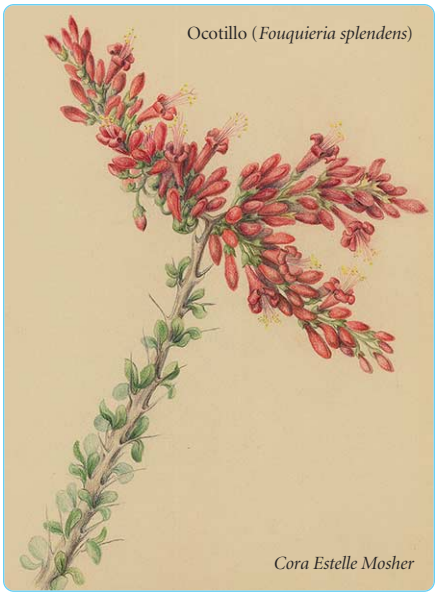

Plant Press Arizona

THE ARIZONA NATIVE PLANT SOCIETY

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In this Issue

With Regular Features

The author with *Hesperoyucca newberryi* (Grand Canyon Hesperoyucca). *Photo by Carrie Cannon*

Grand Canyon —Still Holding Secrets

by Wendy C. Hodgson[1] *All figures courtesy of the author unless otherwise noted*

E.O. Wilson (2000) famously said "phylogenetic reconstruction, currently the dominating focus of systematics, obviously is worth doing, but more scientifically important and far more urgent for human welfare is the description and mapping of the world biota." Les Landrum (2001) noted that as important as phylogenetic studies are, "the very tips of the phylogenetic branches are disappearing" and that we must "describe and map the world's living creatures, activities that are the cornerstones of conservation." Floras, faunas, and monographs, what Les called descriptive systematics, accomplish this. Floras provide baseline data — the foundation — for identifying potential threats including discovering new species, unraveling phylogenetic relationships, discerning trends of rare and/or endemic species, and identifying and tracking invasive species, all of which are important in conservation. Descriptive systematics "discovers the pattern in nature," which can help us understand extinct branching events — i.e., it is complementary to phylogenetic systematics (Landrum 2001).

Even in a place as famous as the Grand Canyon (Figure 1), descriptive and phylogenetic systematics contnue to unveil secrets. Sure, the Canyon is known more for jaw-dropping geology/scenery and cute squirrels. But, its green heart is big, being home to more than 1,900 different species of vascular plants. Such diversity is due in large part to the region's complex topography and elevation range of almost 8,000 feet with numerous slope exposures and corresponding varying temperature, moisture

continued page 3

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President's Note

by Douglas Ripley jdougripley@gmail.com

From left: Palmer's Century Plant (*Agave palmeri*) and Soaptree Yucca (*Yucca elata*). *Photo credits: Doug Ripley*

Hello and welcome to the Summer issue of *Plant Press Arizona*. We sincerely hope that you will have a rewarding and enjoyable summer that, with some luck, sees at least a little relief from our ongoing drought in the form of decent monsoon rains. Sadly, the winter and early spring precipitation in most parts of the state has been extremely low, which has translated to a disappointment for native plant lovers hoping for abundant spring wildflower displays. However, even lacking a good spring flora, one can still find native botanical enjoyment in many places. At my home on the western slopes of the Dragoon Mountains in Cochise County, the huge cream-colored inflorescences of the Soaptree Yucca (*Yucca elata*) dot the landscape now and it seems that the magnificent Palmer's Century Plant (*Agave palmeri*) is having a banner flowering year.

Despite the ongoing drought and frequent wildfires, your Arizona Native Plant Society has kept soldiering on with its efforts to address our primary mission of promoting knowledge, appreciation, conservation, and restoration of Arizona native plants and their habitats. Our membership continues to grow at a healthy pace and we recently added a new chapter in the White Mountain region thanks to the efforts of the new chapter's first president Anita Thompson. Additionally, we anticipate that a second new chapter will be formally established soon in the Tonto Basin area with Becky Settije serving as the chapter organizer and first new president.

Most chapters have been able to continue traditional activities such as monthly meetings and field trips. However, in-person meetings continue to be very limited and most meetings are held remotely via Zoom conferencing. The Board of Directors recently agreed to hold the annual botany conference in November as a remote offering. The two previous conferences were held remotely to great success and with a significantly larger audience than in our traditional in-person meetings. We are hopeful that such circumstance will prevail for the 2022 conference. We will be providing information about the conference during the summer and hope that you will be able to participate in it. One tradition that will be returning this year after a two-year absence due to the pandemic is the very popular annual three-day Chiricahua Mountain workshop, which will be held at the Southwestern Research Station in Portal on 17–19 September. Stay tuned this summer for more information on that event.

Keeping everything running smoothly in the Society is only accomplished through the conscientious efforts of many folks whom I would like to recognize. Thanks to the exceptional efforts of our Conservation Committee, led by John Scheuring, and our Website Committee consisting of Diane Kelly, Lyn Loveless, and Pat Sanchez, the Society continues to make great strides in several very important mission areas. The individual State board members, along with the presidents of each of our individual chapters, who also serve on the State board, and their chapter officers, have continued to keep everything on an even keel.

We hope you will enjoy this issue of *Plant Press Arizona*, which does not have a specific theme, but which represents an effort to broaden the scope of articles by discussing some areas of Arizona botany that have not been covered in much detail in recent issues. Hence, we have included several papers focusing on the native plants of northern Arizona, such as the Grand Canyon and the Arizona Strip, as well as an interesting undertaking in the Phoenix area to connect people to plants in urban ecosystems. We also present a very informative discussion of an initiative to provide via the AZNPS website access to distinguished botanist and photographer Sue Rutman's scanned Arizona native plants, which I'm sure many will find as beautiful as they are useful for plant identification. Finally, we provide a summary of the Desert Legume Program which is a major initiative to understand, conserve, and appreciate the Pea Family (Fabaceae).

All best wishes for an enjoyable and rewarding native plant summer!

Grand Canyon —Still Holding Secrets

continued from page 1

regimes, and other climatic factors. It also provides numerous areas of refugia (ex., Pleistocene refugia) and is a meeting place of four major deserts and biomes on the biologically diverse Colorado Plateau. It is characterized by diverse geology and soil/substrate types and a major river that may act as a conduit for plant/gene dispersal, as well as isolating populations. The Grand Canyon has also experienced thousands of years of human occupation.

How do we know of such diversity? One way or another it comes back to herbarium specimens. Studying and documenting plants within the Canyon is no walk in the park due to its sheer size and relative inaccessibility. We are fortunate to refer to and build upon the Canyon collections and studies of previous botanists — at least 46 since the 1880s — nearly half of whom were/are women, including Rose Collom, Elzada Clover (Figure 2), Lois Jotter, Susan McKelvey, and Alice Eastwood. Such collections amassed as evolving, published floras of the region, are important to understanding and conserving the area's resources, including genetic diversity.

But, have we identified all the species within the Canyon region? Factors that contribute towards its diversity, including opportunities for special and temporal isolation, provide the necessary ingredients for speciation, be it a plant, toad, or insect. As scientists continue to document and observe the Canyon's flora, patterns of similarities and differences amongst plant groups emerge. Since 2000, researchers have published five new species found in the Canyon; no doubt more will be discovered. Many are examples of "cryptic taxa" — overlooked plants that may represent a new variety, subspecies, species, or genus.

And, is the Canyon region adequately documented, considering that habitats and their organisms are not static? Being a national park, can we assume its plants and animals are relatively safe when the overarching human-caused climate changes may impact species? At least assessing what was in a particular area at a particular time can help us understand population trends. There is a saying amongst botanists — a flora is never done. But when is it time to quit, hoping the next generation will carry the torch even in an area deemed complete? Here are a few species that I hope help convey the importance of continued documentation.

Hesperoyucca newberryi (Grand Canyon Hesperoyucca)

Hesperoyucca newberryi (Grand Canyon Hesperoyucca) (Figure 3a–b) is one of three species in the genus, the other two being *H. whipplei* (California, Nevada, Baja California) and *H. peninsularis* (Baja California). Until two years ago, *H. newberryi* (named for John Newberry, an American physician/naturalist/geologist), was considered one of 19 species endemic to the Grand Canyon region (Table 1). In 1985, Richard Felger collected a specimen identified as *H. whipplei* from northern Sonora along Highway 2. We revisited the

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Figure 1. The Grand Canyon.

Figure 2. Collection of *Nolina microcarpa* by Elzada Clover.

Grand Canyon —Still Holding Secrets *continued*

population 35 years later and determined it as *H. newberryi*. Can this disjunct population help us understand how the species will do with predicted climate changes (as well as how and when it diverged — another story)? Packrat middens containing leaves of a *Hesperoyucca* dated to 11,000–13,000 B.P. were found along the lower Colorado River corridor (Cole 1986; Van Devender 1987). Habitat and Richard's collection strongly suggest that the leaves belong to *H. newberryi* rather than *H. whipplei*, their populations presumably extirpated with rising temperatures during the Holocene. How the predicted changes in climate during this interglacial period will affect a relatively drought and heat-adapted species and its sole pollinator is unknown.

Cirsium ssp. — The Thistles

When duplicates of the same collection have different names or if a specimen has several annotation labels with different determinations, there is a good chance that the specimen represents an undescribed taxon. Such is the case for tall, mesic-loving Grand Canyon thistles. These plants belong to the large,

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Table 1. Endemic and near endemic plants of the Grand Canyon region (outside and inside the Park) and Grand Canyon National Park, with dates of publication; although not endemic to the Canyon region, *Agave phillipsiana* is included as it was first described from a Canyon population.

Species	Grand Canyon Region	Grand Canyon National Park	Date of Publication
Agave phillipsiana			2001
Agave utahensis kaibabensis	Endemic		1949
Argemone arizonica		Endemic	1958
Astragalus cremnophylax cremnophylax		Endemic	1948
Astragalus cremnophylax hevronii	Endemic		1992
Camissonia confertiflora		Endemic	1962
Camissonia specicola hesperia	Endemic		1962
Camissonia specicola specicola		Endemic	1962
Castilleja kaibabensis	Endemic		1973
Cirsium "Buck Farm, South Canyons"		Endemic	
Cirsium "Cliff Springs"		Endemic	
Cylindropuntia abyssi	Endemic		1943
Encelia resinifera tenuifolia	Endemic		1998
Ericameria arizonica	Endemic		2005
Eriogonum zionis coccinea	Endemic		1943
Euphorbia aaron-rossii	Endemic		1988
Flaveria macdougalii	Endemic		1977
Hesperoyucca newberryi			1934 *
Homalocephala polycephala xeranthemoides			1896 *
Lorandersonia salicina			1935 *
Mentzelia canyonensis	Endemic		2010
Mentzelia hualapaiensis	Endemic		2013
Opuntia basilaris longiareolata	Endemic		1941
Pediocactus bradyi	Endemic		1962
Pediocactus peeblesianus fickeiseniae	Endemic		1961
Phacelia filiformis	Endemic		1911
Rosa stellata abyssa	Endemic		1992
Sclerocactus havasupaiensis	Endemic		1942
Scutellaria potosina kaibabensis	Endemic		2010
Silene rectiramea		Endemic	1899

*near endemic

Figures 3a and 3b. *Hesperoyucca newberryi* (Grand Canyon Hesperoyucca).

Figure 4. New species of *Cirsium* from North Rim overlooking East Clear Creek drainage.

Figures 5a and 5b. New species of *Cirsium* from Buck Farm/South Canyon.

Grand Canyon —Still Holding Secrets *continued*

taxonomically challenging genus *Cirsium*, made up mostly of native thistles that through no fault of their own, bear the brunt of being misunderstood and maligned because of a few introduced species (Ackerfield et al. 2020). Within the Grand Canyon, botanists often identified these seep-loving large-leaved thistles as *C. rydbergii* Petrak. Decades ago, while hiking up Buck Farm and South Canyons I documented a population of this type of thistle. Sensing it was not *C. rydbergii* but a new species, I typed cf. *rydbergii* on the label and hoped someday my gut feeling would be confirmed.

Growing under a mesic alcove on the North Rim overlooking East Clear Creek drainage is another tall thistle that also forms large colonies, determined as *C. rydbergii*. Years later, molecular, morphological, and geographical evidence supported Cliff Springs (Figure 4) *and* Buck Farm/South Canyon thistles (Figures 5a and 5b) as distinct from *C. rydbergii*. And, although the Cliff Springs thistle is related to Buck Farm/South Canyon thistles, its morphology differs markedly, representing two distinct taxa that will be published in the future (Ackerfield, et al. 2020).

Populations on Hualapai Nation in western Grand Canyon resemble huge, cloning *C. virginense* or *C. mohavense* (Figure 6). Glenn Rink and I tried to sort this out, thinking it could represent a new species. Fortunately, graduate student Austin Rosén has taken this on, comparing it to many populations in Utah, Nevada, and California, including Death Valley National Park. The torch continues to be carried.

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Inset: Figure 6. Possible new species of *Cirsium* from Hualapai Nation in Western Grand Canyon. *Photo courtesy Melissa McMaster.*

Figures 7a and 7b. *Opuntia basilaris* var. *longiareolata.*

Grand Canyon —Still Holding Secrets *continued*

Opuntia basilaris var. *longiareolata*

In 1938, the intrepid botanists Elzada Clover and graduate student Lois Jotter became the first women known to *successfully* travel down the Colorado River. During this epic trip they collected many plants, especially cacti. Collecting plants in the Canyon is hard, but collecting cacti is even harder! One of the several cacti they collected and named as new was a little prickly-pear, *Opuntia longiareolata*, later deemed a variety of *O. basilaris* (Figures 7a and 7b). This Grand Canyon endemic occurs mainly from near Lee's Ferry to Fossil Canyon; further downstream it is replaced by the typical variety. Collections made over the past 30 years have helped Lucas Majure and colleagues uncover intriguing evidence (to be published soon) for the importance of Grand Canyon beavertail as it relates to the divergence and distribution of other prickly-pears in general, and beaver tail cacti specifically.

Mentzelia hualapaiensis and *M. canyonensis*

After years of searching for populations, I named and described — with collaborators John Schenk and Larry Hufford — the perennial white-flowered *M. hualapaiensis* and *M. canyonensis* in 2010 and 2013, naming them for the Hualapai Nation and Grand Canyon, respectively. These Canyon region endemics

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Figures 8a and 8b. *Mentzelia hualapaiensis.*

Figures 9a and 9b. *Mentzelia canyonensis.*

Grand Canyon —Still Holding Secrets *continued*

grow in difficult to access areas, often in Muav Limestone and Muav Limestone/Bright Angel Shale interfaces. Their distributions do not overlap; *M. hualapaiensis* grows in the lower half of Grand Canyon (Figures 8a and 8b), while *M. canyonensis* (Figures 9a and 9b) occurs in the upper half. They may be related and have diversified from their most recent common ancestor in the Grand Canyon (Schenk et al. 2013).

Scutellaria potosina var. *kaibabensis*

This blue-flowered perennial is endemic to the eastern edge of the Kaibab Plateau and Nankoweap Canyon, growing in rocky, sandstone washes in pinon-juniper/Gambel oak woodland and ponderosa pine/white fir/Gambel oak woodland (Figures 10a and 10b). I first collected it in 1993 while documenting plants in the Cockscomb area. I had difficulty identifying it and suspected it represented a new taxon; however, I filed it away and proceeded with other projects. Fortunately, graduate student Suzanne Rhodes and mentor Tina Ayers followed the process through, naming it for the Kaibab Plateau.

Agave phillipsiana

In the 1930s, Rose Collom knew that this agave — well known to the early peoples of the Canyon — was different. Sixty-eight years later I named it *Agave phillipsiana,* honoring Arthur Phillips III, another intrepid Canyon botanist who told me of this unusual, large plant (Figure 11a and 11b). Although it has since been found outside the Canyon, its occurrence here was especially significant. It helped prove it was a species domesticated and grown by early peoples as large, long-leaved plants that would not

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Above: Figures 10a and 10b. *Scutellaria potosina* var. *kaibabensis.*

Figure 11a and 11b. *Agave phillipsiana*. Art Phillips III with his namesake.

Grand Canyon —Still Holding Secrets *continued*

have evolved in the Canyon since agaves become shorter and more compact with increasing latitude.

What other species are we overlooking in the field or a herbarium cubbyhole where they wait to be discovered? We need to not only study and understand who begot whom and when, but who is out there, i.e., descriptive systematics, a field that requires more respect, funding, and students.

Resource protection and research requires collaboration among colleagues/scientists, land managers such as Park staff, community scientists, and indigenous communities such as the Hualapai Nation, for whose help we are grateful, in unveiling the Canyon's secrets (Figure 12).

Figure 12. Community scientists Susan and Bill Ahearn carrying a yucca for further study.

References cited

Ackerfield, J., D. Keil, W. Hodgson, M. Simmons, S. Fehlberg, and V. Funk. 2020. Thistle be a mess: Untangling the taxonomy of *Cirsium* (Cardueae: Compositae) in North America. *Journal of Systematics and Evolution* 58(6): 881–912. https://doi.org/10.1111/jse.12692.

Cole, K. 1986. The Lower Colorado River Valley: A Pleistocene desert. *Quaternary Research* 25(3): 392–400. https://doi.org/10.1016/0033-5894(86)90010-4.

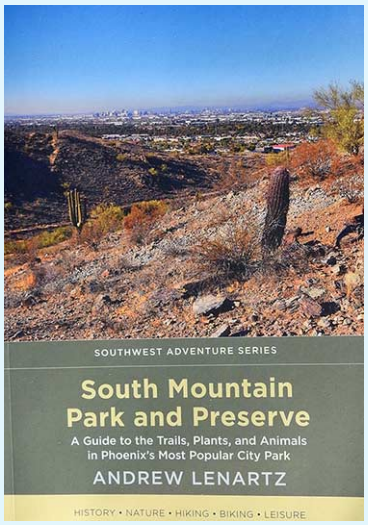
Landrum, L. 2001. What has happened to descriptive systematics? What would make it thrive? *Systematic Botany* 26(2): 438–442.

Schenk, J., W. Hodgson, and L. Hufford. 2010. A new species of *Mentzelia* section Bartonia (Loasaceae) from the Grand Canyon, Arizona. *Brittonia* 62: 1–6. https://doi.org/10.1007/s12228-009-9088-6.

Schenk, J., W. Hodgson, and L. Hufford. 2013. *Mentzelia canyonensis* (Loasaceae), a new species endemic to the Grand Canyon, Arizona, U.S.A. *Brittonia* 65: 408–416.

Van Devender, T. 1987. Holocene vegetation and climate in the Puerto Blanco Mountains, Southwestern Arizona. *Quaternary Research* 27(1): 51–72. https://doi.org/10.1016/0033-5894(87)90049-4.

Wilson, E. O. 2000. On the future of conservation biology. *Conservation Biology* 14(1): 1–3.



BOOK REVIEW *Lisa Rivera, Arizona Native Plant Society, Phoenix Chapter*

South Mountain Park and Preserve: *A Guide to the Trails, Plants, and Animals in Phoenix's Most Popular City Park*

by Andrew Lenartz

2021. 184 pages. ISBN: 978-0-8263-6290-2. $19.95 (paperback). E-ISBN: 978-0-8263-6291-9. $9.99 (e-book). University of New Mexico Press, MSC05 3185, University of New Mexico, Albuquerque, NM 87131-0001. Available at local bookstores and online retailers.

South Mountain Park and Preserve is the largest municipal park in the country and a must-see attraction in Phoenix. With three mountain ranges and 16,000 acres of Sonoran Desert habitat, this gem has views and trails aplenty.

South Mountain Park and Preserve: A Guide to the Trails, Plants, and Animals in Phoenix's Most Popular City Park is part of a Southwest Adventure Series from the University of New Mexico Press. Author Andrew Lenartz lives in the local area, volunteers as a Phoenix Park Steward, and explores the park nearly every day.

The target audience is locals or tourists wishing to become familiar with the park's trails for hiking or mountain biking. The book serves this purpose well, with 76 color photos, 13 maps, and no technical language. It is organized in four sections that provide an introduction to the park, the native wildlife (including the park's unique orange-tailed chuckwallas), and recreational activities.

The most useful feature is narrative descriptions of nearly every trail (the authorized trails, at least). This is especially handy since some trails are not well-marked in the park. The detailed trail descriptions will help you access the trail and stay on the right path.

Through the descriptions you'll also discover the trails that offer the best city views, the most peace and solitude, and shade on a hot summer day. Whether you are seeking an easily accessible, flat trail or a challenging feat with a commanding view, Lenartz provides the answers. Plant lovers should check out the Kiwanis Trail to see a variety of vegetation. Or, if you are new to hiking, start by trying one of the suggested beginner trails.

Anyone who has hiked at South Mountain knows that the biggest challenge occurs before you even step on the trail — finding a parking spot! Luckily, Lenartz provides descriptions of the parking areas and the likelihood of finding an available spot.

The maps in the book are useful for getting the lay of the land, but are very small. To aid in planning your visit and ensuring you follow the correct route, supplement them with a map app on your smartphone or download maps from the City of Phoenix website.

Other features of this book include the history behind names of park trails and features, such as the Holbert Trail and Marcos de Niza Trail. It also gives a good introduction to the Civilian Conservation Corps (CCC) and how it shaped the park into what it still is today. Those inspired by the CCC legacy will be pleased to learn how park visitors can give back by becoming a volunteer Park Steward.

Eight pages of the book are dedicated to plants, including eight natives and two invasive grasses, buffelgrass and fountain grass. The information is basic, so other sources are best if you would like to learn more about the park's flora. One exception is recommended spots to view elephant tree (*Bursera microphylla*), which is uncommon in metro Phoenix.

Although the book was published last year, some information is already out of date. The South Mountain Environmental Education Center (SMEEC) is no longer operated by the Arizona Center for Nature Conservation (i.e. Phoenix Zoo). Also, the author indicates that park hours change often, and some trail names and routes are also changing. Therefore, Lenartz recommends visiting the park website for the most current information.

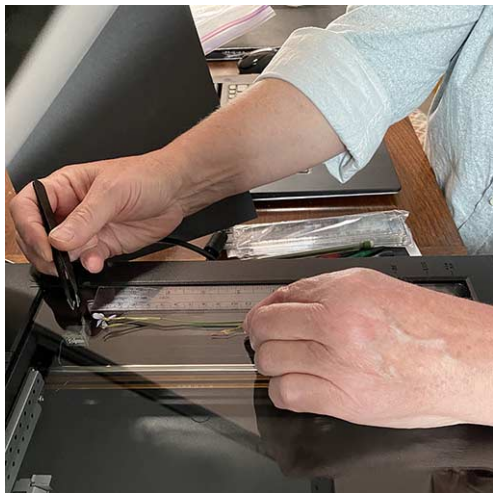
As a small and fairly lightweight guidebook, it is easy to pop it into your backpack before heading out. The tradeoff is very small print, so the e-book version may be a better option if your eyes would benefit from the ability to make the text larger.

Overall, this book provides the basics that everyone visiting South Mountain should know, and also serves as a primer to hiking or mountain biking in the Sonoran Desert. Hopefully it leaves you with a thirst to learn more and further explore the park. For a deeper dive into the history, plants, and animals of the park, see the bibliography at the end of the book for recommended further reading.

Sue Rutman's Scanned Arizona Native Plant Images are Valuable and Beautiful

by Lyn Loveless[1] *Images by Sue Rutman*

Those of us who love the Arizona native flora have received a wonderful gift from Tucson botanist Sue Rutman (Figure 1). Over the past 17 years, Sue has collected and scanned images of hundreds of plant species and compiled those images, along with digital photographs of plant habit, into the plates that make up the "Sue Rutman Plant Identification Guides," now available on the AZNPS website: **https://aznps.com/rutman-image-collection/**. Sue uses a digital scanner to capture detailed images of the close-up structures of fresh plant material (Figure 2). Her scans show not only the colors and forms of each plant in a three-dimensional way, but also reveal amazing detail about the minute features of the plant. The composite images, each one depicting various views of a single species, are a superb resource for plant identification. And beyond that, the scanned images are artistically spectacular, revealing wonderful patterns and shapes that transform even common weedy species into amazing artistic forms (Figures 3, 4, and 5). Sue's efforts have produced a unique online resource for botanists and plant lovers who want to explore and better appreciate the Arizona native flora.



Sue's images have been many years in the making. Seventeen years ago, in a conversation with Elgin artist Matilda Essig, Tilda mentioned that she often scanned plant materials as a starting point in creating botanical illustrations. Soon afterward, Sue's father-in-law in Pennsylvania sent her a scanned image of his garden harvest — a page of perfect pea pods. The unique three-dimensional qualities of the scan intrigued Sue, and she began experimenting with the plants around her, exploring the potential in this new technique (Figure 3).

At the time, Sue was the resident botanist at Organ Pipe Cactus National Monument (a preserve actually named for a native plant species!) and part of Sue's job was to help interpret the plants of the region to visitors. The Monument had a herbarium of pressed plants in glass mounts that guests could leaf through to try to identify plants they had seen. But in 2010, as a renovation of the Visitor Center loomed, it became obvious that these aging glass-bound specimens were not going to be retained. Sue began to think about the potential of the scans she had been making. "Sometimes you get ideas and you don't have a use for them, and then they come back to the surface once you find a use," she said. She approached her supervisor, Mitzi Frank, the Chief of Interpretation, to ask if these scanned images might be a possible replacement. Guests often made use of the herbarium, Sue noted, and there needed to be some alternative for the new Visitor Center. Mitzi agreed. So Sue went into production mode.

The scans she made 12 years ago were, of course, not the same as those of today. Sue has continued to fine-tune her technique to make the photographs more informative, more useful, and aesthetically more pleasing. Her early images used the white scanner lid as a background. The plates contained more explanatory text, and they didn't have a uniform format. But they met the needs of generations of Park visitors. In 2013, Sue moved on, but she took her scanner with her. She retired from the National Park Service and devoted her energy to co-authoring, with Richard Felger and many other collaborators, a flora "Ajo Peak to Tinajas Altas: Flora of Southwestern Arizona." Her scans were used throughout this flora to illustrate the species, and they provide an interesting comparison with the scans she creates today. The SW Arizona flora is available online and for download at the University of Arizona herbarium website: **https://cals.arizona.edu/ herbarium/content/flora-sw-arizona**.

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Insets: Figure 1. Sue Rutman. Figure 2. Sue arranging Dwarf blue-eyed grass (*Sisyrinchium demissum*) on scanner.

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Figure 3. Detail of various floral parts.

Sue Rutman's Scanned Arizona Native Plant Images *continued*

The key to the special immediacy of Sue's scanned images lies in the fact that she uses fresh material for her work. The plants have not been pressed or dried, so they haven't lost their color or been smashed flat. When she is out prospecting for plants, she carries a ready supply of ziploc bags and opportunistically collects what she happens to find. Since fruits and flowers are often not available at the same time, most final plates require at least two trips to a location to collect the appropriate material. One of the most challenging species she's done so far was the Cliff Fendlerbush (*Fendlera rupicola*). Since the seeds take six months to mature she made repeated trips to check on the plant so that she didn't miss collecting the ripe fruit and seeds.

There are now 632 species plates online at the AZNPS website. You can navigate to them under the tabs entitled "The Plants" or "Resources." The launch page also includes a link to detailed instructions in case you want to try the technique for yourself. The plates are organized by family and by genus. The photographs are high-resolution, and viewers can zoom in to see more detail. Images can also be downloaded and enlarged for further study. The collection is especially rich in the Asteraceae (Sunflower Family) and the Poaceae (Grass Family), both plant groups with species that can be difficult to identify. And Sue continues to seek out, scan, and prepare new images as material becomes available. "It's not done," she says of the project. "I'll continue to do this as long as the plates are being used."

Sue is especially enthusiastic about the scanning project because it represents, for her, a serendipitous blend of science and art. "They were so beautiful!" she said, describing her initial reaction to using this technique on live plants. "The details you see are eye-opening. I love looking at plants, and this just blew me away. It was a way to experience plants that I'd never seen before. I really wanted to share it with everybody!"

And she has, indeed, done just that. The Rutman Plant Identification Guides are a wonderful showcase of lovely and compelling images of Arizona native plants that will be of immense value and inspiration to anyone interested in learning more about native plant diversity.

Figure 4. Fragile Grass (*Aegopogon tenellus*).

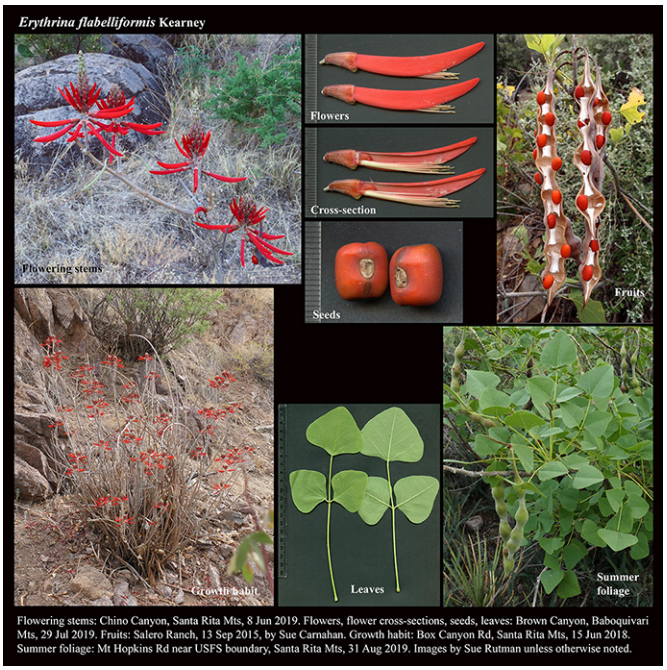
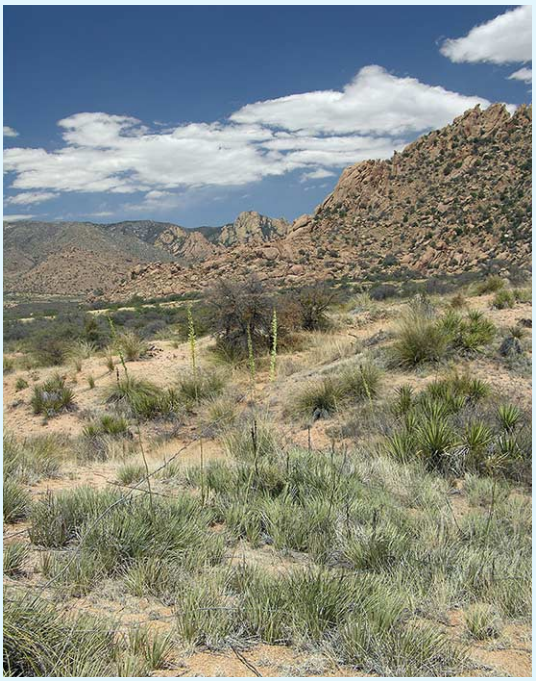


Figure 5. Coral Bean (*Erythrina flabelliformis*).



Figures 1–5, clockwise from top left.

SPOTLIGHT ON A NATIVE PLANT

by Douglas Ripley, Arizona Native Plant Society, Cochise Chapter. Photos by author

Schott's Century Plant, Shindagger (*Agave schottii* Engelm.) Family: Asparagaceae

Schott's Century Plant or Shindagger is a wonderfully interesting and beautiful plant that occurs in southeastern Arizona, extreme southwestern New Mexico, and northern Sonora, Mexico, in rocky grasslands at elevations ranging from 2,000 to 6,500 feet. The plant typically forms dense stemless rosettes that can be solitary or densely clumped (Figures 1 and 2). The firm yellowish green to deep green leaves typically curve toward the apex with brutally sharp spines that attest to the appropriateness of the plant's common name. Besides serving for its own protection, the plant's foliage often provides a safe haven for various cacti such as the Rainbow Hedgehog Cactus (*Echinocereus rigidissimus*) (Figure 3). In June, the Shindagger produces striking flower stalks (Figure 4), ranging in length up to five feet, and bearing beautiful fragrant yellow flowers (Figure 5).

The shindagger was named in 1878 by the German-American botanist George Engelmann for the remarkable Austrian botanist, naturalist, and artist, Heinrich Wilhelm Schott, who first collected the plant in 1855 while serving on the U.S.–Mexican Boundary Survey. The genus *Agave* was described by Linnaeus and is derived from the Greek word for *noble* or *admirable*.

Vascular Plants of the Kaibab Plateau, Arizona

by Glenn Rink[1]

Introduction

The Kaibab Plateau, with its visions of spruce/fir forests, serene meadows, bountiful deer, and bison, stunned me with its beauty during my first visit in 1979, long before I became involved with the plant world. Twenty-six years later, the inspiration to inventory its plants came to me during a trip to climb Steamboat Mountain north of the Powell Plateau.

My impetus was mostly to enjoy exploring this amazing place. But I was also curious about the success of National Park Service (NPS) botanical inventories, which I was involved with during the early 2000s. The goal of the inventories was to account for 90% of the plants present in each NPS unit.

Managers targeted parks thought to be under-explored. Nancy Brian, then botanist at Grand Canyon NP, thought that 90% of the plants that occur at Grand Canyon were already vouchered, so advised project leaders to not focus there. While Grand Canyon NP has been extensively explored for plants along the eastern rims and the Colorado River, it encompasses many hard-to-access areas that have not been explored thoroughly. Was Nancy's assessment accurate? I suspected it would be for an area like the Kaibab Plateau (one third of the Kaibab Plateau is within Grand Canyon National Park), which was well-explored at that time and is readily accessible compared to the inner canyon. But I suspected that Nancy's assessment would not be accurate for poorly explored areas of the western canyon. I surmised that Surprise Canyon would be a good test of this idea, since it encompasses a large elevation range, many springs, and riparian areas. It is the largest western tributary on the north side of Grand Canyon. I felt certain that there would surely be much more unknown diversity in Surprise Canyon than on the Kaibab Plateau.

Research Methods

During 2007 and 2008, I spent eight days in Surprise Canyon making 170 collections but did not complete an inventory there. *Epilobium nevadense* and *Eriogonum pharnaceoides* var. *cervinum* were the only new records for Grand Canyon NP from that effort. Though the Surprise Canyon inventory is incomplete, this work will be a good starting point for the next generation of hardy botanists!

For work on the Kaibab Plateau, I recruited Wendy Hodgson of the Desert Botanical Garden and Barbara Phillips, then of the US Forest Service. We sought help from what was then called the Grand Canyon Field Institute, thinking that class participants could provide help in seeking plant diversity while enjoying rubbing elbows with knowledgeable botanists. We ran these classes for five years and the participants were so enthusiastic that they didn't want to quit after we had visited our target locations on the Grand Canyon NP portion of the Kaibab Plateau. In response to that interest, we continued our surveys north to the National Forest portion of the Kaibab Plateau. I can't mention everyone who helped us out, but have to mention that Bill and Susan Ahearn enthusiastically participated in every trip.

We enjoyed our nearly 2,000 person-hours exploring for diversity, mostly visiting wetlands — 69 natural lakes, 70 springs, many cattle tanks, and 36 natural sinks — collecting over 900 specimens during the years 2007–2015. We concentrated on under-collected families and plant groups not well represented in herbaria, such as the Cyperaceae, Juncaceae, Poaceae, and aquatics. That huge effort was matched by the effort to find and review thousands of herbaria records, both from our local Arizona herbaria as well as from herbaria as far afield as New York.

We learned that the Kaibab Plateau is essentially the southernmost of the Utah plateaus with close floristic affinities to southern Utah and the Rocky Mountains. As such it acts as a "sky island," separated from other high areas by intervening deserts.

Results

Our work produced a list of 792 vouchered taxonomic entities for the Kaibab Plateau. Our herbaria reviews eliminated 230 taxa that had either been published by Phillips et al. (1987) in their *Annotated Checklist of Vascular Plants of Grand Canyon National Park* or were recorded in the SEINet database. Nancy Brian's assessment for how complete the inventory was for the Grand Canyon NP portion of the Kaibab plateau proved to be correct. Just thirteen of our records were new to the Kaibab Plateau portion of Grand Canyon NP and seven were new to the park overall. For the Kaibab Plateau as a whole, we found 73 new records. Since this effort, my review of a voucher from New York added *Penstemon laevis* to this list. Our focus on under-collected groups paid off with five new *Carex* records, nine new Poaceae records, and four new aquatic plant records. You can find the results of this work in Rink, et al. (2020). I have provided here a list of what we found either in the field or in herbarium reviews (and resulting revised identities) that were new to the Kaibab

continued next page

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Vascular Plants of the Kaibab Plateau, Arizona *continued*

Plateau (Table 1). Two new records (*Mentzelia laevicaulis* and *Phacelia alba*) are interesting in that they are native to the southwest but are recent arrivals to the Grand Canyon. They were found at the CC Hill on the North Rim where imported fill for construction purposes most likely was the source of their introduction. Two other records (*Eriogonum hieracifolium* and *Penstemon subglaber*) are also native to the region but not to the Kaibab Plateau, and were almost certainly brought in by automobile traffic along Highway 67. These plants were in low numbers during our survey but may increase and become naturalized. Other interesting new records include *Silene rectiramea* which is a Grand Canyon endemic but not previously found in the vicinity of the Kaibab Plateau. *Botrychium pinnatum* is the only record of the genus on the Kaibab Plateau. *Cryptantha torreyana* is a common *Cryptantha* in the mountainous West but had never been found on the Kaibab Plateau.

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Table 1. New Records for the Kaibab Plateau

Amaranthaceae	*Atriplex patula*	exotic, Allen's Riding Corral
Apiaceae	*Pteryxia petraea*	native, below rim
Apocynaceae	*Asclepias latifolia*	native, below the rim
	Asclepias speciosa	native, pine forest
	Asclepias subverticillata	native, Big Springs Canyon and Pleasant Valley
Aspleniaceae	*Asplenium septentrionale*	native, rock crannies, Robber's Roost and Basin Springs
Asteraceae	*Brickellia eupatorioides* var. *chlorolepis*	native, pine forest
	Chaetopappa ericioides	native, rim margins
	Machaeranthera tanacetifolia	native, disturbed areas
	Thelesperma subnudum	native, east side
	Tripleurospermum inodorum	exotic, margins of water bodies
Boraginaceae	*Cryptantha confertiflora*	native, xeric places
	Cryptantha gracilis	native, Naji Point
	Cryptantha torreyana	native, under rock overhangs at Harvey Meadow
Brassicaceae	*Cardaria draba*	exotic, Castle Springs
	Draba aurea	native, De Motte Park
	Erysimum inconspicuum	native, pine forest
	Thelypodium wrightii	native, Point Sublime
Cactaceae	*Opuntia fragilis*	native, Moquitch Spring
Caprifoliaceae	*Lonicera arizonica*	native, shaded forests
	Valeriana acutiloba	native, Mangum and Greenland Springs
	Silene latifolia subsp. *alba*	native, Joe's Mud Hole, Union Pacific Lodge
	Silene menziesii	native, Swamp Point
	Silene rectiramea	native, steep mesic slopes in canyon
	Silene verecunda	native, hanging garden in Coconino Sandstone about one mile south of Atoko Point
Cyperaceae	*Carex aurea*	native, Cliff Spring, Milk Creek, Big Springs
	Carex curatorum	native, hanging gardens in canyon
	Carex duriuscula	native, pine forests
	Carex obtusata	native, Walla Valley
	Carex wootonii	native, meadows
	Schoenoplectus tabernaemontani	native, Fracas Lake
Cystopteridaceae	*Cystopteris utahensis*	native, Neal Spring
Dryopteridaceae	*Polystichum lonchitis*	native, below east rim
Ericaceae	*Pyrola minor*	native, Milk Spring
Euphorbiaceae	*Chamaesyce serpyllifolia*	native, disturbed areas
Fabaceae	*Astragalus lentiginosus* var. *diphysus*	native, Cliff Spring and La Fevre Ridge

Vascular Plants of the Kaibab Plateau, Arizona *continued*

Conclusion

Documenting previously unknown native plants on the North Rim of Grand Canyon National Park and adjacent parts of the iconic Kaibab Plateau with the assistance of many intrepid botanists, both amateur neophytes and renowned Arizona authorities, has been an incredibly rewarding experience, which I hope has made an important contribution to our understanding of the Arizona native flora.

Literature Cited

Phillips, B.C., A.M. Phillips III, and M.A. Schmidt Bernzott. 1987. Annotated checklist of vascular plants of Grand Canyon National Park. Grand Canyon Natural History Association.

Rink, G.R., W. Hodgson, and B. Phillips. 2020. Checklist of the vascular flora of the Kaibab Plateau, Coconino County, AZ. Monographs of the Western North American Naturalist: Vol. 12, Article 2. Brigham Young University, Provo, Utah. Available at: https://scholarsarchive.byu.edu/mwnan/vol12/iss1/2.

Table 1. New Records for the Kaibab Plateau (continued)

Hydrophyllaceae	*Phacelia alba*	exotic, Bridle Path to North Rim Lodge
Juncaceae	*Juncus bufonius*	native, Outlet Canyon.
Lamiaceae	*Clinopodium vulgare*	native, South Big Springs.
Malvaceae	*Alcea rosea*	exotic, Big Springs
Montiaceae	*Montia chamissoi*	native, Robber's Roost and Milk Springs
Namaceae	*Nama dichotomum*	native, plateau margins
Onagraceae	*Circaea alpina* subsp. *pacifica*	native, mesic shaded rocks.
Ophioglossaceae	*Botrychium pinnatum*	native, forests.
Orchidaceae	*Platanthera sparsiflora*	native, springs and mesic places on the west side
Plantaginaceae	*Penstemon subglaber*	exotic, along Highway 67
	Plantago argyrea	native, Neal Spring
Poaceae	*Achnatherum perplexum*	native, rim
	Achnatherum speciosum	native, rim edges
	Bromus sterilis	exotic, upper Bright Angel Trail
	Hordeum murinum subsp. *glaucum*	exotic, Castle Springs
	Leymus cinereus	native, tank 9022 east of Hwy 67
	Lolium perenne	exotic, Moquitch Tank/Allen's Riding Corral
	Schedonorus arundinaceus	exotic, throughout in disturbed areas
	Schedonorus pratensis	exotic, throughout in disturbed areas
	Torreyochloa pallida var. *pauciflora*	native, South Fork of Upper Big Spring Canyon
Polygonaceae	*Eriogonum heermannii* var. *argense*	native, Naji Point/Dragon Overlook
	Eriogonum heracleoides var. *heracleoides*	exotic, along Highway 67
	Persicaria lapathifolia	native, Warm Springs Lake
	Rumex crispus	exotic, springs and ponds.
Potamogetonaceae	*Potamogeton alpinus*	native, Three Lakes
	Zannichellia palustris	native, North Glenn Lake
Pteridaceae	*Pellaea glabella*	native, meadows
Rosaceae	*Amelanchier alnifolia*	native, mesic areas
	Physocarpus malvaceus	native, east rim edges
	Potentilla biennis	native, Swamp Ridge
	Potentilla pulcherrima	native, Thompson Canyon
	Rubus neomexicanus	native, mesic slopes
Rubiaceae	*Galium mexicanum*	native, Greenland Spring
Salicaceae	*Salix fragilis*	exotic, Big Springs
Scrophulariaceae	*Limosella aquatica*	native, Milk and Robber's Roost Springs
Typhaceae	*Typha latifolia*	native, Frank's Lake

Two Arizona Strip Edaphic Endemics of the Utah Borderlands:
Fredonia cat's-eye (*Cryptantha semiglabra*) (Boraginaceae) and Morton's buckwheat (*Eriogonum mortonianum*) (Polygonaceae)

by Glenn Rink[1] *Images by the author unless otherwise noted*

The Fredonia area of north central Arizona supports two gorgeous, edaphic-endemic, underappreciated plants. Fredonia cat's-eye blooms in the spring (Figures 1–3) and Morton's buckwheat (Figures 5 and 6) blooms in the fall, so if you want to appreciate them in their full glory, you'll need to make two trips. Both primarily occur on Paiute tribal lands, but they also occur within the right-of-way of Highway 389 about 6 miles southwest of Fredonia, where they are readily observable.

Inset: Figure 1. Fredonia cat's-eye (*Cryptantha semiglabra*) (*Oreocarya semiglabra*). *Credit: Wendy McBride, SEINet*

Cryptantha semiglabra

Finding these plants will require a bit of looking around, but it will be well worth the effort to find Fredonia cat's-eye (*Cryptantha semiglabra* Barneby). These herbaceous perennial plants are distinctive and attractive.

Rupert Barneby and Dwight Ripley discovered the species in 1942 on the outskirts of Fredonia, Arizona. Barneby (1943) noted some similarities between the Fredonia plants and two other endemic cat's-eyes of the Colorado Plateau — capitate cryptantha (*C. capitata*) and James cryptantha (*C. pustulosa*) — but believed his collection was distinct enough to be named as a novel species, *C. semiglabra* Barneby (Cronquist et al. 1984).

Fredonia cat's-eye only occurs on gypsiferous shaley substrates of the Moenkopi Formation within 12 km of Fredonia, Arizona, in Coconino and Mohave counties. It grows and flowers in the spring, then dries up and disintegrates, making it almost undetectable from late summer and fall until the following spring. Though Fredonia cat's eye was first described as *C. semiglabra*, later work (Hasenstab-Lehman and Simpson 2012) interprets the perennial *Cryptantha* species as belonging in the genus *Oreocarya*, so this plant is also known as *Oreocarya semiglabra.*

Cryptantha semiglabra was on the original 1978 Smithsonian list of proposed threatened and endangered plants for listing under the Endangered Species Act (ESA) as Threatened (Ayensu and DeFilipps 1978), but was never listed. It is presently on the Bureau of Land Management (BLM) Arizona Sensitive list; BLM Utah does not list it as Sensitive. NatureServe ranks it G1/S1 (critically imperiled globally and in AZ and UT) NatureServe Explorer (2022).

One specimen (*J. W. Harrison sn*, Dixie State University, Saint George, Utah (Acc # 1087)) documents the presence of *C. semiglabra* in Utah, but has never been corroborated by further collections, despite efforts of Utah botanists (Larry Higgins, pers. comm.). The label for this specimen (Figure 4) indicates that the specimen was collected on May 31, 1927 and determined as *C. confertiflora* by A.H. Barnum, herbarium curator at Dixie State University. Larry Higgins, noted *Cryptantha* expert, annotated the specimen to *C. semiglabra* in 1968. J.W. Harrison and his wife were professors at Dixie State University for several years and according to A.H. Barnum, were known for accurate labeling of their specimens. Harrison's label indicates that the

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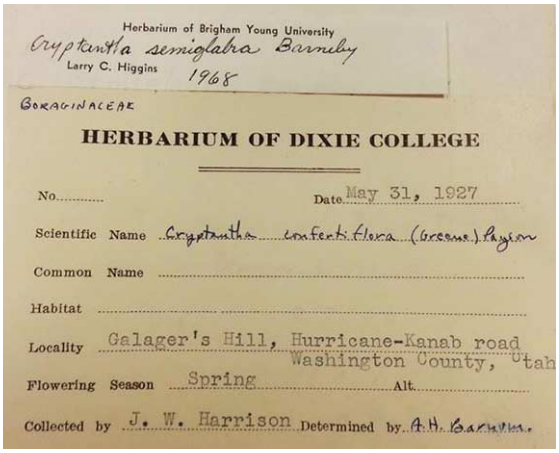
Fredonia cat's-eye (*Cryptantha semiglabra*) (*Oreocarya semiglabra*), from left: Figure 2. Flower. Figure 3. Fruit.

Two Arizona Strip Edaphic Endemics of the Utah Borderlands *continued*

specimen was collected at "Galager's Hill, Hurricane-Kanab road, Washington County, Utah." Much of the Hurricane-Kanab Road passes through Arizona, but the location of Galager's Hill is today a mystery. Hence, this specimen has long been a conundrum in Utah botany. It is accepted as being a part of the Utah flora by Higgins (1972), Cronquist et al. (1984), and Welsh et al. (2003) without these authors knowing whether Galager's Hill is in Arizona or Utah.

With W. Fertig (ASU at the time), G. Clifton (Kingman), and J. Azar (Fredonia), I surveyed on the Arizona Strip during April and May of 2016, hoping to locate previously unknown locations of Fredonia cat's eye. We searched for Fredonia cat's-eye to the south of Fredonia and found three previously undocumented populations. We searched for, but were unable to corroborate, Harrison's 1927 collection from Washington County, Utah. We mapped nearly 5,000 plants within nine populations as GPS waypoints within 7.2 miles of Fredonia, Arizona. We searched on appropriate substrates further afield with negative results. Five of the known populations and over 90% of the plants are on Kaibab/Paiute Tribal lands. Permission is required from the Kaibab Paiute Tribal Council to visit or conduct research on their land. But there are several places to see the plant that are not on Tribal lands. You need to go in the spring when you can see them along Hwy 389, four to eight miles west of Fredonia. Be sure to park safely and remain on the right-of-way. Lands on the other side of the fence are tribal. You can also find these plants on hills within a mile east of Fredonia.


Herbarium of Brigham Young University
Cryptantha semiglabra Barneby
Larry C. Higgins 1968
BORAGINACEAE
HERBARIUM OF DIXIE COLLEGE
No. ..... Date May 31, 1927
Scientific Name Cryptantha confertiflora (Greene) Payson
Common Name .....
Habitat .....
Locality Galager's Hill, Hurricane-Kanab road Washington County, Utah
Flowering Season Spring Alt. .....
Collected by J. W. Harrison Determined by A.H. Barneby.

In 2016, the Arizona Department of Agriculture funded work to document Fredonia cat's-eye through the U.S. Fish and Wildlife Service Cooperative Endangered Species Conservation Fund (Section Six of the Endangered Species Act) Grant Program.

Eriogonum mortonianum

Another beautiful plant endemic to the Fredonia area is Morton wild buckwheat or Fredonia buckwheat (*Eriogonum mortonianum*), a somewhat shrubby perennial (Figures 5 and 6). It occurs in an area of less than 300 acres within Kaibab-Paiute lands along Highway 389, about six miles southwest of Fredonia on arid, red-clay soils and shales of the Moenkopi Formation. This is a plant best observed in the fall when it creates a showy display of yellow flowers. Look for it on clay hills along Hwy 389 about 6 miles west/southwest of Fredonia. Again, be sure to park safely and remain on the right-of-way. Lands on the other side of the fence are Tribal.

During 2015, with Section Six funding from the USFWS in conjunction with the Arizona Department of Agriculture and with Tribal permission, J. Azar and I searched areas that seemed promising for finding unrecorded *E. mortonianum* on Kaibab-Paiute lands and elsewhere in the region, but failed to make any new discoveries. We also placed 12 transects at right angles to the boundaries of three groups of *E. mortonianum* plants on Kaibab Paiute Band

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Inset: Figure 4. Herbarium label for Harrison sn, the only known evidence for the possible occurrence of *C. semiglabra* in Utah.

Two Arizona Strip Edaphic Endemics of the Utah Borderlands *continued*

tribal lands with the hope that future monitoring will be able to document either increase, stability, or decline in these plants.

The presence of this narrow endemic species in this area may be explained by several alternative possibilities described below,

1) The vicariance model suggests that *E. mortonianum*, or the parent of *E. mortonianum* and *E. smithii* (Smith's buckwheat, from south-central Utah), were once more widespread, and that range shrinking has now caused the two taxa to become disjunct (Reveal 1974a & b, 2005, 2012).

2) Another possibility is that *E. mortonianum* is recently evolved, probably of hybrid origin *in situ*, and it is slowly expanding its range (Rink and Fertig 2016).

3) A third possibility is that *E. smithii* dispersed to Arizona from south central Utah, then proliferated. *Eriogonum smithii* and *E. mortonianum* may not be clearly distinguishable entities, with *E. smithii* having only slightly larger involucres and flowers (Reveal 2012).

The variability of this population supports the hybrid model. Future monitoring of these transects will allow us to learn if *E. mortonianum* is expanding or contracting, which will help determine whether conservation measures are needed and will also support one or two of the above hypotheses.

The next time you are traveling along Highway 389 west of Fredonia, make a point of budgeting enough time for a stop to look for these two species. You'll find it well worth the effort to see these beautiful plants that occur in a very restricted range.

Above: Figure 5. Morton buckwheat (*Eriogonum mortonianum*) west of Fredonia. Inset: Figure 6. Close-up of flowers.

Literature Cited

Arizona Game and Fish Department. 2001. *Eriogonum mortonianum.* Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, AZ. 4 pp.

Ayensu, E.S., and R.A. DeFilipps. 1978. Endangered and threatened plants of the United States. Smithsonian Institution Press and World Wildlife Fund, Washington, DC. 403 pp.

Barneby, R.C. 1943. Miscellaneous diagnoses. Leaflets of Western Botany, Vol III, pp 193–208.

BLM Sensitive Species List for Arizona. Accessed online on June 17, 2022. https://www.blm.gov/sites/blm.gov/files/policies/AZ-IM-2017-009-a1.pdf.

BLM Sensitive Plant Species List for Utah. Accessed online on June 17, 2022. https://www.blm.gov/sites/blm.gov/files/Utah%20BLM%20Sensitive%20Plant%20Species%20List.pdf.

Cronquist, A., A.H. Holmgren, N.H. Holmgren, J.L Reveal, and P.K. Holmgren. 1984. Intermountain Flora, Vascular Plants of the Intermountain West, U.S.A., The New York Botanical Garden, Bronx, New York.

Hasenstab-Lehman, K.E., and M.G. Simpson. 2012. Cat's eyes and popcorn flowers: Phylogenetic systematics of the Genus *Cryptantha* s. l. (Boraginaceae). *Systematic Botany* 37(3): 738–757.

Higgins, L.C. 1972. The Boraginaceae of Utah. Brigham Young University Science Bulletin, Biological Series, Volume XVI, Number 3. 83 pp.

NatureServe Explorer. 2022. Accessed on line on May 26, 2022. https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.134692/Cryptantha_semiglabra.

Reveal, J.L. 1974a. Two shrubby novelties in *Eriogonum* (Polygonaceae) from the deserts of Utah and Arizona. *Brittonia* 26: 90–94.

Reveal, J.L. 1974b. Two new varieties of *Eriogonum* (Polygonaceae) from the Intermountain Region. *Great Basin Naturalist* 34(3).

Reveal, J.L. 2005. Polygonaceae. *In:* Flora of North America North of Mexico. Flora of North America Editorial Committee, eds. Oxford University Press USA. Vol. 5, pp. 216–601.

Reveal, J.L. 2012. Polygonaceae. *In:* Intermountain flora, Vascular Plants of the Intermountain West, USA, Volume 2A, New York Botanical Garden Press, Bronx, New York.

Rink, G., and W. Fertig. 2016. Survey for *Eriogonum mortonianum* (Fredonia buckwheat) Polygonaceae, Final Section 6 Report, Reference #: 2014-2016-06, unpublished report for USFWS.

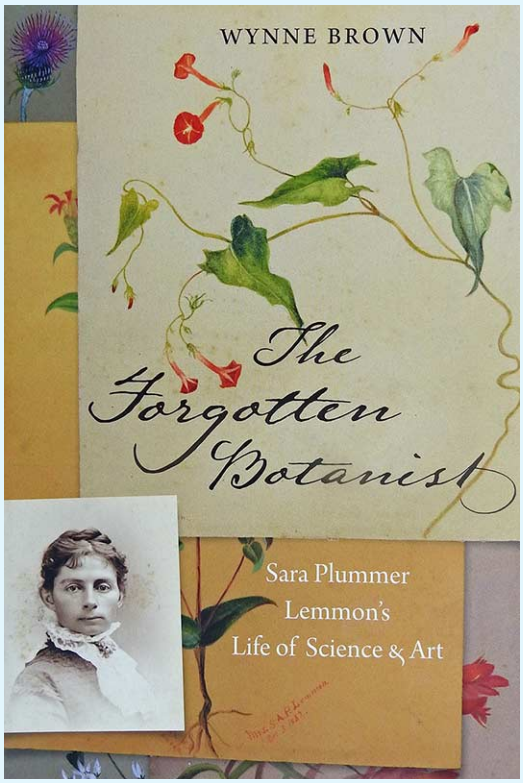
Welsh, S.L., N.D. Atwood, S. Goodrich, and L.C. Higgins. 2003. A Utah Flora. Brigham Young University, Provo, Utah.

BOOK REVIEW *Marcia Lindley, Arizona Native Plant Society, Tucson Chapter.*

The Forgotten Botanist: Sara Plummer Lemmon's Life of Science & Art by Wynne Brown

2021. 308 pages. ISBN: 9781496222817. $27.95 (paperback), University of Nebraska Press, Lincoln, NE 68588. Available at local bookstores and online retailers..

It doesn't take long for someone who moves to Tucson or even visits for a short while to take a drive up Mount Lemmon. Some of those people might inquire about why the mountain is named Lemmon and why the name is spelled with two m's. And a few members of that group might even learn that the mountain was named for a woman. But how many of all those exposed to the name will go further to find out just who Sara Plummer Lemmon was (Figure 1)? That group will be in luck because they can now read *The Forgotten Botanist* and learn Sara's amazing story. And, eventually, Sara will no longer be forgotten. Wynne Brown spent seven years researching and writing this book, and her dedication to share Sara's story shines through every page of her beautifully written book.



Sara Plummer grew up in New England, earned a teaching certificate and degrees in chemistry and physics, and helped nurse soldiers during the Civil War. But many years of severe illnesses led her to leave New York City in 1870 to travel alone by steamer to Panama, across the Isthmus of Panama by land (no canal yet), and again by steamer up the west coast of Central America, Mexico, and much of California to San Francisco in hopes the change in climate would improve her health.

Sara's lack of money and various serious health issues would plague her the rest of her life, but they never kept her from working. Brown skillfully guides her readers through Sara's challenges in life, weaving details from the 1,200 pages of family and professional letters, numerous photographs, and articles Brown photographed at the University of California at Berkeley, not to mention the newspaper articles, field notes, and various other memorabilia she found by and about Sara. Best of all, though, are the photographs of Sara's watercolors of plants, accurately and beautifully painted (Figure 2).

Sara spent a number of years in the then-small town of Santa Barbara where she established a subscription-lending library and sold artists' supplies, stationary, and the like. And she began studying the natural history of the area around Santa Barbara and learning about the local plants, animals, insects, birds, etc. After she helped start a women's natural history association, she published a field guide to the algae in the area. And she learned how to preserve plants, dry them properly, and mount her specimens to keep them safe.

Santa Barbara is also where Sara met the man she would eventually marry, John Gill Lemmon (Figure 3). JG had volunteered to serve in the Civil War, had fought in numerous battles, and had survived terrible hardships in the Confederacy's notorious Andersonville Prison, but his lungs were permanently affected by his wartime experiences. Like Sara, JG suffered from serious health issues throughout his life. And, like Sara, JG had traveled to California in hopes of improving his health. A former teacher and already well-known botanist, he spent several years collecting plants from his first California home in Sierra Valley, sometimes with other well-known botanists who also lived in the state. JG submitted a number of his specimens to Dr. Asa Gray at Harvard University for identification, which resulted in Gray naming a number of newly identified specimens after JG, their first collector.

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From left: Figure 1. Sara Plummer Lemmon. Figure 2. Sara's drawing of the Golden Columbine (*Aquilegia chrysantha*). Figure 3. Sara and JG. *Photos by Wynne Brown. Originals at the UC and Jepson Herbaria Archives, University of California, Berkeley.*

BOOK REVIEW The Forgotten Botanist: Sara Plummer Lemmon's Life of Science & Art *continued*

In telling the story of Sara and JG's budding romance and lengthy courtship, Brown includes historical information about other botanists who traveled to or lived in and collected specimens in California during that same time, noting that Sara had begun corresponding with a number of those botanists and that JG had been on collecting trips with them. This list of botanists included Cyrus Pringle, Charles Parry, George Engelmann, Edward Green, Sereno Watson, and the like. When Sara became one of the first women permitted to join the California Academy of Sciences, she also began to meet and travel with those botanists.

After the Lemmons married, they traveled to many places in the Southwest where they collected plant specimens for numerous herbaria, including one they established themselves when they moved to Oakland. The couple sent many of their specimens to Dr. Gray, who frequently named the previously unidentified ones for their collector. Most of those specimens, however, were labeled J. G. Lemmon and wife; hence, the book's title.

Despite the couple's health and financial challenges, Sara and JG managed to travel, by train or mule or horse or feet, to southern California, to northern Mexico, to what were then the Arizona Territory and the New Mexico Territory, and even to the area around El Paso. In 1881, they spent their delayed honeymoon trip taking the train on the recently built railroad to the small town of Tucson. Sara and JG spent two weeks climbing up various routes on the front side of the tallest mountain in the Santa Catalina Mountains without finding a way to the top. They then descended and went back to a cabin north of Fort Lowell where they had stored some of their supplies. When they tried again, this time with the assistance of a local rancher and his horses, they ascended the back side of the mountain that now bears Sara's name. The rancher suggested it be named Mount Lemmon in honor of Sara, the first white woman to reach its top.

This book is neither a botanical field guide nor a botanical travelogue. Instead, it's a well-told story of the challenges of collecting and identifying plant specimens in rugged deserts, mountains, and sometimes, dangerous areas, at a time when travel itself was difficult and camping did not include the efficient, dedicated, and comfortable equipment and tools available today. This story of an intrepid couple who overcame numerous obstacles to pursue their passion for botany has recently been named one of the Top Picks of the 2022 Southwest Books of the Year and has been awarded the Best Western Biography by the Western Writers of America.

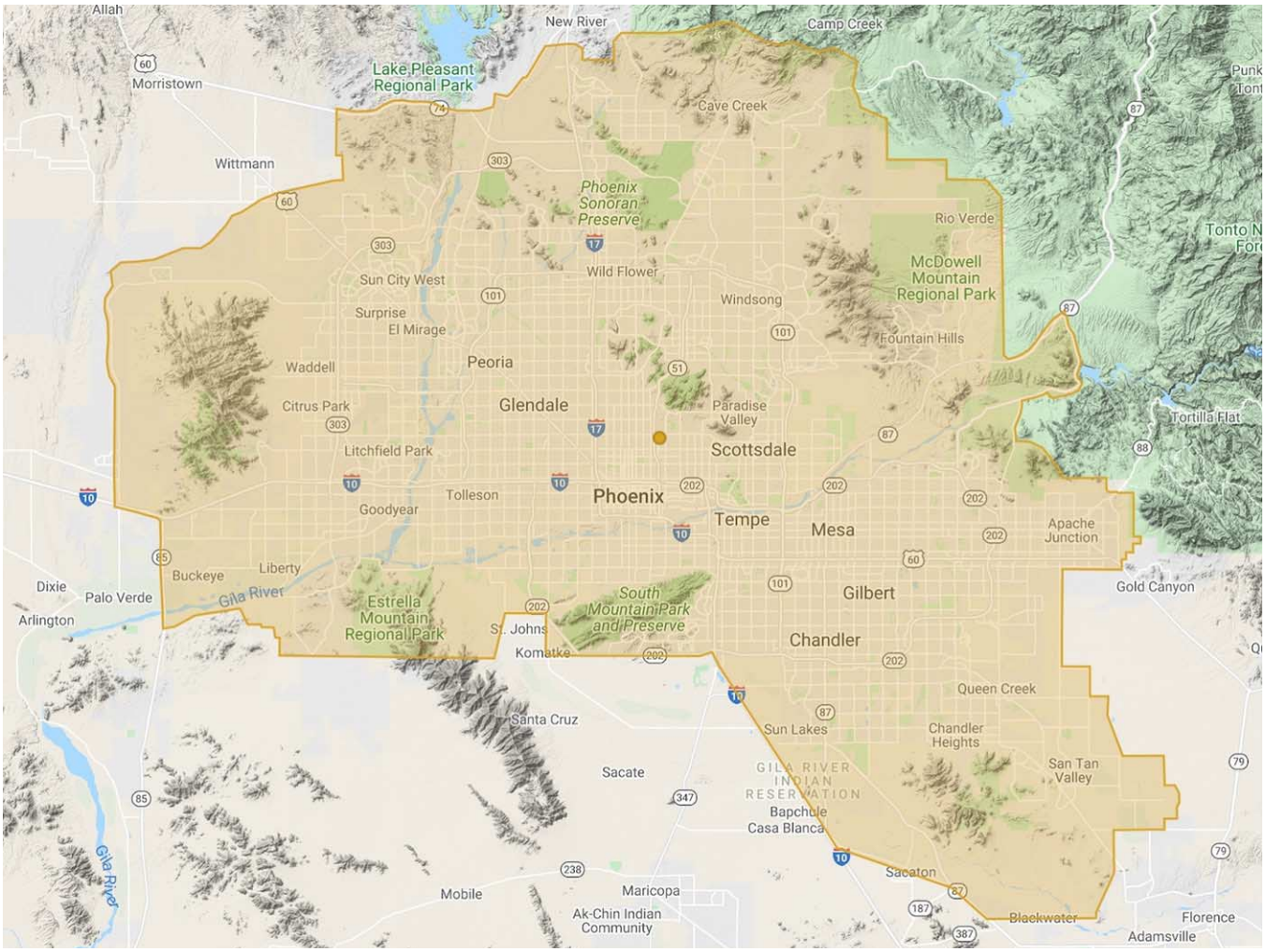

Figure 1: iNaturalist Boundary. Study area boundary for the Metro Phoenix EcoFlora.

EcoFlora: Connecting People to Plants, Plant Science, and Urban Ecosystems

by Jeny Davis[1] Photos courtesy the author.

Over half of the world's population currently lives in urban areas. By 2050, the United Nations (2018) predicts that this will increase to nearly 70% of the population. People have, in general, become less connected to nature and this is especially true for densely populated urban areas that lack ample incorporation of nature or access to green space. What's more, the connection to plant life and plant sciences is even further lacking. People generally have a more difficult time identifying with and recognizing plants in their environment, so much so that it has coined the term "plant invisibility," or "plant blindness." Many people cannot identify five plant species, or tell you what an herbarium is, or what it's used for. In addition to these disconnects, urban ecosystems are understudied, and again, plant life especially so. Urban areas are often dismissed in favor of studying places considered more "wild," and it is more difficult to engage people in supporting plant awareness and conservation efforts compared to public lands or charismatic wildlife.

Ironically, urban areas can be an appreciable resolution to these issues as they are critical intersections between people and nature. People do not need to travel to distant wilderness to learn about or appreciate nature and plant life. Even in dense urban areas that largely consist of a built environment, plants can be found climbing building walls or growing in empty lots and cracks in the sidewalk. And who better to study urban

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EcoFlora: Connecting People to Plants, Plant Science, and Urban Ecosystems *continued*

ecosystems than those living and working in them every day? Engaging the public in the study of urban plant life and ecosystems encourages the appreciation of them and can be a gateway to conservation. If people learn about and care for nature right where they are, it can lead them to care for and advocate for nature at large and in all forms.

The EcoFlora program works to connect people to nature in urban areas and directly involve them in plant science. EcoFlora combines the power of technology with science communication and community engagement to recruit and support members of the public in becoming community scientists, directly involving them in the digital collection of plant life and urban biodiversity data. The EcoFlora program was started in 2016 by New York Botanical Garden (NYBG) and in 2019, the garden received a National Leadership Grant from the Institute of Museum and Library Services (IMLS) to implement the program across the United States. Four partner gardens were chosen to create their own EcoFlora projects, including Chicago Botanic Garden, Denver Botanic Gardens, Desert Botanical Garden (Phoenix, AZ), and Marie Selby Botanical Gardens (Sarasota, FL). In February of 2020, in collaboration with the Desert Botanical Garden (DBG) and the Central Arizona Conservation Alliance (CAZCA), the Metro Phoenix EcoFlora was created for the metro Phoenix area (Figure 1).

A key component of EcoFlora is the use of iNaturalist, a website and mobile device app owned by the California Academy of Sciences and the National Geographic Society. iNaturalist's primary goal is to connect people to nature. Users observe organisms, signs of organisms, or biological interactions, and their observations are recorded and saved with images, date, time, and location coordinates. Each user has a life list of observations and can also collaborate and share the data and information they collect. The greatest draw to iNaturalist is its crowdsourced identification system. By providing a few photos and location information, iNaturalist can accurately suggest which organism a user is seeing, along with information about it. This easily accessible information increases the ability to learn about nature, both nearby and around the world. iNaturalist also features the ability to message other users, comment on other user's observations, and create journal posts, which EcoFlora uses to further engage and communicate with project members. Adding species to their life lists, communicating and interacting with other users, and learning more about nature, not only attracts EcoFlora participants, but keeps users engaged and makes iNaturalist an ideal platform to work with community scientists.

Although iNaturalist's engagement value alone is immense, it is much more than helping people see and learn more about the natural world. iNaturalist's secondary goal is to advance biodiversity science and conservation and it can be used by professional scientists to many ends, such as monitoring species presence and distribution, documenting biological interactions, tracking phenology, and contributing to global biodiversity databases. One of the greatest advantages is the sheer amount of data collected by over 2.5 million iNaturalist users. Although the quality of observations can sometimes be problematic, it is still a valuable resource that provides a vast amount of information that may not otherwise be attainable by professional scientists alone. The Metro Phoenix EcoFlora currently has 455 project members and has made over 60,000 observations of nearly 3,000 species. Of those observations, 39,000 are plants consisting of 1,357 species. The project is responsible for 30% of the iNaturalist observations made in the metro Phoenix area for all time, and 40% of observations since the project's start. There is immense opportunity and power in having innumerable amounts of people on the ground observing nature, nearly at all times.

For EcoFlora, the digital observations made by community scientists can be used to contextualize data, bolster herbarium collections, and contribute to research and conservation efforts.

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Inset: Figure 2. Urban Saguaro. Metro Phoenix EcoFlora is collaborating on the Saguaro Census, which will aid in the study of urban saguaros.

Figure 3: Gander at Grasses. Metro Phoenix EcoFlora hosted an outdoor class in an urban area focused on grasses (*Poaceae* spp.) with botanist Steve Jones.

EcoFlora: Connecting People to Plants, Plant Science, and Urban Ecosystems *continued*

The Metro Phoenix EcoFlora project has created a species checklist in the Southwestern Environmental Information Network (SEINet) that combines species from iNaturalist observations and occurrence records in SEINet. By comparing iNaturalist observations that community scientists have made with occurrence records in SEINet, the project has found nearly 40 plant species (excluding cultivated) that have not been recorded in the metro Phoenix area. Some species are a first for the county and others possibly the state. These species can be collected, vouchered, and added to local herbaria. There are also an estimated 1,000 species (cultivated and non-cultivated) currently under review that have records in SEINet, but have not yet been observed with iNaturalist.

The Metro Phoenix EcoFlora project works with professional scientists and organizations and uses the data and information collected for meaningful and actionable opportunities that people can directly participate in. During the summer of 2020, the metro Phoenix area recorded its hottest, and one of its driest, summers ever. There were numerous reports of saguaro cactus (*Carnegiea gigantea*) losing arms or falling throughout the Valley. The project is working with Dr. Tania Hernandez at Desert Botanical Garden to study what may be happening to saguaros and the effects climate change may have on them. Through the **Saguaro Census**, the public documents saguaro cactus within the metro Phoenix area using iNaturalist (Figure 2). The data collected will provide a baseline of saguaro distribution and size, inform assessments of urban saguaro health, and serve as sampling points for a genetic assessment and long-term tracking. The project has also worked with **Great Milkweed Grow Out** (GMGO) to provide data to help track movements of Western monarchs (*Danaus plexippus*), and has worked with the **Urban Nature Society** to document plants and wildlife living in the alleys of metro Phoenix, providing a glimpse into the biodiversity they hold and how they could be used as habitat corridors. The observational data collected by EcoFlora are open access, allowing for a wide range of use by professionals, organizations, and others.

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EcoFlora: Connecting People to Plants, Plant Science, and Urban Ecosystems *continued*

In addition to engaging participants and sharing data through iNaturalist, EcoFlora provides educational resources and opportunities to learn more about plant life and urban ecosystems, and connect people with professionals in plant science through various materials, communications, collaborations, and hands-on activities. The project has collaborated with over 40 organizations, professional scientists, local experts, and community members and has hosted events, classes, and iNaturalist and SEINet workshops with approximately 500 attendances (Figure 3). Every month, a new EcoQuest is hosted, tasking project participants with finding specific species or biological interactions. **EcoQuestions** sessions are presentations where scientific experts or community leaders share knowledge on a topic related to the EcoQuest and engage in discussion with attendees. This provides a direct link between professionals and community scientists. Communication and interaction are important for engagement, and social media should not be discounted as an important channel for increasing appreciation of plant life and support for plant conservation. The Metro Phoenix EcoFlora project currently has 1,315 combined followers and over 15,000 combined reaches on Instagram, Facebook, and Twitter. The Metro Phoenix EcoFlora newsletter is sent to nearly 2,000 people every month and is used to communicate about EcoQuest species, EcoQuests, and project happenings. These opportunities all translate to real people learning about plants and carrying the knowledge, tools, and skills they gain with them, and connecting them to nature.

Creative and effective methods are needed to communicate with the public, increase awareness of plant life, and boost support for the study of urban ecosystems and plant conservation. EcoFlora and iNaturalist are complementary tools to traditional plant science and are a bridge between plant life, plant science, urban ecosystems, and the public. Professionals that are already limited in time, capacity, and resources can collaborate with community scientists. Connecting people to nature in their own neighborhoods and directly involving them in real-life science projects are critical to garner support for plant science, research, and conservation at large. The EcoFlora program provides a model for collaborating and connecting with the public in urban areas by studying local biodiversity, contributing to existing collections, and supporting sustainability and conservation efforts. The websites indicated below offer detailed information and instructions for joining the Metro Phoenix EcoFlora.

References and Resources

Metro Phoenix EcoFlora **https://dbg.org/partner-initiatives/ecoflora/**

Metro Phoenix EcoFlora on iNaturalist
https://www.inaturalist.org/projects/metro-phoenix-ecoflora

Metro Phoenix Species Checklist
https://swbiodiversity.org/seinet/checklists/checklist.php?clid=24132&emode=0

iNaturalist **https://www.inaturalist.org**

The 2018 Revision of World Urbanization Prospects produced by the Population Division of the UN Department of Economic and Social Affairs (UN DESA).
https://population.un.org/wup/publications/Files/WUP2018-Report.pdf

The Desert Legume Program: A Major Initiative to Understand, Conserve, and Appreciate a Major Plant Family

by Shelley McMahon[1]

Palo verdes, mesquites, acacias, ironwood — low elevations throughout southern Arizona are clothed in arid land legumes. These trees and shrubs from the Pea or Legume Family (Fabaceae), whose resilience in poor soils and low water habitats is renowned, provide shade, habitat, fodder, and local foods such as mesquite flour. These Sonoran Desert denizens are not alone — they have equally resilient relatives in other desert regions throughout the world.

The Desert Legume Program (DELEP) at the University of Arizona has been gathering, growing, documenting, and storing seeds from arid land legumes since 1988. The collection of seeds, a.k.a., seedbank (or more technically, germplasm repository), includes 4,318 accessions from 1,493 species, in 251 genera, from 71 countries. Seeds are cryogenically preserved (less technically: they are frozen!) and made available for worldwide researchers, primarily through a partnership with the USDA Germplasm Repository Information Network (**https://npgsweb.ars-grin.gov/gringlobal/search**). During a typical year, a hundred or more requests are received, each involving seeds from a couple or several hundred samples, depending on the project. Seeds are provided for all researchers (for a small shipping and handling fee), and for other interests as well, in cases where the need is clear and the seeds are abundant.

Ongoing Activities

The DELEP offices and the seedbank are housed in a building near the Campus Agricultural Center in Tucson, near two fields that have been used over the years to grow selected species of shrubs and trees from seed. One goal of the grow-outs is to increase seeds towards the program-wide goal of 10,000 seeds of each species. Seeds are collected by the program's long-time field manager, Ken Coppola. They are then processed for storage by a wonderful crew of volunteers, who have met monthly throughout the history of the program (with a break for the pandemic). Volunteers painstakingly remove seeds from easily cracked pods like Catclaw Acacia (*Senegalia greggii*) or the incredibly durable fruits of the Velvet Mesquite (*Prosopis velutina*). The toughest pods require sharp clippers, strong hands, and much patience; apparently the lively conversation and cookies help.

Another important DELEP goal is to observe the taxa for frost hardiness, drought tolerance, heat tolerance, phenology, non-invasiveness, and for general appeal, especially for the ever-increasing interest in drought-tolerant landscaping plants. Matt Johnson, DELEP's Program Manager, has been with the program since its inception. Matt has gathered these observations from plants grown in four evaluation fields (three in Tucson and one in Yuma) and written many articles, especially for the Boyce Thompson Arboretum's journal Desert Plants — **https://btarboretum.org/desert-plants-journal/**.

Major Projects

We are proud to announce a new website — **https://cals.arizona.edu/desertlegumeprogram/** — sharing detailed information on the seedbank and the living accessions. The site allows the visitor to easily search among our holdings using scientific taxonomic names, and can focus on living accessions and/or seeds. Each species has (or will have) a profile page, which includes a description, horticultural notes from program personnel observations, as

continued next page

[1]Associate Research Professor, School of Plant Sciences; Director, Desert Legume Program; Director, UA Herbarium; UArizona, Tucson, AZ

Inset: DELEP Program Manager, Matt Johnson, in the walk-in freezer holding a jar of Texas mountain laurel, mescalbean (*Dermatophyllum secundiflorum*) seeds. *Photo by Pat Rorabaugh*

Shoestring Acacia (*Acacia stenophylla)* growing in the demonstration garden, Campus Ag Center, UArizona, native to Australia. *Photo by Shelley McMahon*

Smoketree (Psorothamnus spinosus) flowers, growing in the demonstration garden, native to the low desert in Arizona. *Photo by Ken Coppola*

The Desert Legume Program

continued

well as links to the Legume Data Portal, an international clearinghouse for legume taxonomy and synonymy, and to the IUCN Red List assessment. The most complete pages to date are for the living collections in the "Demonstration Garden" are listed on this page: **https://cals.arizona.edu/desertlegumeprogram/content/delep-demonstration-garden**.

We are excited about this new venue for capturing and sharing the wealth of information that Matt, in particular, has accumulated about these seeds, the living plants, and the taxa. Dr. Joey Charboneau, recent graduate of the UArizona Department of Ecology and Evolutionary Biology (EEB), expert on legumes, and funded through a special EEB post-doc program aimed at supporting collections, developed and deployed the site.

The evaluation fields have changed over the years. Yuma was shut down at the end of 2013, and in Spring 2021 we shut down the West Campus Agricultural Center field (in Tucson, near the western terminus of Miracle Mile, along the Rillito River) because the land is no longer owned by UArizona. Thanks to tremendous donor support, we were able to successfully box and transplant seven mature trees to our field near Campbell Avenue. Five of these trees are important specimens adding diversity to the field, and two are healthy ironwoods we could not bear to see destroyed. One year later, all transplants are doing very well; one has now flowered and set fruit for the first time! The Campus Arboretum, under the leadership of Dr. Tanya Quist, was also able to rescue eight trees, which are thriving in a dedicated space on campus.

The two remaining fields are both at the Campus Agricultural Center on North Campbell Avenue in Tucson. They hold hidden gems, including taxa that are growing nowhere else in North America, to our knowledge, as well as a State Champion *Eysenhardtia orthocarpa* (Desert Kidneywood). To celebrate and educate visitors about our trees and shrubs, we are enhancing one of the fields to become a welcoming space. In support of this project, we received a small grant from the Stanley Smith Horticultural Trust. Ken has spent the winter and spring trimming and clearing the field, to enhance its appeal and accessibility. The main goals of the fields — seed increase and stress tolerance — did not automatically include having them look nice! Over the next several months we will be adding botanical signs that will include QR codes, linking back to the

continued next page

The Desert Legume Program

continued

appropriate pages on our new website. This stage of the project will include augmenting the irrigation system. Once they are ready, we will also plant out a few new saplings that have been in volunteer "foster homes." A larger interpretive sign at the entrance will inform visitors about the program, as well as the importance of arid land plants in horticulture and in other key areas of research in a changing world.

In another project, we are publishing a book. We are excited to be working with the press at the Botanical Research Institute of Texas and are in the final stages of preparing *The Legumes of Arizona: An Illustrated Flora and Reference.* Here, for the first time, we combine taxonomic treatments for each of our 289 native species (354 total native taxa, including varieties and subspecies, in 59 genera) with information on 95 commonly cultivated legumes in our state, horticultural notes on many native species, original illustrations for each genus, color photos for several species, plus introductory material setting the context for legumes in the state of Arizona. Our aim is for it to be accessible and informative, for a broad audience of Arizona residents and visitors who encounter legumes in various contexts. The project has involved contributions from 45 taxonomic and content experts, 29 illustrators, a copy editor, a map maker, four photographers and five editors. We are all thrilled that it is nearing completion and will soon be available for purchase.

Contact Us

If you have questions about opportunities to support our mission through volunteering or through financial support, or other questions about arid land legumes, we'd love to hear from you! Here are some ways to get in touch: email delep@cals.arizona.edu; DELEP main offices phone 520.647.2460; visit 2120 E. Allen, Tucson, AZ 85719; or our website, **cals.arizona.edu/desertlegumeprogram**.

From top, *all photos by Shelly McMahon:*

Screwbean Mesquite (*Prosopis pubescens*) pods, awaiting processing to retrieve the seeds not consumed by bruchid beetles (note the several holes).

Chliean mesquite *(Geoffroea decorticans)* (red seeds) and Ibirá-berá (*Libidibia paraguariensis)* (brown pods).

Rosary Baby-Bonnets (*Coursetia glandulosa*) a papilionoid legume (subfamily Papilionoideae) native to upland desert regions of Arizona.

Featherplume *(Dalea formosa*) a papilionoid legume (subfamily Papilionoideae) and mid-elevation Arizona native, demonstrating post-pollination color change of the upper (banner) petal.

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For more information, please drop us a line, visit **www.aznativeplantsociety.org**, or get in touch with one of the chapter contacts below:

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