Answering questions dealing with extinction and global change
- \* Valuable for modeling species distributions and analysis
- \* Identification resources for agency scientists, academics, and laypeople. For numerous reasons people need to know the identity of plants — Is it poisonous? Is it a rare species? Is it a new to science? Is it edible? How big will it grow? Herbaria provide reference material for positive identification.

## Brief History of the ASU Herbarium

Many of the earliest ASU plant collections were made by Fred Irish, an Iowa transplant hired as the first science teacher at what was then Tempe Normal School. Irish is described as the original “yes” man — he taught every science class, coached the first football team, and women’s basketball (gads! women in sports?) and seemed to be in charge of everything — student publications, organization of the library Dewey Decimal system, Drillmaster for the Cadet Company, founder of such groups as the Cactus Walking Club and the Redheads Club. Early Irish collections (~1900) represent some of the most historically important vouchers of the Salt River Valley and give us insight into the profound environmental changes that have occurred since then. The ASU Herbarium also has a number of historical collections from other important Arizona figures such as J. J. Thornber, C. W. McClellan, and J. J. Stitt.

Irish retired from teaching and moved into administration in the late 20s and the collection of herbarium specimens was subsequently overseen by faculty such as John Gillespie (30s), Martin Mortensen (30s to 40s), James McCleary (40s to early 60s) and Norman Russell (early 60s). The collection grew modestly from the 30s to the early 60s with contributions from these botany professors and other ASU faculty in the life sciences.

In 1962, Elinor Lehto was hired as Curator of the Herbarium in the Botany/Microbiology Department, and continued in this role until 1980. Dr. Donald Pinkava was hired in 1964 and it was during the Pinkava/Lehto era that the ASU Herbarium grew significantly in number of collections and their importance. Pinkava registered the collection with Index Herbariorum, began exchange programs with collections around the world, and secured thousands of dollars in grant

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## ASU Herbarium *continued*

money to collect plants throughout the state. Pinkava raised the money, and Elinor loved to collect plants. The collection grew tenfold from 1962 to 1980 — from a disparate assortment of 11,000 sheets, scattered in several different buildings, to 112,000 sheets and a large space on the third floor of the Life Sciences C-wing. Research was not a mandatory part of professorial duties when Pinkava was hired at ASU, but in the early 70s, when the trends changed, he embraced the research component and he and his graduate students contributed significantly in the areas of systematics, cytology, and floristics, while placing valuable vouchers in the ASU collection.

When Pinkava was promoted to Director of the Herbarium, Tom Daniel, a recent graduate from the University of Michigan, was hired as Curator. Daniel continued the trend of exchange and growth and contributed important collection of Acanthaceae, until he moved to the California Academy of Sciences Herbarium.

Les Landrum took over as Curator in 1986, after postdocs at the New York Botanical Garden and the California Academy of Sciences and part-time teaching assignment at UC Berkeley and San Francisco State University. Landrum's life work has resulted in one of the most important collections of American Myrtaceae in the world, and the Landrum era continues to be productive. Landrum has been an organizer of proposals for collaborative NSF grants to database and photograph specimens at ASU, ARIZ, ASC, and DES. These grants have contributed to the early and continued growth of SEINet: [swbiodiversity.org/seinet/index.php](http://swbiodiversity.org/seinet/index.php). Recently, two Mellon Foundation grants to ASU have allowed for the imaging of all the vascular plant types at ASU, ARIZ and DES, part of the Global Plants Initiative.

### Important Activities: Virtual Tools

#### SEINet

The need for taxonomy as the basis for biological inventories is greater than ever as we experience global loss in biodiversity due to climate change, habitat loss, and biological invasions. Natural history collections of the world are assuming a new importance, probably unimagined by their founders, as vast repositories of data become digitized. A lot of work has gone into acquiring, processing, and curating these specimens. The goal of the regional consortium of herbaria associated with SEINet is to make the resource conveniently accessible to everyone so that it may be exploited to its fullest extent. Below are some of the web tools offered:

- \* Collection database >2 million specimens from regional and national herbaria, including all Arizona holdings at ASU, ARIZ, ASC, DES, and several smaller herbaria
- \* Image library of >300,000 herbarium sheets, field photos, and scans
- \* Mapping applications plotting species distributions



above 1903 ASU botany class using specimens from the ASU Herbarium.

- \* Species lists from numerous regional localities
- \* Custom checklists of plants from any delineated area
- \* Interactive identification keys
- \* Fun stuff like plant name games

### *Canotia*, an online journal of Arizona Botany and Mycology

From 1992 to 2003, new treatments for the Vascular Plants of Arizona (VPA) project were published in the Journal of Arizona-Nevada Academy of Science. In 2005 we started a new journal, *Canotia*, to publish these treatments and other articles on Arizona plants and fungi. You can find past treatments of the VPA project at [www.canotia.org](http://www.canotia.org) as well as floristic studies and checklists. The Arizona Native Plant Society has kindly contributed to the publication costs of *Canotia*.

### Some Statistics

- \* >290,000 specimens (vascular plants): ~ 45% Arizona, 25% Latin America, 25% North America and Canada, 5% Old World and Cultivated
- \* >100,000 lichens from around the world
- \* 521 type specimens
- \* Per year, there is an average of... 917 specimens loaned out, 882 specimens loaned in, 4,458 growth, 1,371 exchange in, 2,074 exchange out, and 220 visitors

### “The Move”

As early as 2009, the ASU administration initiated a mandate to move natural history collections out of School of Life Sciences buildings. In 2011, renovation of a recently purchased warehouse-type building was agreed upon as the new space. The “Alameda Building,” as we are calling it for the moment, is located about 2½ miles southwest of the main campus between Roosevelt and Hardy in Tempe. Planners and architects began submitting preliminary designs in October 2012 and construction began shortly thereafter. As one might imagine,

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PRODUCT REVIEW *by Ries Lindley, Arizona Native Plant Society*

## 2800 Arizona Wildflowers, A Standalone Smartphone App

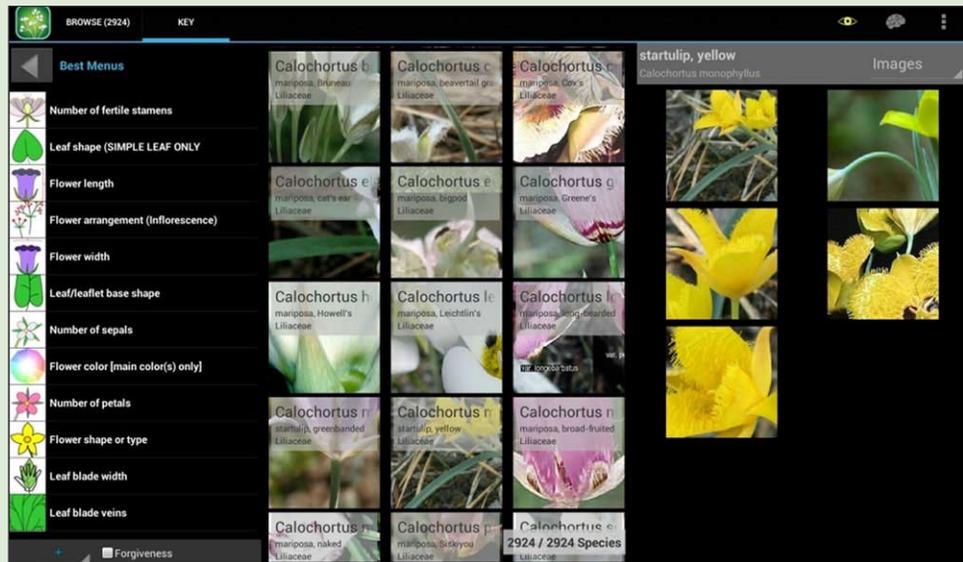
Available at the Google Play Store, \$9.95

Flora ID Northwest, LLC, has recently released a phone app that serves as a field guide and electronic key combined. For those of you who just groaned and rolled your eyes, please feel free to continue carrying five- and six-pound books with you to “identify” plants in the field. I will carry my phone. I was going to anyway, and now it has some help for those times when a plant name does not come to mind or the plant just doesn’t look like anything I’ve ever seen. For me, that’s most of the time.

So what is this fascination with electronic keys? Mostly, they contain a lot of information. *2800 Arizona Wildflowers* has, well, 2,800 plants in its database; most field guides have about 300 species. There are no grasses in this app, probably because there are so few good close-up photos of grass inflorescences. There are 4,200 species of plants in Arizona, and without grasses and the plants you aren’t likely to see, that leaves about 3,000 plants. That’s pretty good coverage. If you think that’s too many plants for a field guide, you are absolutely correct, and that’s why the app’s electronic key functions are so important.

Let’s see how that works with a simple example. You are trying to identify, or perhaps remember, a tree. You open *2800 Wildflowers* and touch the tab at the right-hand upper side of the main screen labeled “key.” Then touch the item labeled “general” on the list that appears. Now you see a list in which there is an item labeled “woody plant habit.” Touch that, and in the next list that appears, touch the item “tree.” Your list now has only 151 plants. If your tree has leaves that are “even pinnate,” then you are left with only seven plants to browse through. If you don’t remember

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## ASU Herbarium *continued*

the logistics of such a major transition were (are) monumental and many people have been (are) working hard to relocate hundreds of thousands of biological collections — wet collections in fragile jars, boxes of pinned arthropods, shelves of heavy fossils, mammals in drawers, and of course, herbarium specimens. All collections are not completely moved, but for the most part, the Herbarium is open for business and the “Big Move” is over. Staff, faculty, students, and student workers are currently organizing, unpacking, and settling into our new home on Alameda.

Since curatorial complexities and challenges are often underestimated, sustained institutional support can be challenging to maintain. We are especially grateful to the

School of Life Sciences for recognizing the importance of our natural history collection and securing a wonderful new facility to grow and move forward — addressing biodiversity issues and engaging in community outreach. The wealth of ancillary data associated with herbaria can be the basis for exploring gaps in our knowledge of life on earth, and filling these gaps to elucidate the beauty and biodiversity of our planet continues to be our motivation. Ultimately, the long-term viability of the Herbarium will depend on its “perceived value” — that an active plant collection is the foundation for scientific research as well as a critical resource for the botanical community; and that knowing the answer to “What species is that?” is profoundly important on many levels.

Stay tuned for our “Grand Opening” announcement. Hope to see you there.



## 2800 Arizona Wildflowers *continued*

what even pinnate means, touch the question mark icon at the bottom of the screen. That brings up the definition and an entire page of leaf illustrations.

One common shortcoming of electronic keys is their inability to handle the characteristics of large families like composites, cacti, or buckwheats. On the first page of the key-tab in this app, the user is offered a menu called “family and genus.” Touching that leads to a list that offers “special family/genus menus” with special keys for such families. The Asteraceae menu allows you to do such things as distinguish ray flowers from disk flowers, answer questions about the involucre (illustrated in the context-sensitive help), or even note whether the plant has ray flowers at all.

Here are a couple tips on making the most of this electronic key. Each time you select a plant characteristic, the key adjusts the number of possible candidates. The number appears in parentheses next to the word “browse” on the browse tab. A little practice will teach every user that some characteristics have a much bigger effect on this number than others. For example, there are 1923 plants in this database with alternate leaves but only 675 with opposite leaves. (If you noticed those two numbers don’t add up to 2800, that’s because this key distinguishes plants that have both types of leaf arrangement on the same plant.) An electronic key is like a game in which you want to reduce the number of candidates by using the fewest possible and most unambiguous characteristics. It’s hard to mistake whether a leaf arrangement is opposite or alternate, and if a plant has opposite leaves, this one characteristic reduces the candidates to less than a quarter of the total.

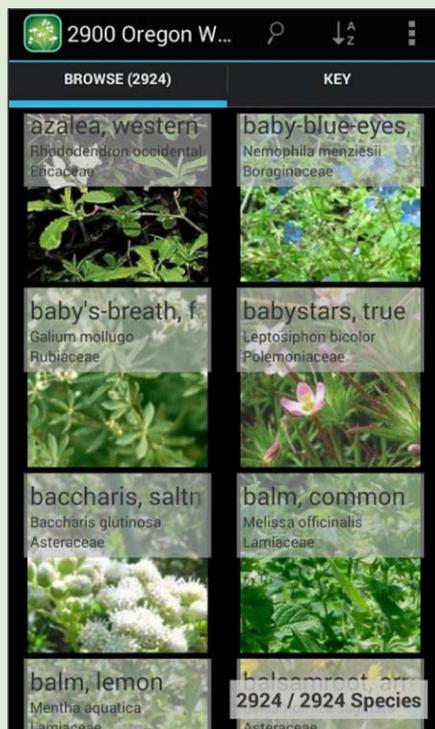
What characteristics should you avoid? Try to avoid those with high variability or high risk of

misinterpretation. I’m not sure about your experience, but mine is this. The plant I am looking at never falls in the middle of those comfortable size ranges listed in any key, written, electronic or otherwise. The leaf I am looking at is always in the size-and-ratio range that overlaps with another species. (Sphaeralcea anyone?) This is not a

problem with electronic keys; it is a problem with *all* keys. Keys are tools we use either to help us remember what we know or to find a list of specimens to compare with the unknown plant in hand. If you really want to be sure what you have, take the plant to your nearest herbarium and compare it with known specimens. The experience can be enlightening.

Once you have pared your list in the app to a small enough number to browse, you will not be able to breeze through nice big photos at the speed of light as you would in a computer-based program like SEINet. This is a phone app, and the pictures are small, sometimes cropped, and a little fuzzy, even on a Samsung Galaxy 4. Often, you will need to click on pictures of each species to view them in full resolution. Is that such a high price to pay for getting to carry five pounds of water instead of five pounds of field guides or floras?

*2800 Arizona Wildflowers* is a user-friendly and well-thought-out package. At a price of \$9.95, it would be hard to pass up if it only had the 8600 field photos. But it has a very useful electronic key, which makes it a practical field tool. Like any tool, the app requires that the user has the patience and experience to fully realize its potential. For those who do have the patience and take the time to gain the experience, its benefits should far outweigh the cost of the app.





above Various specimens from the DES Herbarium.

## Desert Botanical Garden Herbarium (DES) *Phoenix*

by Wendy Hodgson, Curator of the Herbarium and Senior Research Botanist,  
and Andrew Salywon, PhD, Assistant Herbarium Curator and Research Botanist

“The herbarium program represents the pursuit of excellence in the ongoing process of acquisition, curation, and long-term preservation of plant specimens and associated data collected from arid and semi-arid regions. Access by a wide audience of users to these scientific collections and information directly supports the creation, dissemination, and application of knowledge about these plants and the unique environments that sustain them.” — *Desert Botanical Garden Herbarium Mission Statement*

The Garden’s commitment to having a herbarium dates to its founding in 1939. DES, like the Garden, has always focused on plants of arid and semi-arid regions of the world with special emphasis on Southwestern U.S. and Northern Mexico. In the early 1950s, over 1,000 Mexico specimens were collected by George Hinton, and numerous collections from Arizona were collected by E.R. “Jim” Blakley and Rose Collom, the latter a charter member of the Garden and recent inductee into the Arizona Women’s Hall of Fame. In 1972, a building and curator (J. Harry Lehr) were dedicated to the herbarium collection and in 1974 DES was designated as a National Resource Collection by the Advisory Committee for Systematic Resources in Botany. In 1984, Wendy Hodgson became the Herbarium Curator and Research Botanist, positions she continues to hold. DES received a grant from the Institute of Museum Services (now the Institute of Museum and Library Services) in 1994 for new cases and a track system, and in 2001 a new, 2,080 square foot herbarium facility was built as part of the Nina Mason Pulliam Research and Horticulture Center. In 2009, DES, in collaboration with Arizona State University herbarium, received a grant from the National Science Foundation (NSF) to digitize, geo-reference and database its collections, making DES one of the first virtual herbaria in the country. Herbarium staff recently applied for funding to acquire additional cases to appropriately house the existing collection.

DES houses a diverse collection of nearly 75,000 specimens representing 227 families that are further categorized into the following collections:

### *Biogeographical*

The majority of specimens are from the Southwest and Northern Mexico. Arizona’s flora is particularly well-represented in DES, which houses specimens of 80-85% of the state’s known taxa. Many collections are from historically under-collected areas such as the Grand Canyon region and Mogollon Rim.

### *Taxonomic*

The largest families represented in DES are the Sunflower (Asteraceae), Legume (Fabaceae), Cactus (Cactaceae), Agave (Agavaceae), Grass (Poaceae), and Mint (Lamiaceae). The number of Cactaceae and Agavaceae specimens is relatively large, geographically well-represented (primarily from North America), and well curated. The Cactaceae is represented by nearly 5,000 specimens, representing ca. 58% of the 16 known taxa. The Agavaceae is represented by nearly 2,700 specimens representing ca. 60% of the known taxa. The genus *Yucca* is well represented in DES, especially in Arizona and much of the Southwest. DES includes a relatively high number of high quality (material and data) specimens representing the majority of taxa of families from Arizona, the Southwest, and Baja California. Very detailed plant and locality data and photo images are included on the more recent collections by research/herbarium staff from both families. These collections were used as the basis of several taxonomic publications by Garden research staff, including:

- ❖ Edward Anderson’s treatise *The Cactus Family* (2001)
- ❖ Pinkava, et al. *Intermountain Flora* (2012)
- ❖ Howard S. Gentry’s *Agaves of Continental North America* (1982)

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Left Volunteers at the DES Herbarium provide invaluable assistance in the preparation and maintenance of specimens. Center Tours of the herbarium are often provided to university and college classes, Garden members, and other groups. Right DES herbarium cases mounted on tracking system.

## DES Herbarium *continued*

- \* Several new species. In addition, collections are the basis for the planned *Cactaceae of Arizona* monograph

### Type Specimens

DES houses 101 types representing 33 families, with the majority being in the cactus and agave families.

DES also contains horticultural collections from the Phoenix metro area, the DBG Living Collections (an ethnobotanical collection representing vouchers for major publications and those plants represented on the Plants and People of the Sonoran Desert Trail) and a synoptic collection used solely for educational classes.

The herbarium staff are actively involved in several floristic studies: including Grand Canyon, Arizona Trail, and those under the PPAZ (Plant Atlas Project of Arizona) citizen science botany program. Staff are also engaged in ecological studies, such as Las Cienegas, Arizona rare and endemic species studies and documentation, cacti, Agavoideae and Brassicaceae systematics, and ethnobotanical research. Future work will focus on a more complete representation of species from Arizona and the Southwest, including those that are rare and endemic, as well as cacti and Agavoideae taxa from North, Central and South America.

In addition to its collection, DES also has 1) a close association with the Library, Living Collection and other departments including Horticulture and Education, 2) an active research department with 15 staff members and a modern molecular DNA lab, 3) strong, dedicated volunteer participation, 4) dedicated, highly experienced and knowledgeable herbarium staff, 5) an active collecting program, including the Living Collections voucher program, 6) strong relationships with other Southwest herbaria and land management agencies, 7) a database program that is at the forefront of digitization allowing easy access of specimens, 8) active, extensive outreach activities and programs, and 9) access to trained botanical illustrators to illustrate research publications.

Visitors to DES are many and varied. Most are fellow botanists and/or plant systematists from Arizona or outside the state, studying particular rare species, working on taxonomic treatments or preparing floras. Our DBG botanical illustrators have and continue to use the herbarium extensively, providing illustrations of rare and sensitive species of Grand Canyon National Park, Brassicaceae of Arizona, Cactaceae for Intermountain Flora and Cactaceae of Arizona monograph, Fabaceae of Arizona and the monograph on Ephedraceae. Native Americans or those involved with Native American plant programs also visit the herbarium, including Hualapai, Yavapai, and Navajo Nations. Land management agency personnel, including Bureau of Land Management, U.S. Forest Service, and National Park Service frequent the herbarium, often to garner information on rare or invasive plant species. ASU professors and students access the herbarium, including archaeologists who obtain information from present collections to decipher plant distributions and their use in the past. Our specimens have also assisted in ecological, molecular, and bio-geographical studies, forensic cases and illegal plant trafficking/collection litigation. Many have stopped by simply for assistance in plant identification or to inquire where certain plants are found. Tours of the herbarium are often provided to university and college classes, Garden members, and other groups.

DES is situated in the Nina Mason Pulliam Research and Horticulture Center in the Garden; it is open by appointment, Monday through Friday, 9 am – 5 pm. An even easier way to figure out what a certain plant is and where it grows is to access SEINet, the Southwest Environmental Information Network ([swbiodiversity.org](http://swbiodiversity.org)). This database incorporates over a million herbarium specimens and their data, including plant names, images, descriptions, and locality information of thousands of plant species from Arizona and the Southwest.



# University of Arizona Herbarium (ARIZ) Tucson

## *Half a Million Specimens and a Century of Research, Service, and Education in Plant and Fungal Biodiversity*

by George M. Ferguson, Collections Manager, and Dr. Michelle M. McMahon, Herbarium Director

From Arizona's earliest steps in higher education to today's modern research university, the University of Arizona Herbarium in Tucson has served as a focal point for plant diversity research and education.

### **Beginnings and Growth of an Arizona Herbarium**

The University was established by an act of the Territorial Legislature in 1885, though it did not offer a course of study until 1891. James William Toumey, a graduate (A.B. and A.M.) of another land grant institution, Michigan Agricultural College, after teaching a year at Michigan, came to Arizona at the age of 26 as Assistant Professor of Botany and Entomology (one of six original faculty) to teach "first-term freshman botany." Five students enrolled for his course, over half of whom were women. On October 3, the term opened and he wrote in his ledger "Work began in the fall when no flowers were to be found." The first term closed Dec 23, 1891. The next term opened with three of the students continuing in "physical botany" the latter part of December 1891 for two hours a day from 1-3 p.m. The day following their examination on March 8, the same three students continued into the spring term in "systematic botany," until May 26, 1892. The focus was in plant families: "At the opening of the term a number of flowers were in bloom and we began on the Cruciferae. Each student was required to have a microscope and work out and make drawings representing his work... the first hour's discussion was given to observation of *Lesquerella gordonii* and the method of tracing it down with artificial key." In the fall term of 1892, Professor Toumey's "structural botany" grew to eight new students, though the only two males soon "changed his course" making it another all-female class. In the summers (except 1893 when he attended Harvard), Toumey made collections all around the Territory to build the herbarium. Specimens "selected from herb" were sent to Michigan and Harvard (Dr. Charles S. Sargent) for identification and Toumey received hundreds of specimens on herbarium sheets of eastern plants "for the herbarium" in Arizona. He sent 500 specimens "collected in trip from Tucson to Grand Canyon, 1892" to U.S. Department of Agriculture (Dr. Fredrick Coville), and received 500, "including about 100 mounted specimens." Some of the tree specimens he sent East were species new to science, for example in his ledger he wrote "Received to Oct 1894 of Dr. Sargent about 100 species of eastern and foreign trees and shrubs," and "Dec 5, 1894 plants sent to Dept.- set of Ariz. oaks," of which one now bears his name *Quercus toumeyii*. By 1897 (the year he married in New Haven, Conn.) he was Professor of Biology, and Director of the Arizona Agricultural

Experiment Station, and in 1900, began the campus plantings of cacti that promised to be of economic value. Toumey was appointed in the summer to the U. S. government's new Division of Forestry, in charge of research in tree planting. In the fall of 1900, when the Yale School of Forestry opened, Gifford Pinchot selected Toumey, a seasoned westerner, as its first professor of dendrology (one of two original faculty), where he remained, becoming Dean. He brought with him to Yale his own herbarium of 2,500 specimens, many duplicates of his Arizona collections, thus establishing the core of the future collections there.

### **The Thornber Era**

With the University's land-grant mission to fulfill, John James Thornber was selected a month after receiving an A.M. degree in Botany at University of Nebraska. In late July 1901, he arrived in Tucson at the age of 29 with Mrs. Thornber, to take up an appointment as Professor of Biology, and Botanist for the Agricultural Experiment Station for the next 41 years. His salary would be \$58.33 a month for his work at the Station, same as Toumey, though soon raised to \$83.33, plus salary from the College of Agriculture similar to Toumey's \$108.33 a month. In the interim 10 months after Toumey left, Dr. David Griffiths assumed charge of range work under cooperation of the U.S.D.A. and the Experiment Station. Professor Thornber became curator of the herbarium of plants, which included collections of fungi and lichens accumulated by Toumey, and Thornber quickly engaged in documenting the flora of the area. In the first two months of his new position, which began August 1, 1901, Professor Thornber had already collected nearly 400 plants, half being grasses, from the University's campus "Forage Garden" of plants useful to livestock, and from the Experiment Station's "Small Range Reserve" (four sections of land along the Southern Pacific Railroad near Wilmot Siding southeast of Tucson, set apart for the purposes of range study by Executive Order in October 1900), as well as from visits to the University's farms near Tempe and Maricopa. In April 1902, President Roosevelt established the Santa Rita Forest Reserve, of which the Experiment Station's "Small Range Reserve" was made to constitute the northern limit of this larger reserve, for the study of grazing range problems. Thornber's research promoted the notion that Arizona rangeland can be restored by fencing and alternate grazing pastures. He devoted a large part of his time to study of Arizona flora, and, during his first decade, Thornber amassed over 6,000 plant collections for the herbarium, eventually contributing more than 10,000 records.

*continued next page*

## ARIZ Herbarium *continued*

In 1923, Thornber was appointed Director of the Agricultural Experiment Station and Dean of the College of Agriculture, though stepping down as Dean in September 1928 to return to his teaching as Professor of Botany, and Botanist for the Station until his semi-retirement in 1942. The herbarium in this era was housed in the Agriculture Building, in his office, and at his home on Olive Street where “his basement was a laboratory in itself” (*Arizona Daily Star*, 27 Nov 1962). He remained active for two more decades as part-time Taxonomist at the Station and Emeritus Professor. Dr. Lyman Benson was Assistant Professor of Botany in the early 1940s and, in consultation with Dr. Thornber, in 1940 produced *The Cacti of Arizona* as University of Arizona Bulletin Vol. XI, contributing over 1,000 specimens to the herbarium. The University acquired the approximately 3,000 specimen holdings from The Desert Botanical Laboratory on Tumamoc Hill, including the herbarium of Dr. Forrest Shreve after the Carnegie Institute of Washington ceased operations in Tucson in 1940.

### Mid-century Organizing of the Herbarium

Dr. Frank W. Gould replaced Thornber in the fall 1944 as Assistant Professor of Botany and Assistant Botanist at the Agricultural Experiment Station. His study of grasses (*Elymus* in particular) after receiving his Ph.D. from U.C. Berkeley led to the addition of his grass collections from California and Arizona to the herbarium, about 2,300 records throughout his 5-year tenure at the University of Arizona. His book *Grasses of the Southwestern United States* published by UA Press in 1951 is still an important reference. In 1949, Dr. Kittie F. Parker joined the University’s Botany Department and became curator of the herbarium. Her collections of the sunflower family, especially tribe Helenieae, added about 1,500 plants to the herbarium. Her 1958 *Arizona Ranch, Farm and Garden Weeds*, prepared for the Agricultural Extension Service circular 265, was later published by UA Press as *An Illustrated Guide to Arizona Weeds* with drawings by Tucson artist Lucretia B. Hamilton.

Dr. Charles T. Mason, Jr., came to the University of Arizona in 1953, following four years’ instructorship at the University of Wisconsin, and after completing his doctorate at UC Berkeley. His graduate committee included his uncle, Herbert L. Mason, and he received training in running a herbarium from the curator of the UC Herbarium, Annetta Carter. He began a professorship in the Plant Sciences Department and assumed curatorship of the herbarium. Things were in a state of disarray, as emphasis during the “Thornber Era” had been on adding specimens, so Dr. Mason took on a career-long endeavor to create a museum of regional and international importance for both its historical and newer collections. The approximately 4,000 moss collections of Mrs. Inez Haring and colleagues were acquired during Dr. Mason’s time, and by 1957, the University had acquired the 7,300 plant collections



above Historic Herring Hall, constructed in 1903 as a gymnasium, has been home to the ARIZ Herbarium since 2004. Photo courtesy George Ferguson.

of Robert H. Peebles and Thomas H. Kearney at the USDA Field Station at Sacaton, prior to its closing, and the approximately 10,000 specimen herbarium of Leslie N. Goodding from the Soil and Conservation Service. Dr. Mason organized trips around the state, and to Mexico, taking his graduate students along. Many of his former students regard him as a supportive mentor and outstanding teacher, and have appreciated the cultivation of lasting friendships among students and staff at a vibrantly active herbarium. The herbarium’s home since 1962 was the basement of the Shantz building, where it remained for 42 years. Adjacent to it were the extensive holdings in the Fungal Mycology collection of Dr. Robert Gilbertson. Upon becoming Emeritus Curator of the herbarium, Dr. Mason had been a preeminent botanist in Arizona for more than 50 years and had built a strong regional collection of accessions from the state, as well as northern Mexico. His book (with his wife Patricia), *A Handbook of Mexican Roadside Flora* in 1987 by UA Press remains a popular guidebook.

### The Move to Herring Hall

In 1992, Dr. Lucinda McDade came from Duke University as Assistant Professor of Ecology and Evolutionary Biology, and Director of the Herbarium. Phil Jenkins was hired as Curatorial Specialist where he provided the herbarium’s public service function for many years, in particular, responding to queries by the Cooperative Extension, the state’s Veterinary Diagnostic Laboratory, and the Poison and Drug Information Center. The Howard Scott Gentry herbarium had been acquired in 1989, with over 10,000 accessions, most significantly *Agave* including type specimens, and other plants from the Rio Mayo Region of Sonora, Mexico, though many were duplicates of Gentry’s earlier distributions. Being a visionary, Lucinda McDade secured grants to continue the processing of these accessions plus a backlog of unprocessed sheets from Thornber and other early collectors. Computer databasing efforts began, a website was initiated for the herbarium, and grants were won

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## ARIZ Herbarium *continued*

for compactor shelving of some cabinet rows. Meanwhile the holdings continued to grow from donations of voucher specimens for *Gentry's Rio Mayo Plants*, UA Press, 1998. Notably, associated researchers contributed thousands of records over the years — Dr. Richard S. Felger, mostly from Mexico, and Dr. Thomas R. Van Devender, as well as Dr. John R. Reeder and Charlotte Goodding Reeder (grass experts retired from Yale University) — all their collections together totaling at least 30,000 specimens.

This recent growth was addressed by Dr. Steven P. McLaughlin, a former student in Biology with Dr. Mason on his graduate committee, and Professor in the Department of Arid Lands, when appointed Director of the Herbarium in 2001. The following is his description of the move: "The very first item I had to deal with was a conceptual plan for moving the Herbarium from Shantz to a to-be-remodeled Herring Hall. This conceptual plan had ARIZ occupying the basement and a new mezzanine of the building; about 20 miscellaneous College of Agriculture and Life Sciences offices were designated for the main floor. After briefly studying this plan, it was obvious to me that the Herbarium could not be fit into the space allocated for it. Essentially it provided for storage of herbarium cabinets but lacked any of the necessary work spaces. After further discussion, it was decided that Herring Hall would be dedicated to housing both the vascular plant herbarium and the mycological herbarium, along with an office for the Campus Arboretum. Before final plans were drawn, I convinced the College to include new rail systems on both the main floor and the mezzanine that could be used to expand the compactor systems, which would allow both collections to grow. In 2002 we had received an NSF grant in collaboration with ASU and NAU to produce an online data base of all of the collections from the state. We thus needed desk space for up to four students to work on entering label data into the database. All these recommendations were included in the final design. Construction took place during most of 2003, and the move of the herbaria from Shantz to Herring required most of 2004. We invited Lucinda McDade back to present the keynote address at the dedication, which took place on September 3, 2004. The remodeling of Herring Hall and relocation of the vascular plant and mycological collections would not have been possible without the support of Dean Eugene Sander, Experiment Station Director Colin Kaltenbach, and, particularly, Assistant Director Randy Ryan who listened carefully to all of our concerns and came up with the creative solutions that made the project possible."

The resulting well-lit and spacious work areas of Herring Hall provided a wonderful place for the research and curatorial tasks of a herbarium. Constructed in 1903 as a gymnasium, Herring Hall, the second oldest building standing on campus, was placed on the National Register of Historic Places in 1986. Hence, its interior renovation endeavored to reflect some of the building's original uses; the main floor resembles a basketball court, the side walls have the outline of bleacher seats and a basketball backboard and hoop are suspended from the mezzanine providing for a most interesting and unique herbarium work space setting.

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# ARIZ Herbarium *continued*

## ARIZ Today

Two years later, Dr. McLaughlin retired and in September 2006, Dr. Michelle (Shelley) McMahon, a former student of Dr. McDade, arrived from U.C. Davis to take a position in Plant Sciences and as Director of the Herbarium. Dr. Elizabeth (Betsy) Arnold, also a former student of Dr. McDade, had been hired into Plant Sciences and as curator of the mycology collection the previous year. Together they immediately began seeking support for additional storage for the collections; by then tens of thousands of plant specimens and nearly the entire fungal collection were at risk of insect infestation. In 2008, the National Science Foundation awarded funding for mobile carriages and hundreds of new cases, to go on the floor rails that Dr. McLaughlin had ensured were in place for both collections. The mycological-botanical collaboration continues as ARIZ embraces the future, a future that includes continuing to open up the collections to online access, bringing the collections in line with modern systematics, and teaching students and visitors to see the details that really matter for understanding our botanical and mycological floras.

Online access to the label data allows researchers to aggregate data in new and creative ways; projects using ARIZ specimen data have included studies on wild crop relatives, geographic distributions of tree species, and current and projected ranges of invasives, to name a few. In addition to the “virtual” data, visitors travel to view the physical specimens; recent examples include research on epidermal phytoliths, and pollen and seed morphologies. Visiting researchers also work on regional floras, as well as taxonomic revisions, and thousands of specimens are sent on loan each year to other institutions for taxonomic study. Modern taxonomic research frequently involves DNA analysis, and such research often results in better understanding of relationships among species. These in turn result in name changes, requiring updates to the specimens and to the database. On a larger scale, the last few decades of very active research by the world-wide systematics community has produced a substantial revision of our understanding of plant families. In 2009 an international group of researchers, the Angiosperm Phylogeny Group, proposed a new classification (their third and most complete), nicknamed “APG III.” This system has been adopted in most recent texts and textbooks. The timing of the publication happily coincided with the cabinet installation project at ARIZ, so the collection was rearranged according to the new evolutionarily-based classification scheme.

ARIZ currently holds an estimated 420,000 plant specimens, including algae, bryophytes, and vascular plants, and over 40,000 fungal and lichen specimens. Four to six thousand specimens are deposited each year, and every specimen that is added to the collection is added to the online database accessible through the website.

## Hours of Operation and Public Outreach

ARIZ is open to the public 8:30 am to 4:30 pm, Monday through Friday, and staff are available to help with plant identifications, access to our extensive botanical literature (including the UA Science Library’s botanical holdings), and training in use of the collections. Campus courses and off-campus tours are frequent and welcome. As part of the UA, Arizona’s Land Grant Institution, ARIZ is particularly dedicated to providing plant identification services and is doing so at an unprecedented rate (nearly 1,000 plants were identified last year), due in part to the ease of emailing photographs. Workshops have been offered at the herbarium as continuing education for the public (for example, grass identification) and future workshops are being planned. For more information, visit [ag.arizona.edu/herbarium](http://ag.arizona.edu/herbarium) or email [herbarium@ag.arizona.edu](mailto:herbarium@ag.arizona.edu)



## Welcome to Claire McLane

At the beginning of the year Claire McLane replaced Anna Van Devender as the Arizona Native Plant Society’s Administrative Assistant. Since then she has been doing a superb job handling the many administrative details of the Society. Claire is a second-generation Tucsonan, with a strong connection to the Sonoran Desert and culture. She received her B.A. from Prescott College in Cultural Regional Studies, focusing on the U.S./Mexico border region. Claire is now a full-time mom of a dynamic little boy, and she enjoys being outside as much as possible, gardening, photographing, and writing. Thank you, Claire, for keeping the Society on an even keel.



# Deaver Herbarium (ASC) Northern Arizona University, Flagstaff

by Dr. Tina Ayers, Curator and Associate Professor, Biological Sciences

The Deaver Herbarium houses pressed, dried, vascular and non-vascular plant collections comprising over 100,000 specimens. Seventy-eight percent of the collections are from Arizona and most are from the northern half of the state. Compared to the rest of the U.S., much of this region is poorly known botanically. This makes the collections scientifically valuable and important resources for botanical research in the U.S. The Deaver Herbarium houses significant collections from Grand Canyon and Petrified Forest National Parks and six national monuments — Tusigoot, Montezuma Castle, Walnut Canyon, Navajo, Wupatki, Canyon de Chelly, and Sunset Crater. Many collections have been made from the Coconino and Kaibab National Forests, BLM land (including the “Arizona Strip,”) and Wilderness Areas within these entities.

Each permanent scientific repository is assigned a unique identifier, which takes the form of an acronym. The Deaver Herbarium’s permanent acronym, ASC, was assigned when NAU was called Arizona State College. All Arizona specimens at Deaver are cataloged and searchable, using the ASC designation, on the Southwestern Environmental Information Network (SEINet) maintained at ASU (see [swbiodiversity.org/seinet/index.php](http://swbiodiversity.org/seinet/index.php)). Historical out-of-state collections, collected prior to 1990, remain uncataloged. In 2012, all of the type specimens (8 holotypes and 52 isotypes) were removed from the general collections and are now stored separately. In 2013, they were digitally imaged and added to the worldwide type project as part of the Global Plants Initiative. Important collections within the Deaver Herbarium include those made by the following people: M. Baker, R.E. Collom, C.F. Deaver, D. Demaree, R.K. Gierisch, L.N. Gooding, G.

Goodwin, R.H. Hevly, M.E. Jones, T.H. Kearney, M. Licher, E.L. Little, Jr., V.O. Mayes, A.M. Phillips, III, G. Rink, C.G. Schaack, J.J. Thornber, and A.F. Whiting.

In 1965, the herbarium was named for its first curator, Chester “Danny” Deaver, who started the herbarium in 1930. Early collections included Deaver’s Flora of Oak Creek Canyon, Marcus Jones’ collections from the 1880s and Leslie Gooding’s collections from 1910 to the 1930s. At Deaver’s retirement in 1965, the collections numbered 15,000. Deaver was succeeded by Dr. James Rominger, a grass specialist and expert in the bristlegrass genus *Setaria*. His students completed 10 floristic inventories ranging from the San Francisco Peaks Wilderness Area and Alpine Tundra to the Petrified Forest National Monument. Under Dr. Rominger’s direction, the herbarium grew to 50,000 specimens housed in 52 cabinets. The Rocky Mountain Research Station collection (FSLF) of 1,000 specimens was incorporated into the Deaver Herbarium in 1989.

Dr. Rominger retired in 1989 and was replaced by Dr. Tina Ayers. Under her direction, the collections were refiled alphabetically in color-coded genus folders. Ayers added 24 used cases from Harvard University. Ten new cases, paid for through indirect-cost returns on National Park Service contracts, were added to house the vouchers for additional floristic studies, including Glen Canyon, Canyon de Chelly, and areas of the Coconino National Forest. In 2006, the growth in the collections and new cases required additional space, so the herbarium incorporated the adjacent botany classroom as the processing and mounting room.

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BOOK REVIEW by Al Schneider, President of the San Juan/Four Corners Native Plant Society

## Flora of the Four Corners Region: Vascular Plants of the San Juan Drainage, Arizona, Colorado, New Mexico, and Utah

by K.D. Heil, S.L. O’Kane, Jr., L.M. Reeves, and A. Clifford

1,098pp. Missouri Botanical Garden Press, 2013. ISBN: 981-1-930723-84-9. \$72.00

Let’s cut to the chase: BUY THIS BOOK! Whether you live in, near, or far from the Four Corners, and whether you are a book collector, a casual observer of wildflower beauty, a budding amateur botanist, or a professional working in the field, you will more than enjoy owning this masterfully created book.

Facts: The book was 15 years in the making after the scheme was hatched over lunch at the Elk Ridge Café in Blanding in

1996. Major collectors were Ken Heil, Steve O’Kane, Arnold Clifford, and Wayne Mietty, with considerable assistance from Rich Fleming, Cyndie Holmes, Dave Jamieson, Les Lundquist, Lynn Moore, J. Mark Porter, Tim Reeves, and Glenn Rink. The 60+ list of major contributors (especially those writing the individual keys and descriptions) reads like a *Who’s Who of Botany*.

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## ASC Herbarium *continued*

The botanist for the Navajo Natural Heritage Program moved to the herbarium in 2002. The Navajo Nation Herbarium (NAVA) was moved from Window Rock in 2008 as part of a long-term housing agreement. It is not incorporated into the Deaver Herbarium but kept separately in the adjacent room as stipulated in a memorandum of understanding between NAU and the Navajo Nation.

The herbarium staff includes one curator, one student curatorial assistant, currently Brittany Burgard, and a fabulous group of volunteers. The volunteer staff includes two additional Ph.D. botanists and four M.S. botanists (Greg Goodwin, Andrea Hazelton, Sue Holiday, Gisela Kluwin, Max Licher, Vera Markgraf, Glenn Rink, and Randy Scott). The staff members serve as human resources at the Deaver Herbarium, act as regional editors for *Flora of North America*, and regularly review family treatments using specimens in the Deaver Herbarium. They are also spearheading an effort to produce a flora of the San Francisco Peaks and help organize and lead PAPA training and collecting trips in Northern Arizona.

The herbarium is the center of a good deal of activity these days. Staff and students are completing treatments of families for the new flora of Arizona. Three recently completed treatments (Rhamnaceae, Portulacaceae, and Fabaceae I (*Errazurizia*, *Psorothamnus*, and *Marina*) are published in *Canotia*. Four more treatments, *Carex*, Lamiaceae, part II, Phymaceae, and Scrophulariaceae, are nearing completion. Greg Goodwin is working on floristic inventories of the Cataract and Espee Ranches. Gisela Kluwin and Vera Markgraf are working on their floristic inventory of the Truxton area. Max Licher and Glenn Rink are busy collecting all over the



Southwest but have particular fondness for *Carex*. Randy Scott is working on a monograph of the genus *Brickellia*. The graduate students also use the herbarium to complete M.S. theses that involve floristics or systematics projects. Current M.S. students at the Deaver Herbarium include Rich Crawford, Kimberly Hansen, Elizabeth Johnson, Wendy McBride, Kate Noonan, Amy Prince, Shelley Silva, and Joe Talboom.

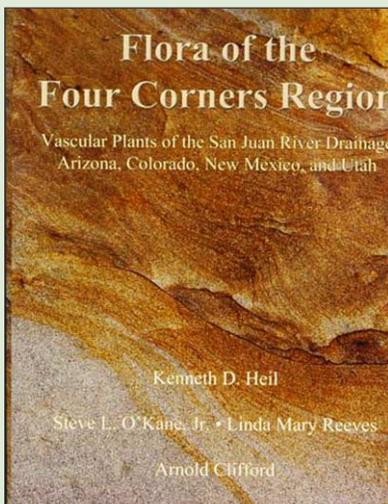
The Deaver Herbarium staff can identify plants and generate scientifically accurate labels when an acceptable specimen is also donated by a non-profit organization, an individual from northern Arizona, or members of governmental agencies or the scientific community. Free database access is available to those same patrons, either in the herbarium or on the internet. Plant identification, database access for non-internet archives, label generation, specimen processing, data collection, and photograph identification are available at \$50 an hour to for-profit patrons such as book authors and private consultants.

The herbarium is located in Room 314 in the Biological Sciences building, 617 South Beaver Street, in Flagstaff. The Deaver Herbarium is open to visitors, professional and non-professional. Staff is available to provide tours for educational purposes or to demonstrate how to use herbarium resources to identify plant material. If you wish access or a tour of the collection, please make an appointment by emailing [deaver.herbarium@nau.edu](mailto:deaver.herbarium@nau.edu) to schedule an appointment. For more information on current projects or to contact our staff, visit [nau.edu/Merriam-Powell/Biodiversity-Center/Deaver-Herbarium](http://nau.edu/Merriam-Powell/Biodiversity-Center/Deaver-Herbarium).



*above* Many types of botanical materials are available for study at the ASC Herbarium.

### BOOK REVIEW *continued*



The 4-pound *Flora* covers the Four Corners region drained by the San Juan River from its head waters at the Continental Divide at 4,292 meters to its confluence with the Colorado River at 1,130 meters — an area of 65,382 square kilometers, or the size of West Virginia. The *Flora* covers this region in 1,098 pages cataloging 120 families and 2,355 taxa (41 endemics). There is a Glossary of 32 pages and over 23 pages of Literature Cited. The heavy stock pages are graced with 118 of Steve O'Kane's superb photographs splendidly reproduced; 200 lovely and valuable line drawings, almost all by Linda Reeves; eleven mesmerizing color botanical illustrations (some full-page) by Carolyn Crawford; a most unusual and ethereal set of fifteen Glenn Vandre landscape watercolors of the vegetation associations and life zones covered by the *Flora*; and inside the front and back covers are full-sized political, topographic, and river maps of the area covered. The type face is large and easy on the eyes. All of this is wrapped in a very handsome dust cover with picture sandstone on the front and an exciting full-color collage of the area's flora and terrain on the back.

The introductory material very nicely contains the expected scope of the project, methodology, geology, climate, plant communities, etc. But we also get an

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# Grand Canyon Museum Collection Herbarium

(GCNP) *Grand Canyon National Park* by Kim Besom and Colleen L. Hyde

The efforts to found a Museum Collection at Grand Canyon began not long after the establishment of Grand Canyon National Park, in 1919. A small “study collection” was established for which park staff began collecting materials that demonstrated the diverse natural and cultural history of the park. Items from the collection could also be used by park staff for interpretive purposes, including talks and exhibits, to aid understanding of the park by park visitors. Natural and cultural collections and their associated records also provided baseline data, serving as scientific and historical documentation of the park’s resources.

While the initial emphasis of collecting at Grand Canyon might have been on geology, for obvious reasons, over time that changed, as it was acknowledged that the size and depth of the Grand Canyon, encompassing five of the seven life zones and three of the four desert types in North America, provided for an incredible diversity of plant and animal life. Over 1,750 vascular plant species, 167 species of fungi, 64 species of moss, and 195 species of lichen have been found in the park — more plant diversity than at any other national park. The park also serves as an ecological refuge for undisturbed remnants of dwindling ecosystems (such as boreal forest and desert riparian communities) and is home to some rare, endemic, and specially protected (threatened or endangered) plant species.

Reflecting the diversity of what is found in the park, the Grand Canyon National Park herbarium houses over 12,500 botanical specimens onsite, including a handful of type specimens. These specimens were collected by early park naturalists, including



Eddie McKee, Pauline Mead, John Merkle, and Louis Schellbach, as well as thousands of specimens collected by botanists Rose Collom, Walter Cottam, and Wendy

Hodgson. Thousands of other Grand Canyon plant specimens are stored at other herbaria around the country, but especially at the Deaver Herbarium, on the Northern Arizona University campus in Flagstaff, the McDougall Herbarium, on the campus of the Museum of Northern Arizona in Flagstaff, and at the Desert Botanical Garden in Phoenix. The park’s collection currently is composed mostly of vascular plants, though lichens, fungi, moss, and tree ring samples are also included. The purpose of the herbarium collection is to serve as a reference collection to help the public and park staff, including maintenance, vegetation crews, and fire crews, identify

plants occurring in Grand Canyon.

Some of the Grand Canyon herbarium collection can be found on the Southwest Environmental Information Network (SEINet) database at [swbiodiversity.org/seinet](http://swbiodiversity.org/seinet).

The park’s herbarium collection is located in the Museum Collection storage and research facility on the South Rim. For more information about the collection and hours of operation, or to make an appointment, please call 928.638.7769, or email [grca\\_museum\\_collection@nps.gov](mailto:grca_museum_collection@nps.gov).



*above* Wendy Hodgson, a major contributor to the GCNP Herbarium, collecting at the Grand Canyon. *Courtesy Lisa Harloe.*

## BOOK REVIEW *continued*

unexpected number of other pieces of very thoughtful and welcomed information: a two page list of historical collectors in the San Juan area, a list of endemics, one and a half pages defining “weed,” plant migration routes, and definitions of measurements, such as,

“Flower length = Point of insertion of the pedicel to the apex of the longest petal.”

Because the *Flora* just came on the scene in September 2013, I have not had much time to work with its heart and soul, the keys and descriptions, but those I have used and examined are compact, accurate, and helpful. For example, plant keys often require discriminating between annual and perennial plants, but how are we to do that? Certainly most of us can

tell a perennial tree from a *Gilia* but how about a *Gilia* from an *Ipomopsis*? The opening of the *Lupinus* key gives us assistance with that genus by asking us about its cotyledons:

1. Plants annual, the cotyledons commonly persistent
- 1’ Plants perennial, the cotyledons not present at flowering

And let’s have a standing ovation for the *Salix* keys, yes, plural “keys”: vegetative, pistillate, and staminate keys.

The complete plant descriptions make it easy for the reader to focus in on specific plant parts by capitalizing and bolding key words (STEMS, LEAVES, etc.). The complete descriptions also include, I am glad to say, the etymology of the specific epithet, synonyms, habitat, associated plant communities, a list of all the counties in the Four Corners

*continued next page*

# McDougall Herbarium (MNA) *Museum of Northern Arizona, Flagstaff*

by Kirstin Olmon, Botany Research Assistant

The Museum of Northern Arizona's McDougall herbarium is located in the Easton Collection Center on MNA's Research Campus. The McDougall herbarium focuses on plant collections from the Colorado Plateau, containing plants from numerous botanists, including Alfred F. Whiting and Walter B. McDougall. Whiting, a former curator and ethnobotanist, studied and collected both native and cultivated plants from the Flagstaff area, Hopi mesas, and Hopi crops. McDougall, for whom the herbarium was named, was a professor, naturalist, ecologist, and former curator known for his floras of Yellowstone, Big Bend, Death Valley, and Natchez Trace. He also authored *Plant Ecology*, the first textbook on this subject, and two important plant keys for this area: *Seed Plants of Northern Arizona* and *Grand Canyon Wildflowers*. One of the many contributions McDougall made while curator was growing the herbarium collection from 7,000 to over 26,000 plant specimens.

Today, MNA's McDougall herbarium houses approximately 34,000 cataloged specimens. This important collection contains examples of most of the flora of Northern Arizona and is particularly strong in plants of the Grand Canyon region. Cataloged specimens represent 155 vascular plant families, 891 genera, and 2,582 species as well as a significant collection of nonvascular plants including mosses, liverworts, hornworts, and fungi. Numerous rare plants representing federally threatened and endangered species are preserved in the collection, as are a limited number of type specimens. Three regional ethnobotanical collections are maintained in the McDougall herbarium and include the Alfred F. Whiting Hopi and Havasupai collection, the Grenville Goodwin Apache

collection, and the Louisa Wetherill Navajo (ASM Collection) collection. These holdings contain indigenous food plants as well as medicinal and ceremonial plants.

Plant collection information from the Museum of Northern Arizona's McDougall Herbarium can be accessed through the Southwest Environmental Information Network (SEINet), an online, collaborative database resource: [swbiodiversity.org/seinet](http://swbiodiversity.org/seinet).

The McDougall Herbarium is open to the public by appointment Monday through Friday, 9am–5pm by contacting Janet Gillette at [jgillette@mna.mus.arizona.edu](mailto:jgillette@mna.mus.arizona.edu) or 928.774.5211 x265.



above Living roof on the Easton Collection Center, which houses the McDougall Herbarium. *Courtesy the Museum of Northern Arizona.*

## BOOK REVIEW *continued*

area where the plant has been found (really amazing!), elevation range, flowering time, entire U.S. range, unusual characteristics, and Native American uses.

Nothing is perfect; what are some of the problems in the *Flora*?

In some ways the large number of contributors that I mentioned above is good: we get the top experts in each family writing the descriptions. But in other ways, confusion can result — and does. For example, the Angiosperm Phylogeny Group (APG) recommendations are followed by some contributors (for Scrophulariaceae) but not others (for Chenopodiaceae). Be prepared to be flexible and speak several botanical languages.

*Colorado Flora* very nicely indicates where its treatment of a family, genus, or species is in conflict with the treatment in

the monumental *Flora of North America*. That same contrast and comparison definitely should have been carried out in the *Flora of the Four Corners Region*.

I find it very unfortunate that the keys do not provide a way for you to backtrack when you make a mistake in keying. If, for instance, you arrive at choice #27 in a key and you realize that you are in the wrong place, there is no indication about what number you were at before #27. You cannot easily retrace your steps. Look at Weber and Welsh's floras; they both provide this thoughtful, time-and-frustration-saving numbering in brackets [ ].

The glossary gives fine definitions (and has some very unusual and welcomed entries, such as: Hawkmoth, disjunct species, relict species, Ramah Navajo, Piki, Park, sub, tuff, Ant Lion, and 2 definitions of herb), but the glossary omits some necessary entries: inflorescence, villous, limb, spp, sp,

*continued next page*

# Cochise County Herbarium (CCH) Sierra Vista

by Bob Ballard, Cochise County Herbarium Curator

Founded in 2002 by Dr. Cecile Lumer, the Cochise County Herbarium (CCH) is associated with the University of Arizona Cochise County Cooperative Extension. Among its multiple uses are research of botanical, ecological, ethnobotanical, and other aspects of plants by scientific researchers. Gardeners and landscapers interested in native plant species may also use the resources of the herbarium. Additionally, the herbarium provides educational material that can be incorporated into plant, ecology and wildlife courses at the high school and college levels.

## How the Herbarium Can Help You

The Sky Islands and San Pedro River contribute to the unique habitats found in Cochise County. The herbarium is a repository for plant species from these habitats, reflecting the variation and diversity present in Cochise County and surrounding areas. The herbarium is a place where the general public, as well as professionals, can find information specific to these areas.

## Herbarium Credentials and Resources

The Cochise County Herbarium has been given the internationally recognized code of CCH. This code serves to identify the CCH throughout the worldwide botanical community.

The CCH has all specimens entered into a Microsoft Access 2010 database. The database contents and specimen photographs are then made available for viewing on the internet at [www.cochisecountyherbarium.org](http://www.cochisecountyherbarium.org). The CCH is also a member of the United States Virtual Herbarium via the

Southwest Environmental Information Network (SEINet) at [swbiodiversity.org/seinet/index.php](http://swbiodiversity.org/seinet/index.php).

The herbarium currently has 3,325 plant specimens with 1,392 separate plant species available for viewing and study by those interested. The herbarium also has a very fine library

containing more than 100 books which are available for viewing and study as well, ranging from novice to expert levels.

The herbarium is staffed by a dedicated group of volunteers including Bob Ballard (Curator), Virginia Bealer, Dave Bly, Carol Campbell, Bob Herrmann, Mimi Kamp, and Cindy Sprecher.

## Location

The Herbarium is located in a small building inside the southeast corner of the fenced-in area immediately to the south of the main campus of the University of Arizona Sierra Vista. 1140 N. Colombo Avenue, Sierra Vista, AZ 85635

## Would you like to visit the herbarium or become a volunteer?

Please contact the CCH at 520.458.8278 x2172 and leave a message. One of our volunteers will return your call as soon as possible. Better yet, email [robert@cochisecountyherbarium.org](mailto:robert@cochisecountyherbarium.org) with your request.



above Sample CCH specimen sheet: Arizona caltrop (*Kallstroemia grandiflora*), James Mustard (collection). Photo courtesy Bob Herrmann.



## BOOK REVIEW *continued*

ssp, dorsal (but ventral is there!), sori, sporophore, trophophore. Scale, awn, and bristle are not defined sufficiently to assist with keying Asteraceae.

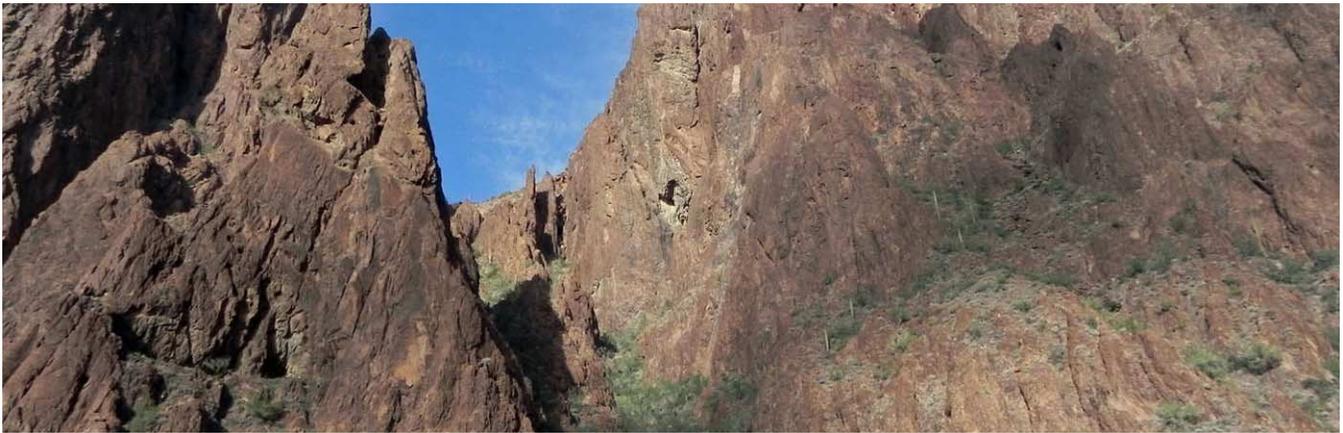
There seems to be a bias for publishing illustrations of rare or uncommon plants in the *Flora*. The point of drawings is not just to look good (which they certainly do), but also to help identify. It would have been nice to have illustrations of some of the common *Astragalus* or *Erigeron* as well as the more unusual plants.

I have developed a website to identify updates and corrections for the *Flora*. Readers may find this a useful

guide when using the *Flora*: [www.swcoloradowildflowers.com/floraofthefourcornersregion.htm](http://www.swcoloradowildflowers.com/floraofthefourcornersregion.htm)

The bottom line is this: the excellence of *Flora of the Four Corners Region* enormously outweighs the few errors. After approximately 20,000 miles of walking, 150 miles of horse riding, and 150,000 miles of driving to, from, and on field trips to collect over 23,000 specimens (including 1,700 county records, 42 state records, and 17 new species), Ken and Steve deserve a great thank-you from us and a long rest for themselves. The former they have been receiving; the latter they have not taken, for they immediately began work on a flora of New Mexico, and if all goes well we can expect that in the next few years.





## SPOTLIGHT ON A NATIVE PLANT

# California Fan Palm (*Washingtonia filifera*)

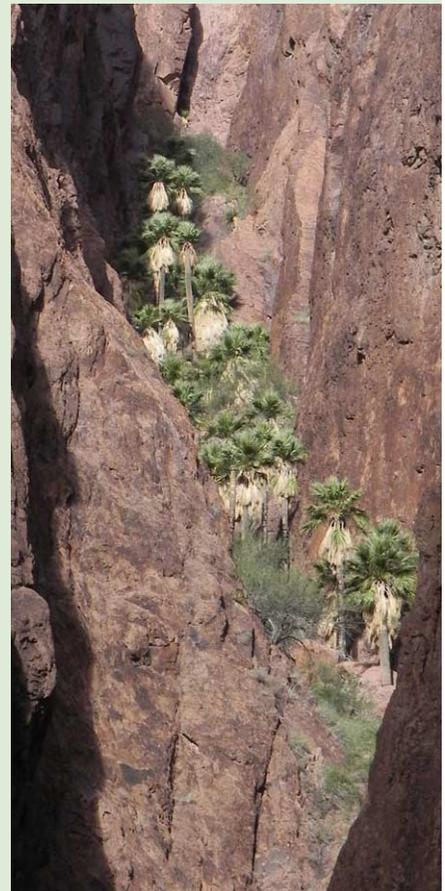
by Douglas Ripley, Cochise Chapter, Arizona Native Plant Society

Of the eleven palm species occurring in North America, the California Fan Palm is the only palm species to occur in the Western United States and northern Baja California. Although widely grown in cultivation, its remarkable natural occurrence in Arizona is confined to several steep crevices of an area known as Palm Canyon on the western edge of the Kofa National Wildlife Refuge in Yuma County. The only other natural occurrences of the California Fan Palm are located in the Anza-Borrego Desert State Park and Joshua Tree National Park in California and near Tijuana in Northern Baja California. Palm Canyon is easily accessible by a well-marked road into the refuge off of Highway 95. A short hike from the end of the road brings one to an excellent vantage point to observe these remarkable plants growing in the steep crevices above the trail. A considerably more strenuous hike further up the canyon allows for a much closer view of the palms.

This beautiful tree reaches a maximum height of about 45 feet with a crown spread of about 15 feet and a trunk diameter of more than three feet. The individual fronds are 3-6 feet in length and eventually form a skirt of dead foliage around the trunk. The fruit derived from its three-lobed, funnel-shaped flowers consist of small, sweet berries about one-half-inch in diameter. Evidence exists that Native Americans used the fruits for food and ground the seeds into flour.

Such a widely disjunct distribution has led to speculation on the origin of the California Fan Palm in Arizona. One theory holds that the trees in Arizona are descendants of palms growing in a much wider distribution during the last periods of the North American glaciation (about 12,000 years ago) that eventually retreated to protected niches as the climate warmed to desert conditions. An alternative theory is that the Palm Canyon trees were established from other populations as a result of long-distance dispersal by birds or coyotes

The genus *Washingtonia* was described in 1879 by the German botanist, renowned palm expert, and plant explorer, Hermann Wendland (1825-1903) in honor of George Washington. The specific name *filifera* is derived from the Latin *fili* meaning “thread-like” and refers to the filaments that peel away from the leaf margins.



above California Fan Palms in Palm Canyon, Kofa National Wildlife Refuge, Yuma County, Arizona. Courtesy the author.

below California Fan Palm Fruit. Courtesy M. Kat Anderson @ USDA-NRCS PLANTS Database.





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For more information, please write to AZNPS (see return address above), visit [www.aznativeplantsociety.org](http://www.aznativeplantsociety.org), or contact one of the people below:

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