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Figure 1. Alfred F. Whiting and Vivian Tiwanginoma. Taken at Mishongovi in the late 1930s on one of Whiting's numerous trips to the Hopi villages to visit friends and collect ethnobotanical and other ethnographic information. *MNA Photo Archives E-104D(1938).27*

Buried Treasures: Interesting Finds from the Museum of Northern Arizona Herbarium Backlog

by Kirstin Olmon Phillips[1]

In October 2016, the Museum of Northern Arizona (MNA) received a Museums for America grant from the Institute of Museum and Library Services (IMLS) to process and catalog backlogged botany specimens.

The backlog consisted of specimens that had accumulated in the botany processing lab and were not yet ready to be included in the herbarium. Many of these specimens were from MNA projects where the researchers ran out of time before the specimens could be processed—some collected as early as the 1920s.

This article describes some of the interesting ethnobotanical finds from this backlog that have now been completely processed and cataloged.

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President's Note

by Douglas Ripley jdougripley@gmail.com

Welcome to the 2021 Spring/Fall issue of *Plant Press Arizona*, the semi-annual journal of the Arizona Native Plant Society. Astute readers will notice that our journal has a slightly modified new name and redesigned masthead! These changes were made largely though my instigation but with input from our membership and with the concurrence of the Board of Directors. The March–May 2021 edition of our *Happenings* newsletter contained the background on the rational for requesting a name change and solicited comments from our members for the change. My principal complaint about the old title was that it contained nothing that identified it with Arizona. I had thought that naming the journal after an iconic Arizona native plant, such as the Saguaro (*Carnegiea*), would be especially appropriate. Unfortunately the name *Carnegiea* was not available as it had recently been taken for use by a literary journal. So after some discussion the Board decided to use the name *Plant Press Arizona* which would not be too drastic of a change. Therefore, that is the new name of our journal, starting with this issue. With the new title, our graphic designer Julie St. John prepared a new masthead containing an artistic rendering of an Arizona native plant that will be changed with each issue.

Since the publication of the Fall 2020 issue of our journal, the COVID-19 situation has dramatically improved, thanks mainly to the miraculous development of several COVID-19 vaccines in unprecedented time. If things continue to improve, we may see a return to normalcy or close to it by the end of the year.

Throughout the COVID-19 pandemic, I believe that the Arizona Native Plant Society has done an excellent job of keeping things going. Last October we successfully held our annual Botany Symposium remotely and every chapter has been able to hold monthly chapter meetings remotely via Zoom conferencing as well. Kara Barron, the president of the Upper Gila Chapter, was even able to conduct a Budding Botanist training class during three evenings in February. Kara was assisted by eight AZ Native Plant Society members and 45 students attended the training! Unfortunately however, everything has not totally returned to pre-pandemic conditions. For example, the Board of Directors decided that it would still be too difficult to hold our annual Botany 2021 conference in person. Consequently we will hold it as we did last year, remotely via Zoom conferencing, on the evenings of 27–29 September 2021. A conference planning committee has been established which will soon start working on addressing the many conference details (selecting a theme, lining up speakers, organizing activities, etc.). Unfortunately, one very enjoyable tradition, the Society-sponsored weekend workshop to the Chiricahua Mountains, will have to again be cancelled as it was last year. Our host venue for the workshop, the Southwestern Research Station, simply is not yet geared up to welcome guest groups until next year.

Inset: Arizona Queen of the Night or Night-blooming Cereus (*Peniocereus greggii*). Huachuca City, Cochise County, May 14, 2021. *Photo courtesy Doug Ripley*

One very negative circumstance impacting native plant lovers, which has yet to improve, is the on-going severe drought throughout much of Western North America. One can only hope that we do not have a repeat of last summer when the traditional monsoon season was nearly nonexistent. But even in these exceptionally dry conditions, one can still occasionally enjoy encountering some wonderful Arizona native plants such as a spectacular display of the Arizona Queen of the Night or Night-blooming Cereus (*Peniocereus greggii*) growing in an obscure area in Huachuca City, Cochise County, to which I was recently alerted by AZNPS member Marvin Hershberger.

During these dry times, hopefully this issue of *Plant Press Arizona* will at least provide you with some interesting information about our native plants which you may not be able to observe very well in the field. This issue does not have a particular theme. Rather, it contains a variety of articles about various aspects of native plants throughout our region, including Sonora, Mexico.

In conclusion, I'm happy to report that thanks to members such as you, the Arizona Native Plant Society continues to move forward, effectively meeting our mission of fostering the appreciation and protection of Arizona's native flora.

Figure 2 (left). Alfred F. Whiting holding a Devil's Claw plant (*Proboscidea parviflora*, Martyniaceae), a species for which he helped discover the two distinct varieties (Nabhan *et al*. 1981). *Photo Archives MS-003 Alfred Whiting Collection.*

Figure 3 (above). An example of some of the preserved corn specimens in the MNA Collection that Whiting collected in the 1930s from the Hopi Reservation. *Photo courtesy Kirstin Phillips.*

Buried Treasures: Interesting Finds from the Museum of Northern Arizona Herbarium Backlog *continued from page 1*

Alfred F. Whiting Ethnobotanical Collection

Alfred F. Whiting was appointed curator of Botany at MNA in 1935. From 1935 to 1937, he and Dr. Volney H. Jones, from the University of Michigan Ethnobotanical Laboratory, began a survey of Hopi crop plants. Whiting worked with MNA Hopi interpreter Edmund Nequatewa to record the Hopi names and uses of the Hopi cultivated and wild plants. Whiting published *Ethnobotany of the Hopi* as Museum of Northern Arizona Bulletin 15 in 1939. MNA has a marvelous collection of preserved crop plants from this project.

Whiting began his PhD dissertation on the ethnobiology of the Havasupai in 1937, which he ultimately never completed. Apparently, he couldn't be bothered to finish his manuscripts to the editors' satisfaction. According to a biography of Whiting written by MNA archivist Katharine Bartlett,

> "Al Whiting had a brilliant, active and creative mind, always far ahead of his manual dexterity. When some exhaustive investigation was written to his satisfaction, his agile mind leaped ahead to the next project. He simply could not endure the tedium of writing and rewriting a text to suit an editor and so most of his major research never appeared in print. His manuscript on the ethnobiology of the Havasupai Indians has been inspected by a number of editors but all have given up in despair upon viewing the "completed" work" (Bartlett 1981).

Some of Whiting's unidentified plants — from the Grand Canyon region and Havasupai Indian Reservation from 1940 and 1941 — were in the MNA botany backlog. The specimens were cataloged, but never identified, databased, or added to the herbarium. Included with the specimens were preliminary herbarium sheet labels. I decided to check MNA's Archives to see if we had copies of Whiting's field notes for these collections. I found them! In with his Havasupai ethnobiology manuscript draft in the Archives, were notes from his plant collecting trips with five Havasupai, Hopi, and Navajo native interpreters. In his notes, each plant collection includes the name of the interpreter, how the plant was used, and the native plant name. The catalog numbers were written in the margins or typed into the text, so I was able to directly correlate the ethnobotanical use of the plant with the specimen collected at that time. Many of Whiting's collections are already processed and in the herbarium, but lack information on their ethnobotanical use. I am currently working with volunteers to transcribe his notes so that we can

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Figure 4. Benjamin Wade Wetherill. *MNA Photo Archives MS-122 Rainbow Bridge-Monument Valley Expedition Collection.*

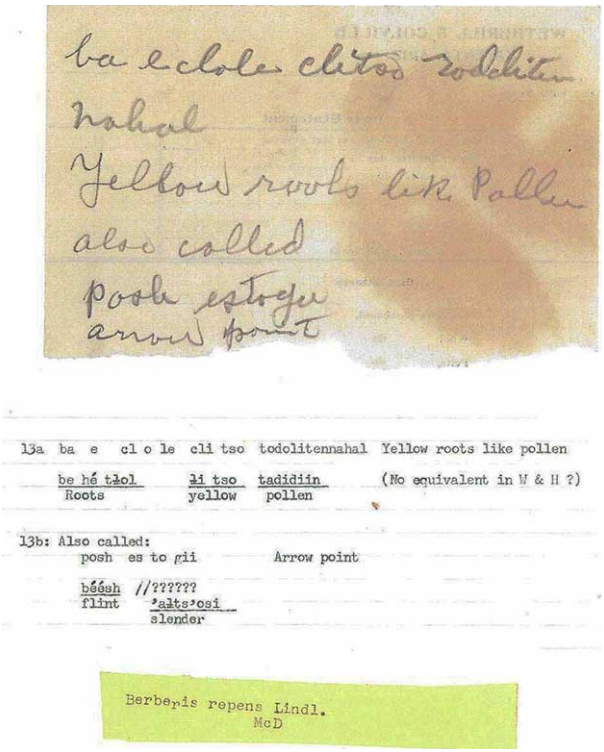

Figure 5. An example of Ben Wetherill's handwritten notes in phonetic Navajo with the English translation (top). Alfred Whiting's interpretation of Wetherill's notes and an annotation label from Dr. Walter McDougall identifying the plant (below). *Photo courtesy Kirstin Phillips.*

Buried Treasures: Interesting Finds from the Museum of Northern Arizona Herbarium Backlog *continued*

add labels to the plant specimens that include the ethnobotanical use by a native interpreter. This significantly increases the value of the collections and provides rare ethnobotanical collections that we are able to share with others (Figures 1–3).

Ben Wetherill Ethnobotanical Collection

The oldest specimens found in the backlog were collected by Benjamin Wade Wetherill, son of famed traders Louisa and John Wetherill. Ben collected approximately 250 plant specimens in the early 1920s from the Navajo Nation and recorded their Navajo names before written Navajo was standardized. Ben wrote the names phonetically on the back of Wetherill & Colville Trading Post ledger paper. Some of the specimens also include the plant's medicinal, culinary, or ceremonial use. Ben's father, John Wetherill, is well known as an amateur archeologist who, with his brothers, were the first Euro-American people to discover the ruins at Navajo National Monument, Chaco Canyon, Mesa Verde National Park, and Rainbow Bridge National Monument (Wetherill Family 2020).

Some of Ben's plant specimens were sent to Per Axel Rydberg, New York Botanical Garden curator, for identification in 1923. Rydberg was considered an expert of plants from the west and had conducted a floristic study of the Rocky Mountain region (Rydberg 1917). He had recently described several new species including ones found in this collection: *Amsonia eastwoodiae* Rydb., *Xylorhiza lanceolata* Rydb., *Gilia spergulifolia* Rydb., *Lathyrus leucanthus* Rydb., *Pachylophus marginatus* Rydb., *Odostemon aquifolium* (Pursh) Rydb., and *Anogra leptophylla* Rydb.

The collection was donated to MNA in 1932 (MNA Accession # 4487) by Milton A. Wetherill, Ben's cousin and MNA's curator of Mammalogy. Alfred F. Whiting organized the collection in 1976 with MNA's Curator of Botany at the time, Dr. Walter B. McDougall, and attempted to transcribe Ben Wetherill's handwritten notes and phonetic spelling. I identified the plants that were not already identified and did my best to interpret Ben's notes. I made herbarium sheet labels with what I believe to be the current spellings of the Navajo names. Nearly 100

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John Scheuring Recognized with BLM Stewardship Award

The Bureau of Land Management (Interior Region 8) recently awarded its Tucson Field Office Manager's Recognition Award for Stewardship to John Scheuring, the Arizona Native Plant Society's indefatigable Conservation Committee Chairman. The purpose of the Stewardship Award is to recognize employees, interns, partners, and volunteers whose actions promote health, diversity and productivity of lands and resources for present and future generations.

The award citation states that the BLM is happy to recognize and thank John and the other Arizona Native Plant Society volunteers for their outstanding work on the Ironwood Forest National Monument, including the restoration of the airstrip in the Waterman Mountains and buffelgrass treatments on the Waterman Mountains, Ragged Top, Wolcott Peak, and the surrounding area. Your tremendous efforts have made a big difference and greatly improved public lands. We are grateful for your determination, even during a pandemic, as you continue your work with a small group of volunteers and BLM employees while following COVID-19 safety protocols.

This award is a well-deserved recognition of the tireless efforts John has made for many years on a remarkable range of conservation efforts in many parts of Arizona.

Buried Treasures: Interesting Finds from the Museum of Northern Arizona Herbarium Backlog *continued*

years after the plants were collected, they have now been added to the McDougall Herbarium. MNA has a similar collection by Louisa Wetherill on permanent loan from the Arizona State Museum (MNA Accession # IL1962-1). The Ben Wetherill collection is a nice complement to the Louisa Wetherill collection (Figures 4, 5).

Conclusion

In addition to the ethnobotanical collections found in the backlog, specimens representing several other categories of plants were found. Those included recently described species, new county records, 50 rare plant species, plants with interesting distributions, and plants that were new to the herbarium collection. I hope to be able to report on those finding in a future issue of *Plant Press Arizona.*

Acknowledgements

This project was funded by the Institute of Museum and Library Services. Many thanks go to my three summer interns, Annie Ayers, Anne-Marie Coble, and Holly Giorgio-Dundon. I also thank the many volunteers who helped with this project.

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Figure 1. Some of the plants added to the MCC Red Mountain campus garden (pictured: *Muhlenbergia rigens* and *Aristida purpurea*).

The Maricopa Native Seed Library: *Inspiring and Equipping the Community to Create Habitat at Home*

by Danielle Carlock[1] *Photos courtesy the author.*

Introduction

"For the first time in its history, gardening has taken on a role that transcends the needs of the gardener. Like it or not, gardeners have become important players in the management of our nation's wildlife" (Tallamy 2019). This change has been prompted by the expansion of urban areas and accompanying habitat loss, as well as threats to wildlands including fire, invasive species, and climate change (Tallamy 2009).

There is a dearth of native seed and plant sources in Maricopa County, so consequently many residential landscapes do not support wildlife. Instead home landscapes tend to have low species diversity, and the plants that are there are often non-native or do not have high wildlife value. Very few home landscapes are intentionally built to support and attract wildlife through careful selection of high value native plants and other techniques such as minimizing fertilizers and pesticides.

The Maricopa Native Seed Library was founded in August 2020 to help the community make the paradigm shift to more intentional gardening for wildlife through education and by increasing the availability of native seed. As opposed to seed banks that store seed for posterity, seed libraries give away seed. They are typically associated with brick and mortar libraries and often ask patrons to return seeds that they grow out. Beyond that, the seed is free, usually with a monthly limit to make sure there is enough seed for everyone.

The Maricopa Native Seed Library is unique among seed libraries because it focuses on native "ornamentals" as opposed to food plants such as tomatoes and lettuce. Specifically, the seed library was founded to help support pollinators in the landscape and has intentionally offered high value native nectar and butterfly/moth larval host plants, especially those that are not commercially available in the local area. Plants include native shrubs, trees, vines, grasses, perennials, and annuals.

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The Maricopa Native Seed Library *continued*

The overall goal of the seed library is to inspire and equip the community to create a "living landscape" at home that provides high quality habitat for people, plants and the wildlife that depends on them. Together, these individual home landscapes can, over time, combine to create a new "national park at home" along the lines of Douglas Tallamy's vision outlined in *Nature's Best Hope* (2019). By doing so, not only can the public enjoy less landscape maintenance and lower water bills, but also reap the health benefits of a living landscape that supports wildlife in a meaningful way.

Implementation

By design, the seed library was to follow a distributed model in order to reach as many people as possible across Maricopa County. The COVID-19 pandemic made this much more difficult, but as of this writing the seed library is currently physically available at three locations: the Fannin Library at Phoenix College, the Gateway Community College Library, and the Red Mountain Library at Mesa Community College (MCC). In addition, we temporarily implemented a mail order service to reach people more broadly during the pandemic, and tabled at farmers markets, giving out free seed and native plant information.

While most seed libraries obtain seed through donations from seed companies, seed for the Maricopa Native Seed Library is collected by Danielle Carlock, author and founder of the seed library, a library faculty member at Scottsdale Community College (SCC). Seed collecting takes place at the Tonto National Forest (under permit) as well as at the SCC campus and the author's home garden. There are about 50 native species currently in the seed library, with more species to be added. We also offer a small amount of food plants seeds that we have obtained by donation.

The website <**https://libguides.maricopa.edu/seed**> contains plant profiles for each of the native species in the seed library. Each profile includes information about germination, growing requirements, and specific wildlife values (eg. nectar plant). The seed library has offered several free workshops including "Introduction to Native Plant Gardening in Central Arizona," "Pollinator Gardening in the Low Desert of Central

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Figure 2. The stunning cienega at the Red Mountain campus of MCC, where seed library plants with ethnobotanical uses have been added to serve as a demonstration garden for the seed library.

The Maricopa Native Seed Library *continued*

Arizona," and "Starting from Seed: Growing Native Plants in the Low Desert." The website includes recordings of the workshops as well as other information about native plant gardening.

In order to bring the plants to life, the seed library is developing demonstration gardens at SCC and the Red Mountain campus of MCC. The intention of the gardens is for the public to be able to view the plants up close and then go into the seed library to make selections as well as to serve as a future seed source. The SCC demonstration garden builds upon work done by the Center for Native and Urban Wildlife (CNUW) to create wildlife friendly garden spaces on campus. Additionally, collaborating with faculty at MCC Red Mountain campus on an AZ Lottery Gives Back grant, the author created a 30-plant ethnobotanical garden that builds on the existing gardens already in place, especially the cienega habitat. A field guide to each garden is forthcoming.

Accomplishments to Date

In the fall semester of 2020 we gave out 1,061 seed packets and are on track to do much more this spring semester with over 1,700 packets given out as of early April 2021. Some of the most popular plants have been easy to grow and more well-known species such as *Penstemon parryi, Asclepias subulata,* and *Gaillardia aristata.* However, we have been surprised and pleased that many lesser-known species have been taken quickly, including *Acourtia wrightii, Cirsium neomexicanum, Oenothera elata hookeri, Erigeron divergens, Chilopsis linearis arcuata, Rhus ovata,* and *Maurandya antirrhiniflora.* Indeed, our supplies of some of these species were limited and we could not meet demand.

We have produced a series of plant palettes for Maricopa County and surrounding areas to assist local gardeners who want to support more pollinators in their landscapes. Palettes focus on high value native nectar and larval host plants and are available on our website.

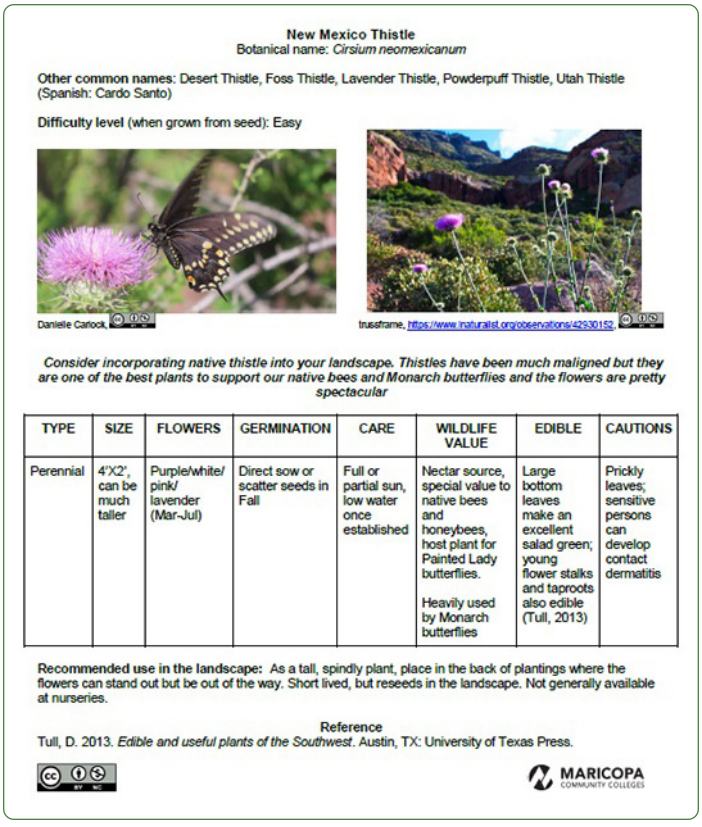
In addition to our workshops, we have been asked to present to several organizations, including the Audubon Society, the Arizona Municipal Water Users Association, and the Central Arizona Butterfly Association. We have also conducted workshops at the Seed Library Summit and with the American Library Association Sustainability Roundtable about how to set up a native seed library.

From July 2020 to April 2021, in collaboration with the Phoenix Chapter of the Arizona Native Plant Society, we distributed seed balls to Society members and supporters and collected data on germination. While the lack of both monsoon and winter rains impacted germination negatively, we did have some plant establishment and have learned that in the future seed balls with less clay may be better suited to our changing climate.

Overall the seed library has been well received by the public, the media, and non-profit conservation organizations. It is becoming clear that we have identified an unmet need in the community.

Future Goals and Next Steps

While the sabbatical which launched the seed library ended in May 2021, plans are in the works to keep the Maricopa Seed Library going. We have been awarded a Maricopa Center for Learning and Innovation Horizon Grant to fund student interns, who will learn about the importance of native plants, how to identify them, how to ethically collect and process native seed, and how to germinate/propagate native plants. Interns will work under the direction of MCC Geosciences and Sustainability faculty Dr. Niccole Cerveny and Phoenix College biosciences faculty Dr. Elena Ortiz. Their work will form the backbone to supply the Maricopa Native Seed



New Mexico Thistle
Botanical name: *Cirsium neomexicanum*

Other common names: Desert Thistle, Foss Thistle, Lavender Thistle, Powderpuff Thistle, Utah Thistle (Spanish: Cardo Santo)

Difficulty level (when grown from seed): Easy

Danielle Carlock, CC BY NC

trussframe, https://www.inaturalist.org/observations/42930152, CC BY NC

Consider incorporating native thistle into your landscape. Thistles have been much maligned but they are one of the best plants to support our native bees and Monarch butterflies and the flowers are pretty spectacular

TYPE	SIZE	FLOWERS	GERMINATION	CARE	WILDLIFE VALUE	EDIBLE	CAUTIONS
Perennial	4'X2', can be much taller	Purple/white/ pink/ lavender (Mar-Jul)	Direct sow or scatter seeds in Fall	Full or partial sun, low water once established	Nectar source, special value to native bees and honeybees, host plant for Painted Lady butterflies. Heavily used by Monarch butterflies	Large bottom leaves make an excellent salad green; young flower stalks and taproots also edible (Tull, 2013)	Prickly leaves; sensitive persons can develop contact dermatitis

Recommended use in the landscape: As a tall, spindly plant, place in the back of plantings where the flowers can stand out but be out of the way. Short lived, but reseeds in the landscape. Not generally available at nurseries.

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MARICOPA COMMUNITY COLLEGES

Figure 3. A plant profile from the seed library's website.

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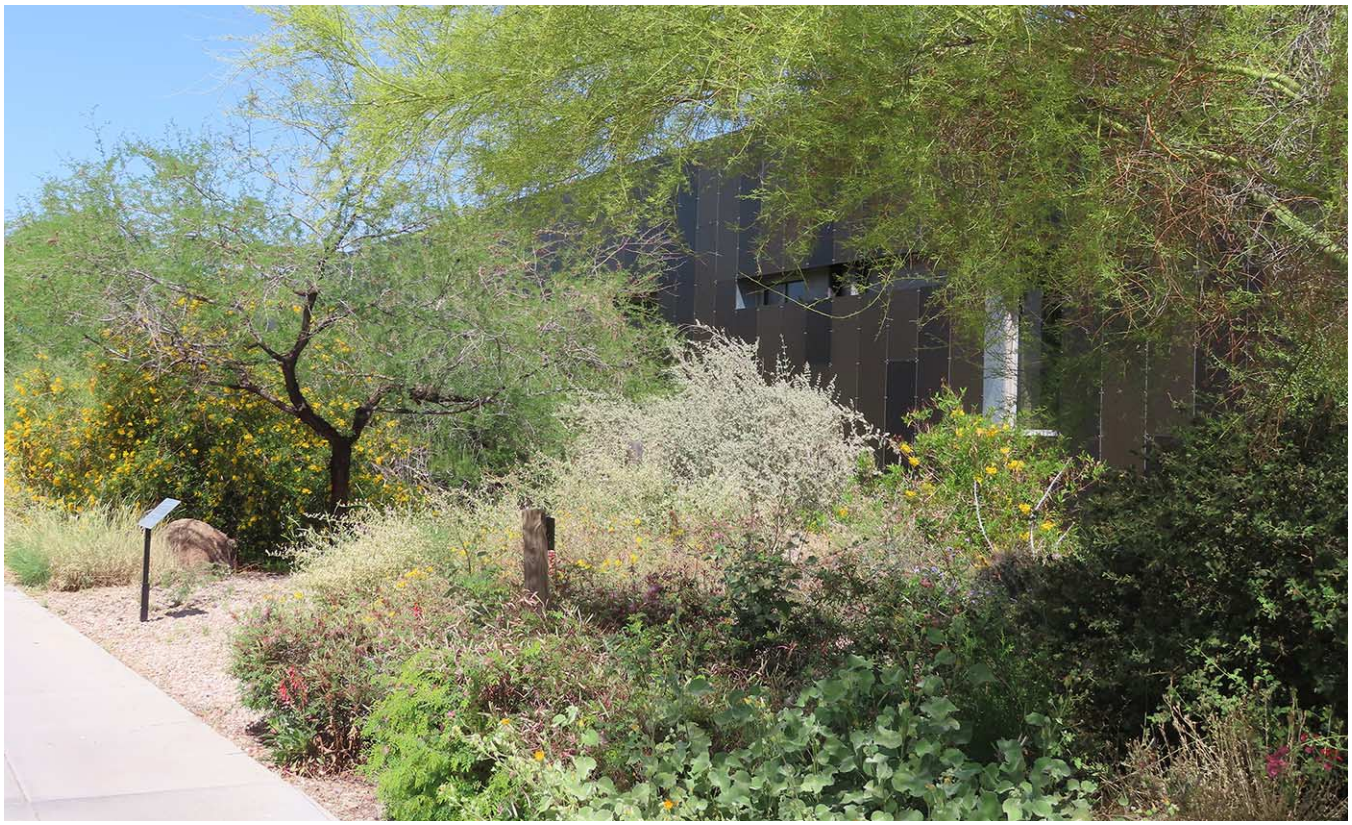

Figure 4. Wildlife habitat at the SCC campus, where over 50 seed library species can be found.

The Maricopa Native Seed Library *continued*

Library moving forward. Also, participating libraries and volunteers will assist with processing and packaging seed. There will be learning opportunities for our interns in partnership with the Tonto National Forest, the Arizona Native Plant Society, CNUW, and the Southwest Native Agriculture Center. We will introduce interns to other ways of knowing, especially indigenous ways of knowing, about such things as connections to land and place that can be explored through native plants. In addition to the internships, we will work across the curriculum at the Maricopa Community Colleges to tie the seed library to student learning through a variety of opportunities related to service learning and co-curricular activities.

For many native plants of the Sonoran Desert, locating germination information is difficult. Another goal of the seed library is to more thoroughly document germination requirements for our native species and make the information open access.

Another goal is to expand seed library offerings. There are a whole host of species that are not commercially available that we would like to add to the seed library but have either had timing problems with collecting or haven't located a large enough population to collect from, including *Aristolochia watsonii, Carlowrightia arizonica, Passiflora arizonica, Eriogonum abertium, Hibiscus denudatus, Mirabilis laevis,* and *Phaseolus angustissimus.*

Finally, we would like to identify grant funds and partners to build a pollinator pathway across Maricopa County that connects existing pollinator habitat across all property types (municipal, higher education, private, etc.) and recruit local homeowners along the pathway to join in by providing them seed/plants and native plant gardening education.

The Maricopa Native Seed Library has demonstrated that distribution of native seeds through a seed library can be an effective avenue for engaging the community in plant conservation and building habitat at home. We encourage other libraries and organizations to consider starting native seed libraries for these purposes.

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From left: Arizona Eryngo at La Cebadilla Cienega, Pima County, AZ. Checkerspot Butterfly on Arizona Eryngo. Katydid on Arizona Eryngo. *Photos courtesy Liz Makings.*

SPOTLIGHT ON A NATIVE PLANT *by Douglas Ripley, Arizona Native Plant Society, Cochise Chapter*

Arizona Eryngo (*Eryngium sparganophyllum*)

The Arizona Eryngo is among the rarest and most endangered plants in Arizona. A member of the Parsley Family (Apiaceae), it is currently known only from four small populations, two in Southern Arizona and two in Mexico, though efforts are underway to re-establish the plant elsewhere, including at the historic Canoa Ranch south of Green Valley, Santa Cruz County. The plant has apparently been extirpated from several small disjunct populations reported in New Mexico many years ago (Makings 2013, Brean 2021).

The plant is a perennial herb that grows to 1.5 meters in height and produces elongate, linear leaves in a basal rosette. The attractive cream-colored flowers form dense heads at the ends of leafless stalks (scapes) that arise from the base of the plant. The genus was described by Linnaeus, who derived the name from the Greek word *erynge* for a type of thistle. The species was described in the late 19th century by the British botanist William Botting Hemsley. The species name is also derived from the Greek (*spargan*), which describes the shape of the leaf. The plant is critically dependent on water, especially as found in the ciénegas of Southern Arizona and Northern Mexico. As the ciénegas have been steadily declining in recent decades, due to drainage and other human impacts, so have the Arizona Eryngo populations.

Owing to its extreme rarity and vulnerability, the species is classified as Critically Imperiled (S-1) in the State of Arizona Natural Heritage Program (NatureServe Explorer 2021). Furthermore, it was recently proposed for listing as an endangered species under the U.S. Endangered Species Act by the U.S. Fish and Wildlife Service (U.S. Fish and Wildlife Service 2021a). If the proposed listing is accepted, it will become the 25th Arizona plant to receive such protection. A provision of the Endangered Species Act calls for the designation of critical habitat for listed species. Critical habitat is defined and used in the Endangered Species Act to designate specific geographic areas that contain features essential to the conservation of an endangered or threatened species and that may require special management and protection (US. Fish and Wildlife Service 2021b). Unfortunately, the proposed listing designates only a total of 13 acres of critical habitat at three locations on public land in Cochise and Pima Counties (Brean 2021).

One can only hope that the listing of Arizona Eryngo as an endangered species under one of the strongest U.S. environmental laws will lead to the eventual recovery of this beautiful native plant.

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Figure 1. Photo of water primrose showing the flowers, leaves, and stems. *Photo courtesy Gene Sturla; Southwest Desert Flora, http://southwestdesertflora.com.*

Water Primrose (*Ludwigia peploides*): An Invasive Aquatic Plant in Arizona

by Phil Hedrick[1]

Introduction

Non-native invasive plants are a concern for many habitats in Arizona (Hedrick *et al.* 2019; Hedrick and McDonald 2020; Scheuring and Chamberland 2020; Scheuring and Franklin 2020). Most invasive plant species in Arizona are terrestrial because of the limited aquatic habitat in Arizona. Furthermore, less than 10% of the riparian habitat, and presumably aquatic habitat, in Arizona remains in a natural state. Both the threat to aquatic ecosystems of invasive species (Reid *et al.* 2019) and the low amount of existing aquatic habitat, make protecting the remaining aquatic areas in Arizona and their native flora and fauna especially important.

The invasive genus *Ludwigia* is one of the greatest threats to aquatic ecosystems worldwide (Thouvenot *et al.* 2013). *Ludwigia* is an emergent aquatic macrophyte, that is, a plant that is rooted in shallow water and has vegetative parts that emerge above the water surface. This genus has a number of characteristics that make it an environmental threat, including rapid growth, high reproduction potential both clonally and sexually, broad ecological tolerance, and high interspecific competitiveness, which includes allelopathic impacts (Thouvenot *et al.* 2013). Further, eradication and control of aquatic invasive species in many cases is thought to be more difficult than for terrestrial invasive species (Simberloff 2021).

In recent years, the species *Ludwigia peploides* has invaded several areas in Arizona. *L. peploides* is in the evening primrose family, Onagraceae, and is commonly called water primrose (the species in the genus are also known as primrose-willow or floating primrose). It is an aquatic perennial that grows very rapidly and can quickly cover the surface of a water body. Elsewhere it has invaded areas of mainly slow-moving shallow water, rivers, lake or reservoir shores, and floodplains, but has also been found in other aquatic habitats with periodic flooding and in some fast-moving waters.

General Background

Water primrose has yellow, primrose-like flowers with 5 (or 6) petals and sepals (Figure 1) and flowers from approximately April to October in Arizona. Its leaves are alternate, bright green, shiny, and oblong up to 4 inches (10 cm) in length, resembling those of willows, leading to its alternative name of primrose-willow. Water primrose can form dense stands

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Water Primrose (*Ludwigia peploides*): An Invasive Aquatic Plant in Arizona *continued*

excluding other aquatic plants (Figure 2). The green or pink stems generally have a fleshy texture and can grow vertically and as long as 9 feet (3 meters) horizontally. Water primrose exhibits root dimorphism with fibrous roots that anchor the plant in the soil and take up nutrients. In addition, it has adventitious roots forming at stem nodes that aid in the uptake of oxygen and allow the plant to grow from broken-off stem fragments.

There are several similar species of *Ludwigia* that are invasive in parts of the United States (Grewell *et al.* 2016). Compared to the congeneric invasive species *L. grandiflora* and *L. hexapetala*, *L. peploides* has more horizontal stems and slightly smaller flowers (see Grewell *et al.* 2016 for distinguishing characteristics). *L. peploides* has a diploid number of chromosomes of 16 (2n = 16) while *L. grandiflora* is hexaploid with 2n = 48, and *L. hexapetala* is decaploid with 2n = 80, reflecting different levels of polyploidy in these other two species (Grewell *et al.* 2016). According to SEINet, *L. grandiflora* and *L. hexapetala* are present in California but not present in Arizona. The possible introduction of these other *Ludwigia* species to Arizona is a concern both because of their invasiveness and their potential for hybridization with *L. peploides*, which might result in increased fitness (Grewell *et al.* 2016).

Water primrose has been widely used as an ornamental plant for water gardens and aquaria because of its attractive primrose-like yellow flowers. It is still sold through internet horticultural distributors and other commercial outlets; so there is a substantial probability of intentional introduction. *Ludwigia* has been investigated both for its potential use in treating wastewater because it is capable of removing nitrates from water and for production of biogas for vehicles (Cohen *et al.* 2013).

Origin and Spread

The invasive species of *Ludwigia* are native to South America (Hoch *et al.* 2015; Gillard *et al.* 2020). In the past, they were thought to be native to parts of the United States, but Grewell *et al.* (2016) suggested that the populations found in Florida and other south Atlantic states are not native but descended from introductions for water gardens and aquaria in the 1800s. *Ludwigia* has long been cultivated by horticulturists because of its attractive yellow flowers and was introduced as

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Figure 2. A dense stand of water primrose. *Photo courtesy Gene Sturla; Southwest Desert Flora, http://southwestdesertflora.com.*

Water Primrose (*Ludwigia peploides*): An Invasive Aquatic Plant in Arizona *continued*

an ornamental into southern France in 1830 (Gillard *et al.* 2020). It has since become one of the most widespread and detrimental aquatic invasive plants in France. As a result, *Ludwigia* species have been banned from sale in France since 2007. In the United Kingdom, it is an offense to plant water primrose in the wild or to allow it to grow.

In recent years, the invasive range of *Ludwigia* has expanded in Europe to other countries such as Belgium, the Netherlands, Italy, Spain, Greece, and Turkey. It has also invaded both Australia and New Zealand, and there is a high risk for its expansion to other countries (Thouvenot *et al.* 2013). Water primrose could become even more common and spread to other areas because of climate change.

The earliest herbarium specimens of *L peploides* into the United States are from the late 1800s in California (Grewell *et al.* 2016). Grewell *et al.* (2016) suggested that because water primrose is a weed in rice fields in Argentina that it might have been a contaminant in rice seeds moved for cultivation into California. It is widespread in California and populations of *L. peploides* are known from the Central Valley, San Francisco Bay, North Coast Range, and Sierra Foothills (Gilliard *et al.* 2020). In addition, water primrose has been introduced into a number of other states such as Oregon; Washington, where it is listed as a noxious weed, New York; and Arizona. Grewell *et al.* (2016) gives extensive details of specific infestations in California, Florida, South Carolina, and Oregon as examples. I have been unable to determine when and how water primrose was first introduced to Arizona.

Figure 3 gives the present, confirmed locations of water primrose in Arizona. Notice that most of the locations are either along the Gila River near Phoenix or along the Verde River north of Phoenix. Water primrose has also been found in Aravaipa Creek (Pinal County) (P. Hedrick, personal observation), a location not designated on the current SEINet map and suggesting that water primrose is probably more widespread than indicated there.

Life History

Growth and Survival

Thouvenot *et al.* (2013) suggested that the life cycle for *Ludwigia* species over a year in France can generally be divided into four parts. First, elongation occurs (probably around December in Arizona) where new shoots develop from the rhizomes; these shoots are erect in shallow water and creeping in a drained environment. Water primrose is extremely fast-growing during this period and, in France, can double its mass in 15 to 90 days in the field and in 11 to 17 days in controlled conditions. Next, there is more growth, branching, and flowering above the water level from approximately April to October in Arizona. Then, there potentially is some fruiting (not generally in Arizona) and the plants begin to degenerate. Finally, the emerged parts of the plant dry up and decay.

Ludwigia species are emergent perennials that are rooted in the substrate and have long shoots or stems that root and branch at stem nodes and can produce aerial shoots. The shoots grow across the surface of the water and can form dense intertwined mats (Rejmánková 1992). The plants can grow well in water up to 3 feet (1 m) deep and to about 2 feet (60 cm) above the water level. They are mainly aquatic but can colonize riverbanks and wetlands (Thouvenot *et al.* 2013). The plants can dry out and survive because of their large rhizomes. In non-native areas, the plants form large stands but they generally exist in only small patches where they are

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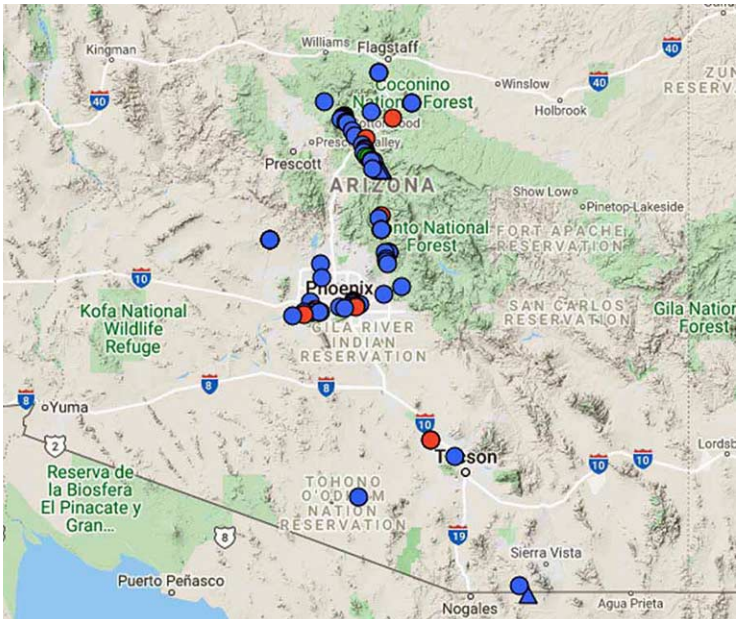

Figures 3. Sites where *L. peploides* has been identified in Arizona. The blue circles indicate sites where the species has been collected and the red circles indicate sites where the subspecies *L. p. peploides* has been identified and collected. *Image courtesy SEINet Arizona – New Mexico Chapter.*

Water Primrose (*Ludwigia peploides*): An Invasive Aquatic Plant in Arizona *continued*

native (Thouvenot *et al.* 2013). Also in their native range, water primrose is found in wetlands and in the transition between terrestrial and aquatic habitat while in the introduced range, they are mainly found in static or slow-flowing water.

L. peploides possess allelopathic activity (the chemical inhibition of one plant by another, due to the release into the environment of substances acting as germination or growth inhibitors)(Thiébaut *et al.* 2019). Dandelot *et al.* (2008) showed that this induces seedling chlorosis, decrease in germination, and increase in mortality for watercress (*Nasturtium officinalis*). This allelopathic capacity could have an additional impact on other aquatic vegetation that goes beyond the high competitiveness of water primrose.

Recently, Gilliard *et al.* (2020) found that when the climatic source of seeds matches the environment where seedlings are grown, fitness components, such as biomass and early timing of flowering, were better than when there was lower matching.

Reproduction

Overall, most reproduction in *Ludwigia* is clonal and can occur in several ways (Skaer Thomason *et al.* 2018). First, plant parts can be broken off by flooding, animals, humans, or wind and these floating plant parts can then root and establish new plants. Second, established patches of *Ludwigia* can spread locally from underground rhizomes. Finally, shoots can grow across the surface of the water and produce roots from stem nodes. To illustrate the importance of clonal reproduction of *Ludwigia* in California, Okada *et al.* (2009) found that all *L. grandiflora* samples had the same genotype and 95% of the *L. hexapetala* samples had the same genotype.

Ludwigia species also reproduce sexually, although seedling recruitment is thought to be low. Therefore, it has a mixed reproductive system of clonal and sexual reproduction. When sexual reproduction occurs, the number of the small seeds (approximately 0.04 inches, or 1 mm, in size) can be very large. As an example, the number of seeds per capsule (fruit) has been estimated to be 20 to 80 and, as a result, in France around 10,000 seeds /m^2 (10.8 square feet) have been estimated (Ruaux *et al.* 2009). The seeds have very high viability in water and the capsules float. Okada *et al.* (2009) found high genotypic variation within two subspecies of *L. peploides* in California, suggesting recruitment from seeds.

The flowers are visited by many insects so insect pollination is likely. *L. peploides* is self-compatible so that self-fertilization is also possible. Although the mating system of *Ludwigia* has not been investigated, *L. hexapetala* is protandrous (having the male reproductive organs come to maturity before the female) and appears to require pollinators to set fruit (Dandelot *et al.* 2005), which suggests outcrossing.

When there is high seed production, it is possible that a large seedbank in the sediment is present. However, the size or longevity of the seed bank has not yet been determined in either the invasive populations of France or California.

Dispersal

In many cases, establishment of water primrose to new areas over the world has been by human introduction as an ornamental plant in water gardens, aquaria, or other aquatic environments. Once established in a new area, the observed, rapid spread of water primrose is thought to be from dispersal by water of vegetative fragments or propagules as discussed above. In this case, stems, which are readily broken off and carried away by flowing water and floods, can float and establish plants in new downstream areas. In larger floods, rhizomes can potentially be carried away and establish new plants. It is possible that when there is seed productio,n there is subsequent dispersal of the small, numerous, and buoyant seeds. In addition, seeds are thought to also be dispersed by water birds (García-Álvarez *et al.* 2015) and accidentally moved by boats.

Problems

Water primrose is very problematic for aquatic ecosystems. For example, in California it is now spreading and choking entire ecosystems (Grewell *et al.* 2016). The dense stands can reduce biodiversity by displacing native flora (Stiers *et al.* 2011), making areas unsuitable or impassable for invertebrates and fish, and making the surface habitat inhospitable for water birds. The extent of the impact on native fish in Arizona is unknown but is thought to be substantial in California (Grewell *et al.* 2016).

In addition, dense stands of water primrose are a serious nuisance for human activity, can interfere with flood control, and can block waterways, irrigation ditches, and canals. With high infestations, there is increased flood risk due to the decrease in the water capacity of the channel. The dense mats of *Ludwigia* are potentially good protective habitat for mosquito larvae and, as a result, they might result in higher rates of the West Nile Virus and other diseases mosquitoes commonly spread (Thouvenot *et al.* 2013; Grewell *et al.* 2016).

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Water Primrose (*Ludwigia peploides*): An Invasive Aquatic Plant in Arizona *continued*

The dense mats also impact navigation and recreation such as fishing, boating, and hunting.

Ludwigia populations can also degrade water quality (Thouvenot *et al.* 2013) and *L. peploides* can greatly change water chemistry and cause severe hypoxia and sometimes anoxia during the summer. These effects can cause what Dandelot *et al.* (2005) refers to as "a dystrophic crisis", an intoxicated ecosystem. Dense stands of *Ludwigia* reduce the dissolved oxygen concentrations in water by limiting water circulation, increasing oxygen demand, and resulting in high decomposition of organic matter (Grewell *et al.* 2016). Such low dissolved oxygen levels produce conditions uninhabitable for fish that are intolerant of low dissolved oxygen. As mentioned above, the allelopathic activity of *Ludwigia* can result in lower seedling survival of native aquatic plant species (Dandelot *et al.* 2008).

Water primrose has a high degree of phenotypic plasticity (variation in aspects of the phenotype, such as morphology or physiology, often due to environmental variation), which allows it to adapt to a broad range of growing conditions and water regimes (Ruaux *et al.* 2009). These characteristics which make it a successful horticultural plant, also result in it being able to invade a broad spectrum of habitats. It appears to have already invaded areas that have environments quite different from those found in their native range (Grewell *et al.* 2016).

Control

Like many other invasive species, prevention of establishment is the best control for water primrose. Prevention includes education of the public about the problems related to water primrose becoming established in natural and other areas, and controlling the sale of water primrose from nurseries, online, and other commercial venues.

If there are small patches of water primrose, manual removal before they become established is possible if it includes removal of all roots. Given an established population, mechanical removal is possible in some areas although small fragments might be broken off and spread to other habitat. Because of its low palatability, herbivores, such as cattle and horses, will eat water primrose only when there are no other species available (Thouvenot *et al.* 2013). As a result, it is unlikely that herbivores will contribute substantially to water primrose control, except to reduce biomass, and they might even increase dispersal by breaking plants apart. Temporarily drying out water bodies might reduce the viability of water primrose but established plants are resistant to drying out and reducing water might reduce the viability of native species more than that of water primrose.

Chemical control of water primrose has been used in France but since 2009 herbicides are not permitted in aquatic habitats there. In the United States, several herbicides are allowed for aquatic habitats, for example, there is a formulation of glyphosate for use in aquatic habitats. A combination of manual, mechanical, and chemical control, and post-treatment monitoring and then further annual control, is generally necessary to adequately control an infestation. As examples of control efforts, Grewell *et al.* (2016) document the success and failures of several *Ludwigia* control efforts in California, New York, and Oregon.

There are a number of insects that feed on water primrose but further work is necessary to determine if any of these insects are potential biological control agents (Gassman *et al.* 2006; Grewell *et al.* 2016).

Conclusions

Water primrose (*Ludwigia peploides*) has become a major invasive-plant problem in aquatic habitats in European countries, such as France and Great Britain, and states, like California. In recent years, water primrose has invaded Arizona and is now well established in parts of the Gila and Verde drainages. Unfortunately, it is still sold commercially because of its attractive flowers, and most people do not realize the problems it causes as a non-native species.

Water primrose has a number of attributes that make it a formidable invasive species. First, water primrose has high clonal reproduction and has a very fast growth rate forming large floating mats on the water surface. Second, it has allelopathic activity that enhances its competitiveness with native aquatic plants. Finally, it appears to have ecological flexibility that has allowed it to invade a number of aquatic habitats. From an initial infestation, it appears primarily to spread into new areas from clonal propagules being broken off by flooding, animal activity, and human activity. At this point, sexual reproduction does not appear to be widespread in Arizona, so spread by seed and growth from seed banks appear minimal.

Water primrose can completely change an aquatic ecosystem. First, it can severely impact native aquatic flora and greatly influence native fauna, including native fish and water birds.

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Water Primrose (*Ludwigia peploides*): An Invasive Aquatic Plant in Arizona *continued*

Second, because of the massive stands of water primrose, it can degrade water quality and result in low dissolved oxygen levels. Finally, it can make human activity, such as water usage, fishing, and boating, difficult or virtually impossible.

Control or elimination of water primrose is very challenging once it becomes established in a water system, and the best control is to prevent introduction. Given establishment of a small population, control can be attempted by thorough manual removal. However, if the population is of any size, coordinated control of manual, mechanical, and chemical methods is likely necessary.

My hope is that this introduction to water primrose and the problems it can cause will help in the efforts to control it in Arizona. From personal experience, water primrose might well become one of the most difficult invasive, non-native plant species to control in Arizona, and certainly one of the most difficult aquatic species to control.

Acknowledgments

I appreciate the initial identification of water primrose in Aravaipa by Ries Lindley; comments about the extent of water primrose in Arizona by Matt Pollock, Kelly Wolf, and Bill Burger; and detailed information about water primrose biology and control and its extent in California from Brenda Grewell.

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Penstemon petiolatus.

Vascular Plants of Arizona Project: Update on *Penstemons of Arizona*

by Glenn Rink[1] *Photos courtesy Andi Wolfe, Ohio State University.*

Non-botanists may think we know everything we need to know about plants in the native landscape. We have Kearney and Peebles' *Arizona Flora* (K&P), which is a dense 4-pound tome. Four pounds would seem to be enough. How much do we need to know about local plants? Field botanists know that K&P was good when first published in 1951, but that we need to know a lot more now than we knew in 1951. In 1987, Arizona botanists got together and began the Vascular Plants of Arizona Project (VPA), an unfunded program, with the purpose of updating K&P. Now, 34 years later, we are almost halfway done. And some parts of what have been done are ready for re-revision!

My work on *Penstemon* was inspired by a taxonomic problem I encountered while working on the Kaibab Plateau north of the Grand Canyon. At that time, every blue-flowered *Penstemon* in the forests of northern Arizona that wasn't *Penstemon linarioides* or *Penstemon nudiflorus,* was called *Penstemon virgatus.* As a new student of botany, I was thrilled with this simplicity. Plants on the Kaibab Plateau were called *Penstemon virgatus* by previous workers, but I'd also heard of another *Penstemon* that was supposed to be endemic to the Kaibab Plateau, known as *Penstemon pseudoputus.* I didn't think I'd ever seen *Penstemon pseudoputus*, either in the field or in an herbarium, so I thought I'd better figure this out. With additional study, I learned that *Penstemon virgatus* doesn't occur on the Kaibab Plateau. Instead, everything that had been identified as such was *Penstemon pseudoputus.* It seems that when plants are mis-identified at this scale by very qualified botanists, it is time for a new approach. So, I decided to augment the VPA effort with a new work on the *Penstemons* of Arizona.

Through that work, I've learned that *Penstemon* is a fine example of our need to update our information about plants of the state. For instance, when the second edition of K&P was published in 1960, 38 species of *Penstemon* were known for Arizona. After my work, we know that there are 49 or 50 species, a 29% increase. How did this come about?

First of all, one species was eliminated since K&P. The desert shrub now known as *Keckiellia antirhinoides* subsp. *microphyllus*,

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Vascular Plants of Arizona Project: Update on Penstemons of Arizona

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was called *Penstemon microphyllus*, during K&P's time. Second, of the species new to Arizona since K&P, six were published prior to K&P and four were published after K&P. We can't blame K&P for not including the four species that were not even known at the time of their publication. But what about the six that were published prior to K&P?

Penstemon confusus, published in 1893 by Marcus Jones, could be considered a color variant within the *Penstemon utahensis* group with its blue vs. red corollas. Perhaps K&P preferred to overlook this taxon.

Though *Penstemon leonardii* was named in 1913, it was not collected in Arizona until 1989, which explains why it is not in K&P. Though it is primarily known in Arizona from the western Strip (the western part of the area north of the Grand Canyon), a collection was made by USFS ecologists just north of Heber. I have searched this area twice, attempting to relocate these plants but have failed to find them. Our variant is called variety *higginsii*, named after Larry Higgins, the long-time curator of the herbarium at Dixie College in St. George, Utah, and a contributor to *The Utah Flora.*

Penstemon ophianthus was published in 1920, but perhaps because this was later published as a subspecies of *Penstemon jamesii*, K&P included it as *Penstemon jamesii* subsp. *ophianthus.* They also included *Penstemon jamesii* var. *breviculus*, which was elevated to species rank as *Penstemon breviculus* in 1960. *Penstemon jamesii* still exists, but occurs just over the state line in New Mexico and east into the southwestern Great Plains. As far as I have learned, all of the plants that we used to consider as *P. jamesii* (or its subspecies) are *Penstemon ophianthus*, with a few now known as *Penstemon breviculus,* a narrow edaphic endemic to cruddy substrate in the Four Corners area. Another issue with how K&P handled *P. jamesii* is that they described it and keyed it out as a plant that had denticulate leaves. Sometimes these plants do have denticulate leaves, but only on a very few plants. Mostly the leaves are entire, that is, without teeth. This error in the K&P key has resulted in many plant specimens being mis-labeled.

K&P predicted correctly that *Penstemon petiolatus* would be found in the northwestern part of the state. Wes Niles, long-time curator of the University of Nevada, Las Vegas Herbarium, collected the plant in the Virgin River Narrows along I-15 in 1974. That he found it may have had something to do with the construction of I-15 through the Narrows, the most expensive rural interstate highway construction project at its completion in 1973.

Penstemon confusus.

Penstemon strictiformis was published in 1904 and was known in Arizona from a collection that was curated in the New York Botanical Garden Herbarium. This collection was supposedly made north of Flagstaff in 1934. We now know that the species only occurs far to the northeast of Flagstaff, in the Four Corners area, but in the early 1900s, collectors were not always specific about the provenance of their collections. The specimen was determined correctly, but because we lacked databases, such as SEINet, K&P were probably unaware of it. Two other Arizona *Penstemon strictiformis* specimens were collected prior to the publication of K&P, but were not determined as *Penstemon stricitformis* until after K&P was published.

Penstemon putus, published in 1926, was considered a synonym of *Penstemon virgatus* by K&P. We now consider it at the species level. It is very similar to *Penstemon pseudoputus*, but its range is along the Mogollon Rim, where it has a white-flowered variant.

What of the species named since K&P? Arizona has four species of *Penstemon* that were not named when K&P was published. *Penstemon breviculus* (elevated to species in 1960) and *Penstemon ophianthus* are discussed above. *Penstemon deaveri*, named for Chester Deaver, who established and curated the Deaver Herbarium at Northern Arizona University, was published in 1976. It occurs in both the White and Pinaleño mountains. When I started studying *Penstemon*, most specimens of *Penstemon deaveri* were determined as *Penstemon virgatus*, which is not known from those areas. *Penstemon pseudoputus* was published in 1979 and is best exemplified on the Kaibab Plateau, where it was previously determined as *P. virgatus.* It is also known from isolated occurrences in central and eastern Arizona. *Penstemon distans* was the name given in 1980 for plants growing in a small portion of the southern part of the Arizona Strip, so it is one of our narrow endemics.

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Penstemon breviculus.

Penstemon centranthifolius.

Vascular Plants of Arizona Project: Update on Penstemons of Arizona

continued

We would expect that since K&P, new species may have been added to the state list as exotic introductions, either purposely or inadvertently. In fact, we now have *Penstemon centranthifolius* as a new exotic species in Arizona, found to be persisting in the Molino Campground area of the Santa Catalina Mountains. This isn't so far from the west coast of California where this species is common. It is easy to imagine it being inadvertently transported by car up the Mt. Lemmon Highway from California. But another possibility is intriguing. The Molino Basin housed Japanese-Americans who protested the relocation and internment of Japanese-Americans during WWII (**https://www.fs.usda.gov/recarea/coronado/recarea/?recid=25648**). Somewhere, I heard that the wife of the camp commandant was an avid gardener. Perhaps she or an internee brought *Penstemon centranthifolius* to Arizona for a garden. We'll probably never know. But if it was brought in during WWII, then it has persisted for 80 years and could be naturalizing. It is most closely related to our native *Penstemon subulatus* with which it may start crossing, potentially blurring the line between these two species.

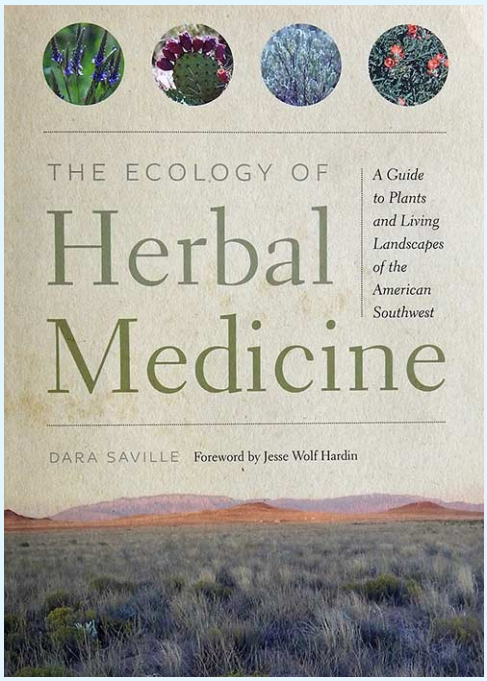
Another intriguing Arizona *Penstemon* is *Penstemon watsonii*, based on an 1877 record by Edward Palmer, who unfortunately, didn't place much emphasis on maintaining his notes in conjunction with his specimens, so the provenance is famously open to question. Palmer's collection of *Penstemon watsonii* was supposedly made at Mokiak Pass on the Arizona Strip. Glenn Clifton, who has written floras of Mohave County, presumes that, after he made several searches of the Mokiak Pass area without finding *Penstemon watsonii*, that the species does not occur in Arizona. I have also searched Mokiak Pass, and found good habitat for *Penstemon watsonii*, but did not find the plants. *Penstemon watsonii* occurs just 30 km north of the Utah/Arizona border, so it could easily occur in Arizona.

Other changes since K&P are name changes; *Penstemon bridgesii* is now called *P. rostriflorus; Penstemon ramosus* has been subsumed into *Penstemon lanceolatus.*

My work has revealed what is likely an undescribed species in northeastern Arizona. If warranted, this will be described as a new species.

Updating K&P is only important if we want to accurately describe nature, which has been a human goal since we started accumulating knowledge. Certainly, a new treatment will allow botanists to more accurately and confidently identify the plants they find in our great state. The VPA is a worthy project that, unfortunately, is taking way too long to complete.

Vascular Plants of Arizona botanical treatments are published both in print and online in the journal *Canotia*, based out of Arizona State University, edited by Dr. Les Landrum and associates, who deserve tremendous credit, along with Arizona herbarium curators for keeping this enormous project going.



Clockwise from above: Cutleaf coneflowers (*Rudbeckia laciniata*). Violet (*Viola odorata*). Cottonwood tree (*Populus deltoides wislizenii*) bud with resin.

BOOK REVIEW *Ries Lindley, University of Arizona Herbarium, Tucson; and Arizona Native Plant Society, Tucson Chapter. Photos by Dara Saville.*

The Ecology of Herbal Medicine by Dara Saville

2021. 312 pages. ISBN: 978-0-8263-6217-9. $24.95. University of New Mexico Press, University of New Mexico Press, MSC05 3185, 1 University of New Mexico, Albuquerque, NM 87131-0001. Also available at Amazon.com.

When searching for knowledge, it is easy to get so lost in the details that we forget the context. So a book that begins by setting the stage with history, ethnography, an array of sciences, and a point of view is something to be valued. Because such books embrace their own context, we can fit them into ours, and learning this way is foundational, not ephemeral.

Herbal Medicine is written in two parts. Part one is titled Knowing the Land, which might also be called "knowing the lay of the land" as it comprises information important to all of us, not just those of us who need an herbal medicine reference for the home library. The author begins by defining the concept of ecological herbalism, which is, as it happens, a good way of explaining the importance of plants to all of us:

> *Ecological herbalism is a way of understanding where we live and learning about the plants around us. It is an interdisciplinary approach to herbal practice that includes learning about the natural processes unfolding in wild areas and how plants interact with each other and their environment.*

This might be stated conversely as what ecological herbalism is not; it is not just about bending nature to our will, but learning to live with it as it is.

Herbal Medicine is written as a guide to the plants and landscapes of the American Southwest. Part one includes a discussion of the vast diversity of the landscape of the Southwest. The author, who lives in Albuquerque, uses New Mexico for specific examples in general discussions, but it is no great leap to see how this approach applies to Arizona and the rest of the Southwest. It is easy to imagine a book about herbal medicine that is focused on Old World plants and the ancient body of knowledge from the other side of the globe, but *Herbal Medicine* is mostly about plants that are the focus of ancient knowledge from our own continent.

The second part of the book, Knowing the Plants, is about specific plants, their natural history, and their medicinal uses. The plant list is about 40 species, most of them natives, some introduced and some invasive. The list is well chosen for plants that are familiar and provide plenty of material for discussion. For those of us untutored in herbalism, many of the plants included are a surprise. Yarrow, *Achillea millefolium*; red root, *Ceanothus fendleri*; ocotillo, *Fouquieria splendens*; creosote, *Larrea tridentata*; cutleaf coneflower, *Rudbeckia lacinata*; and goldenrod, *Solidago canadensis*. All are included.

continued next page

Juniper (*Juniperus monosperma*).

BOOK REVIEW The Ecology of Herbal Medicine *continued*

The discussions of plant species include some natural history; historical uses; chemicals either thought, or proven, to be "active ingredients"; and an overview of the types of preparations prepared from the plant. Snakeweed, *Gutierrezia sarothrae*, may be used topically for arthritis, muscle pain, and inflammation. It has been shown to have a cytotoxic effect on three kinds of cancer. The parts of the plant collected for remedies are foliage and blossoms. Medicinal preparations include soaks, liniments, infused oils, and teas. It was used for many types of remedies by the Pueblo people and Navajos.

Each plant entry includes a list of references, and the lists are extensive. The references appear in the back of the book as a bibliography, which is almost 80 pages long. Although the book is formally organized into two parts, the bibliography is really part three. Some of these bibliographical entries make excellent reading, e.g., *Braiding Sweet Grass* by Robin Wall Kimmerer, and some are an introduction to sources that would be otherwise hard to find. The eclectic nature of the references is an education in itself. There are publications referenced from herbalism, pharmacology, and various specialized journals, for example, the *Iran Journal of Child Neurology*.

There are 161 color photos, most of them by the author, and all of them either stunning or instructive, or both. Many of the photos are of plants, which save us from running to a plant reference every time a plant is mentioned. Some are illustrations of biome types, and other images show ecological changes caused by fire, climate, or invasive plants.

Part two, Knowing the Plants, begins with weeds and ends with invasive trees. This is not the result of some careless disregard for the pitfalls of unwanted plants, but much more practically, a carefully thought-out philosophy of how to live with nature as it is and make the most of it. The Rio Grande River valley has a well-established population of Russian olive. The herbalist in Saville will accept the Russian olive and learn to work with it, and the ecologist in her will understand Russian olive has radically changed the environment.

Herbal Medicine will, no doubt, get plucked from bookshelves by readers interested in herbalism and cultural uses of plants. But the book provides for all readers a well-developed structure for how to think about the world we live in first, and then how we use the nature around us to live in that world. These two points of view are woven together for us into a single braid, just like our lives are woven together with the natural world.

Figura 1. Vista panorámica del Parque Central de Hermosillo, al fondo se aprecia el extremo sur de la sierra Espinazo Prieto. *Foto por J. J. Sánchez-E.*

Entre Palo verdes, Torotes y Siviris: Las Plantas del Parque Central de Hermosillo (Cerro Johnson), Hermosillo, Sonora, México

por José Jesús Sánchez-Escalante[1] and Thomas R. Van Devender[2]

Introducción

El municipio de Hermosillo, Sonora, México, con una superficie de 15,720 km^2, cuenta con varios ecosistemas tales como el Desierto Sonorense, Matorral Espinoso de Piedemonte, Matorral Espinoso Costero, y zonas de humedales naturales como bosques de río, manglares, esteros, dunas y playas costeras. Esta diversidad de ecosistemas ocasiona que el municipio tenga una gran diversidad de flora vascular la cual se estima en más de 760 especies de plantas (Sánchez-Escalante 2021). La ciudad de Hermosillo es la cabecera municipal y, de acuerdo con el último censo de población y vivienda, cuenta actualmente con 936,263 habitantes (INEGI 2020).

El Parque Central de Hermosillo (PCH), con una superficie de casi 30 hectáreas, se localiza al norte de la ciudad de Hermosillo y pertenece al extremo sur de la Sierra Espinazo Prieto (Figuras 1, 2). El PCH, colinda hacia el sur con el fraccionamiento Los Angeles; hacia el poniente con los fraccionamientos Santa Bárbara y Cárdeno I; hacia el oriente con el fraccionamiento Monterosa y hacia el norte con el Cerro Johnson y los senderos de Cárdeno II.

Como fue publicado en 2006 por diferentes medios informativos de Hermosillo, el gobierno municipal hizo aquí una inversión global de varios millones de pesos para proporcionar a los hermosillenses de un espacio natural con instalaciones para reunirse y vincularse con la naturaleza. El gobierno municipal en turno inició un proyecto ambicioso que incluyó la plantación de mezquites, colocación de palapas con asadores y mesas de campo, la instalación de botes para la basura, circuitos de caminata hacia miradores que permiteran una visión panorámica de la ciudad, terreno para estacionamiento, protección y supervisión por parte del personal del ayuntamiento, y la promesa de consolidar el proyecto en todas las áreas en la siguiente administración (Romano 2006; Lara 2006; Ponce 2006).

Fue hasta el 22 de enero de 2009 cuando las autoridades municipales de Hermosillo decretaron al PCH como una Área Natural Protegida Municipal (ANPM), con el objetivo de brindar a la población de Hermosillo un espacio de recreación social y de conservación de la flora y fauna en su ambiente original, para ayudar a la mitigación de las altas temperaturas y a

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[1]Herbario USON, Universidad de Sonora-DICTUS, Edificio 1A, Niños Héroes entre Rosales y Pino Suarez, Colonia Centro, Hermosillo, Sonora 83000, México. [2]Greater Good Charities, 6262 N. Swan Rd., Suite 165, Tucson, Arizona 85718, United States.

Figura 2. A. Matorral desértico en la ladera de Cerro Johnson en PCH. B. Buena condición de la vegetación de la explanada durante el verano de 2006. *Imágenes por J. J. Sánchez-E.*

Las Plantas del Parque Central de Hermosillo *continúa*

la depuración del aire. Dentro de la categoría de Parque Urbano, es la primera y única área protegida de este tipo tanto en el Municipio de Hermosillo como en el Estado de Sonora; sin embargo, a la fecha el plan de manejo de esta ANPM todavía no ha sido elaborado (Murrieta 2020).

Bajo la designación oficial de Parque Rústico Cerro Johnson, el PCH fue abierto al público en el 2006, año en el que comencé a llevar de excursión al club de plantas nativas de la Universidad de Sonora, integrado por estudiantes de la licenciatura en biología y de otras carreras; con su ayuda, comencé a recolectar ejemplares de herbario y a registrar la flora del PCH. Desde entonces, en cada visita al parque hemos obtenido nuevos registros en diferentes épocas del año, incrementando la lista de plantas vasculares. También, se incluyen plantas registradas en lugares ligeramente afuera de los límites del parque, por ejemplo, el helecho *Astrolepis cochisensis* fue visto en los senderos de Cárdeno II contiguos al PCH.

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Paloverdes, Torotes, and Siviris: Plants of the Central Park of Hermosillo (Cerro Johnson), Hermosillo, Sonora, Mexico

Introduction

The Municipality of Hermosillo, Sonora, Mexico, with an area of 15,720 km^2, has several types of vegetation, including Sonoran desertscrub, foothills and coastal thornscrub, and dunescrub and beaches along the Gulf of California. Natural wetlands areas are riparian deciduous forest along rivers and coastal estuaries. Reflecting the diversity of ecosystems, the vascular flora is diverse and estimated at more than 760 species of plants (Sánchez-Escalante 2021). Hermosillo is the seat of the Municipality and currently has 936,263 inhabitants (INEGI 2020).

Parque Rústico Cerro Johnson was opened to the public in 2006 (Figures 1 and 2). The floristic inventory of the park began with hikes by biology students in the native plants club at the Universidad de Sonora followed by Sánchez-E. collecting voucher specimens for the Herbario de la Universidad de Sonora (USON). Since then, the park has been visited regularly at different times of the year to document the flora.

On January 22, 2009, the municipal authorities of Hermosillo decreed the Central Park Hermosillo (CPH) as a Municipal Natural Protected Area (MANP), with the aim of providing the population of Hermosillo recreational space and the conservation of flora and fauna in their original environment (Lara 2006; Romano 2006; Ponce-R. 2006; Murrieta 2020). The CPH, with an area of almost 30 hectares, is located on the north edge of Hermosillo on the slopes of Cerro Johnson in the southern Sierra Espinazo Prieto (Figure 1).

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Figura 3. Herbáceas de primavera. A. B. *Phacelia distans* y Malva anaranjada. *Fotos por J. J. Sánchez-E.* Herbáceas de verano. C. Trompillo (*Ipomoea ternifolia* var. *leptotoma*). *Foto por Ana L. Reina-Guerrero.* D. Baiburina (*Kallstroemia grandiflora*). *Foto por T. R. Van Devender.*

Las Plantas del Parque Central de Hermosillo *continúa*

Flora

Los registros de especies de la flora de PCH están disponibles en la base de datos del Herbario de la Universidad de Sonora (USON): **https://herbanwmex.net/portal/collections/harvestparams.php**.

Actualmente, la flora vascular del PCH y áreas adyacentes cuenta con 167 especies de plantas distribuidas en 135 géneros y 43 familias. Las familias con mayor número de especies son Fabaceae (24), Asteraceae (15), Euphorbiaceae (14), Cactaceae (11), Boraginaceae (10), Poaceae (8), Acanthaceae (7), Convolvulaceae (6), Solanaceae (5) y Malvaceae (4).

La flora está formada por hierbas (84 especies, 50.3%), plantas leñosas (76 especies, 42.5%) y suculentas (12 especies, 7.2%). Las hierbas son dicotiledóneas (75 especies) y zacates (8 especies). Las mismas son anuales (54 especies) y perennes (30 especies). Las plantas leñosas incluyen los arbustos (29 especies), árboles (18 especies), enredaderas leñosas (12 especies), subarbustos (11 especies) y una parásita leñosa. Las suculentas en su mayoría son cactus (11 especies) y un maguey.

Al caminar por los senderos del PCH durante la primavera, y siguiendo el circuito principal de 1 kilómetro, los visitantes puedan ver florecer varias hierbas como *Achyronychia cooperi, Cleome tenuis*, peluditas (*Cryptantha barbigera, C. maritima, Johnstonella angustifolia*), pamita (*Descurainia pinnata*), *Dalea mollis*, *Eucrypta micrantha, Eulobus californicus*, *Marina parryi*, *Nama hispidum,* manzanillas (*Pectis filipes* var. *filipes, Perityle californica*), *Phacelia crenulata, P. distans* (Figura 3A), malva anaranjada (*Sphaeralcea coulteri;* Figura 3B), manzanilla de coyote (*Thymophylla concinna*) y sipehui (*Euphorbia californica*). Si las equipatas (lluvias de invierno) fueron abundantes florecerán algunas golondrinas (*E. florida, E. pediculifera, E. polycarpa*).

Durante el verano, les toca florecer a otras hierbas como el toloache (*Datura discolor*), golondrina (*Euphorbia albomarginata*), trompillo (*Ipomoea hederacea, I. ternifolia* var. *leptotoma;* Figura 3C), baiburina (*Kallstroemia grandiflora;* Figura 3D), mostaza (*Lyrocarpa coulteri*) y hojasén (*Senna covesii*). Si las aguas (lluvias de verano) han sido generosas, la hierba parásita conocida como fideos (*Cuscuta legitima*) es abundante, parasitando algunas anuales como la hierba ceniza (*Tidestromia lanuginosa*). Algunos zacates nativos del verano son el zacate liebrero (*Bouteloua barbata*) y el piojillo de Arizona (*Urochloa arizonica*). Los únicos helechos del desierto en el PCH son *Astrolepis cochisensis* y *Notholaena lemmonii.*

Varios tipos de arbustos se encuentran en la vegetación del parque. Entre ellos *Adelia obovata,* jumete (*Asclepias subulata;* Figura 4A), torote prieto (*Bursera laxiflora*), torote (*B. fagaroides* var. *elongata*), torote blanco (*B. microphylla*; Figura 4B), sámota (*Coursetia glandulosa*), vara prieta (*Croton sonorae*), rama blanca (*Encelia farinosa*), palo dulce (*Eysenhardtia orthocarpa* Figura 4C), salvia (*Condea albida*), sangrengado (*Jatropha cardiophylla*), papelillo (*J. cordata*), chuparrosa (*Justicia californica*; Figura 4D), tullidora (*Karwinskia humboldtiana*), confiturilla grande (*Lagascea decipiens*) y gatuño (*Mimosa laxiflora*). La pata de gallo (*Manihot angustiloba*), no ha sido vista desde que se registró en 2006; sin embargo, la hemos observado recientemente en las áreas contiguas al parque.

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Figura 4. Arbustos del PCH. A. Jumete con mariposa reina (*Danaus gilippus*). B. Torote blanco. (*Bursera microphylla*). *Foto por Patricia Estes*. C. Palo dulce (*Eysenhardtia orthocarpa*). D. Chuparrosa (*Karwinskia humboldtiana*). *Foto por Diane Drobka. Fotos A y C por J. J. Sánchez-E.*

Plants of the Central Park of Hermosillo *continued*

Flora

Individual records for the flora of the CPH are available in the USON database: **https://herbanwmex.net/portal/collections/harvestparams.php**.

Currently, the vascular flora of the CPH and adjacent areas has 167 species of vascular plants in 135 genera and 43 families. The families with the highest number of species are Fabaceae (24), Asteraceae (15), Euphorbiaceae (14), Cactaceae (11), Boraginaceae (10), Poaceae (8), Acanthaceae (7), Convolvulaceae (6), Solanaceae (5), and Malvaceae (4).

The flora contains herbs (84 species, 50.3%), woody plants (71 species, 42.5%), and succulents (12 species, 7.2%). The herbs are dicots (76 species) and grasses (8 species). There are annuals (54 species) and perennials (30 species). The woody plants include shrubs (29 species), trees (18 species), woody vines (12 species), subshrubs (11 species), and a woody parasite. The succulents are mostly cacti (11 species) and an agave.

Along the kilometer loop trail, springtime visitors can see herbaceous plants, including frost-mat (*Achyronychia cooperi*), *Cleome tenuis*, popcorn flowers/*peluditas* (*Cryptantha barbigera, C. maritima, Johnstonella angustifolia*), tansy mustard/*pamita* (*Descurainia pinnata*), hairy prairie clover (*Dalea mollis*), wild heliotropes (*Eucrypta micrantha, Phacelia crenulata, P. distans* [Figure 3A]), California suncup (*Eulobus californicus*), Parry's false prairie-clover (*Marina parryi*), sand bells (*Nama hispidum*), daisies/*manzanillas* (*Pectis filipes* var. *filipes, Perityle californica*), Coulter's globemallow/*malva anaranjada* (*Sphaeralcea coulteri* [Figure 3B]), *manzanilla de coyote* (*Thymophylla concinna*), and California spurge/*sipehui* (*Euphorbia californica*). If the winter rains are good, some spurges/*golondrinas* (*E. florida, E. pediculifera, E. polycarpa*) flourish.

During the summer, flowering herbs include desert thorn-apple/*toloache* (*Datura discolor*), spurge (*Euphorbia albomarginata* /*golondrina*), morning glory vines/*trompillos* (*Ipomoea hederacea, I. ternifolia* var. *leptotoma* [Figure 3C]), summer poppy/*baiburina* (*Kallstroemia grandiflora* [Figure 3D]), Coulter's lyrepod/*mostaza* (*Lyrocarpa coulteri*), and desert senna/*hojasén* (*Senna covesii*). If the summer rains have been good, the parasitic annual dodder/*fideos* (*Cuscuta legitima*) is abundant, parasitizing annuals like woolly tidestrom/*hierba ceniza* (*Tidestromia lanuginosa*). Native summer grasses are six-weeks grama/*zacate liebrero* (*Bouteloua barbata*) and Arizona signalgrass/*piojillo de Arizona* (*Urochloa arizonica*). The only desert ferns in the Park are Cochise scaly and Lemmon's cloak ferns/*helechos* (*Astrolepis cochisensis, Notholaena lemmonii*).

Various shrubs are found in CPH, including *Adelia obovata,* rush milkweed/*jumete* (*Asclepias subulata* [Figure 4A]), *torote prieto* (*Bursera laxiflora*), fragrant bursera/*torote* (*B. fagaroides* var. *elongata*), elephant tree/*torote blanco* (*B. microphylla* [Figure 4B]), rosary babybonnets/*sámota* (*Coursetia glandulosa*), Sonoran croton/*vara blanca* (*Croton sonorae*), brittlebush/*rama blanca* (*Encelia farinosa*), kidneywood/*palo dulce* (*Eysenhardtia orthocarpa* [Figure 4C]), desert lavender/*salvia* (*Condea albida*), limberbush/*sangrengado* (*Jatropha cardiophylla*), tree limberbush/*papelillo* (*J. cordata*), *chuparrosa* (*Justicia califórnica* [Figure 4D]), *tullidora* (*Karwinskia humboldtiana*), *confiturilla grande* (*Lagascea decipiens*), and Mexican mimosa/*gatuño* (*Mimosa laxiflora*). The desert mountain manihot/*pata de gallo* (*Manihot angustiloba*) has not been seen in the Park since 2006 but was recently observed in adjacent areas.

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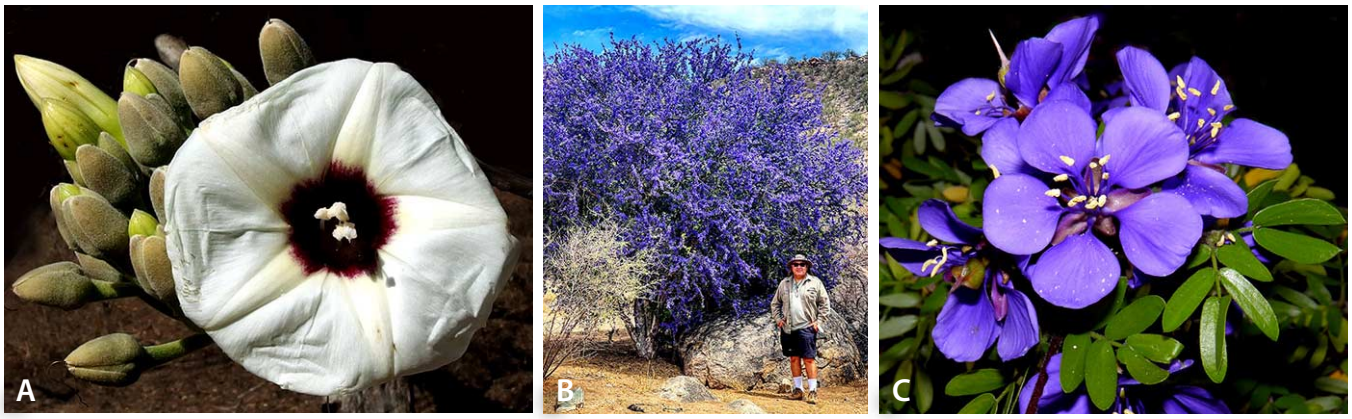

Figura 5. Árboles de PCH. A. Flor de palo santo (*Ipomoea arborescens*). *Foto por Stephen F. Hale.* B. C. Guayacán (*Guaiacum coulteri*). *Fotos por G. G. Morales-F. y T. R. Van Devender.*

Las Plantas del Parque Central de Hermosillo *continúa*

Los árboles son las plantas más grandes en el matorral desértico Sonorense. En la primavera, el palo blanco (*Ipomoea arborescens*) se observa sin hojas y grandes flores blancas (Figura 5A). En abril, aparecen las flores lilas con blanco del palo fierro (*Olneya tesota*) y las flores amarillas del palo verde (*Parkinsonia microphylla*). En abril-mayo, el guayacán (*Guaiacum coulteri*) se cubre de flores moradas (Figuras 5B, C). El guayacán y el palo fierro son especies protegidas en la NOM-059, la ley mexicana de especies en peligro (SEMARNAT 2010).

Figura 6. Enredaderas de PCH. A. *Cottsia gracilis. Foto por J. J. Sánchez-E.* B. Farolitos (*Cardiospermum corindum*). *Foto por T.R. Van Devender.*

Las enredaderas leñosas se trepan a los arbustos del parque, entre ellas *Cottsia californica*, *C. gracilis* (Figura 6A), *C. linearis* (endémica a Sonora), talayotes (*Marsdenia edulis, Polystemma cordifolium*), *Nissolia schottii* y el trompillo (*Merremia palmeri*). Las gallinitas (*Callaeum macropterum*) tienen flores amarillas y frutos grandes de cuatro alas. Farolitos (*Cardiospermum corindum*) es una enredadera común de flores blancas y frutos inflados como linternas (Figura 6B).

Las plantas suculentas son miembros importantes del ambiente del PCH, destacan los cactus columnares como la sinita (*Lophocereus schottii*; Figuras 7A, B), el pitahayo (*Stenocereus thurberi*; Figuras 7C. D), y la sina (*S. alamosensis*), así como el siviri (*Cylindropuntia thurberi* subsp. *versicolor*; Figura 8A) y los viejitos de espinas anzuelo (*Mammillaria grahamii* [Figuras 8B, C], *M. mainiae*). El verano de 2006, una biznaga (*Ferocactus emoryi*) se registró en el margen norte del parque, pero no se volvió a ver. Un cactus de interés especial, la sacamatraca (*Peniocereus striatus*), hace años se registró en el parque, pero es muy críptico. El maguey (*Agave angustifolia*) se registró en las laderas del parque en 2006, pero los incendios subsecuentes de zacate buffel (*Pennisetum ciliare*) dañaron seriamente el matorral desértico (Figura 9). Esta es una especie emblemática para los sonorenses, ya que el bacanora, el mezcal regional tradicional, se produce del mismo. Es una especie tropical que llega al límite de su distribución más al norte en el Desierto Sonorense. Los magueyes que actualmente se observan en el PCH fueron plantados por el Colectivo Sonora Silvestre.

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Figura 7. Cactáceas columnares de PCH. A. B. Sinita y acercamiento a sus 5 costillas (*Lophocereus schottii*). *Fotos por T. R. Van Devender.* C. D. Pitahayo y su flor (*Stenocereus thurberi*). *Fotos por George M. Ferguson y T. R. Van Devender.*

Plants of the Central Park of Hermosillo *continued*

Trees are the largest plants in Sonoran desertscrub. In spring, tree morning glory/*palo blanco* (*Ipomoea arborescens* [Figure 5A]) has showy large white flowers on leafless stems. In April, you can see the lavender and white flowers of desert ironwood/*palo fierro* (*Olneya tesota*) and the yellow flowers of foothills paloverde/ *paloverde* (*Parkinsonia microphylla*). In April-May, *guayacán* (*Guaiacum coulteri*) is covered with blue to blue-purple flowers (Figure 5B, C). *Guayacán* and desert ironwood are protected species in the NOM-059, the Mexican endangered species law (SEMARNAT 2910), although they are common species without apparent threats.

Woody vines such as desert vines (*Cottsia californica*, *C. gracilis* [Figure 6A], *C. linearis* [endemic to Sonora]), milkweed vines/*talayotes* (*Marsdenia edulis, Polystemma cordifolium*), Schott's yellowhood (*Nissolia schottii*), and a morning glory (*Merremia palmeri*) climb on the shrubs in the Park. The yellow orchid vine/*gallinitas* (*Callaeum macropterum*) has yellow flowers and large four-winged fruit. Balloon vine/*farolitos* (*Cardiospermum corindum*) is a common vine with white flowers and inflated lantern-like fruits (Figure 6B).

Succulent plants are an important part of the environment of CPH, especially the columnar cacti oldman cactus/*senita* (*Lophocereus schottii* [Figure 7A, B]), organpipe cactus/*pithayo* (*Stenocereus thurberi* [Figure 7C, D]), and *sina* (*S. alamosensis*), as well as staghorn cholla/*siviri* (*Cylindropuntia thurberi* subsp. *versicolor* [Figure 8A]) and fishhook cacti/*viejitos* (*Mammillaria grahamii* [Figure 8B, C], *M. mainiae*). In the summer of 2006, an Emory's barrel cactus/*biznaga* (*Ferocactus emoryi*) was recorded on the north margin of the park but not seen again. The *sacamatraca* (*Peniocereus striatus*), a cactus of special conservation interest, was only observed years ago, but is very cryptic. The narrowleaf century plant/*maguey* (*Agave angustifolia*) was seen on the slopes of the Park in 2006, but later buffelgrass/*zacate buffel* (*Pennisetum ciliare*) fires severely damaged the desertscrub vegetation (Figure 4). This is an emblematic species for the Sonoran people because *bacanora,* the traditional regional *mescal* distilled alcohol, is produced from it. This is a tropical species at its northern distributional limit in the Sonoran Desert. The *magueyes* currently found in the CPH were planted by the Colectivo Sonora Silvestre.

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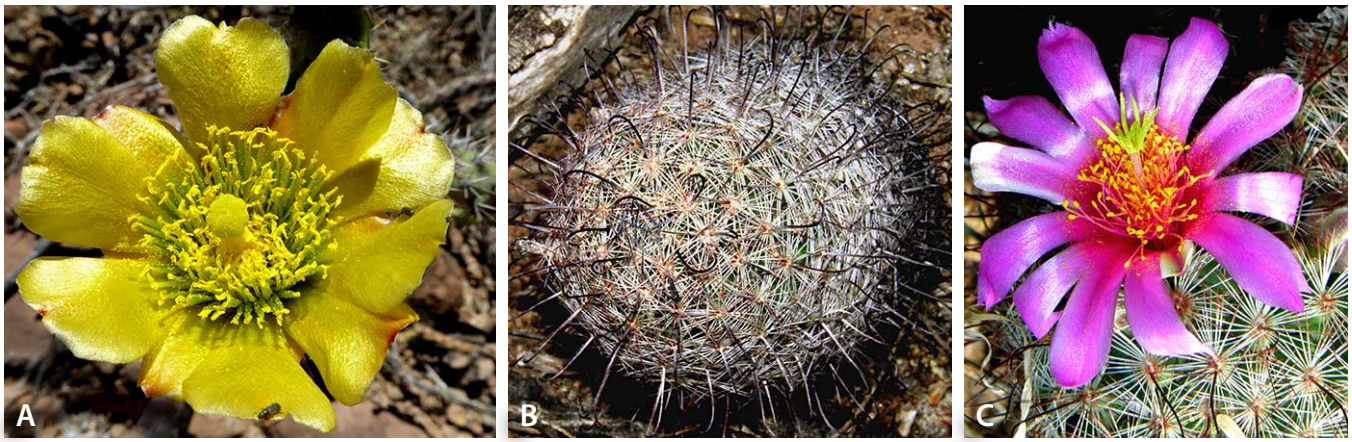

Figura 8. Cactáceas en el PCH. A. Flor de siviri (*Cylindropuntia thurberi*). *Foto por A.L. Reina-G.* B. C. Viejito de espinas anzuelo y con flor (*Mammillaria grahamii*). *Fotos por T. R. Van Devender.*

Figura 9. Zacate buffel es una invasora agresiva de Africa. A. Planta. *Foto por Kelly G. Lyons.* B. Zacate buffel quemando. *Foto por Mark A. Dimmitt.*

Las Plantas del Parque Central de Hermosillo *continúa*

Especies no nativas

La flora del PCH contiene16 especies no nativas, 9.7% de la flora. Entre ellas seis especies que se plantaron en el parque. En general, las otras especies se encuentran a la orilla del camino, cerca de la entrada del parque. Excepto por el guaje (*Leucaena leucocephala*), todas son hierbas, entre ellas *chual* (*Chenopodiastrum murale*), *trébol agrio* (*Melilotus indica*), zacate Bermuda (*Cynodon dactylon*), lechuga silvestre (*Lactuca serriola*), pamitón (*Sisymbrium irio*), chinita (*Sonchus oleraceus*) y toritos (*Tribulus terrestris*). En la primavera de 2021, chamizo volador (*Salsola tragus*) se registró por primera vez, pero no es tan invasora en el matorral desértico como en otras partes. Una planta de sandía (*Citrullus lanatus*) registrada en 2006 probablemente creció de las semillas de la fruta consumida por visitantes. El guaje es un árbol invasor en zonas tropicales de todo el mundo. Algunas especies no nativas fueron introducidas como árboles de sombra cerca de la entrada del parque, entre ellas el neem (*Azadirachta indica*), palma datilera (*Phoenix dactylifera*) y mezquite chileno (*Prosopis chilensis*).

El tepeguaje (*Lysiloma watsonii*) plantado cerca de la entrada es nativo del sur de Sonora, llegando en el norte hasta Arizona, pero no en el Desierto Sonorense. Un bagote (*Parkinsonia aculeata*) pudo haber sido plantado o la semilla llevada por animales o el viento. Es una especie tropical nativa, se encuentra por lo común en hábitats perturbados o ribereños que llega al sur de Sonora, pero se considera no nativa en la mayor parte del estado. Especies nativas a Sonora tales como brea (*Parkinsonia praecox*) y guamúchil (*Pithecellobium dulce*) que no pertenecen a este hábitat se han introducido al plantarse cerca de la entrada al parque. La única especie no nativa que es una invasora peligrosa es el zacate buffel. También en la entrada al parque, varias especies nativas se encuentran a orillas de caminos perturbados, entre ellas: cardo (*Argemone ochroleuca* var. *ochroleuca*), chamizo cenizo (*Atriplex elegans*), lentejilla (*Lepidium lasiocarpum*), pega pega (*Mentzelia multiflora*), anisillo (*Mollugo verticillata*) y agujitas (*Palafoxia arida*).

Conservación

Aunque esta Área Natural Protegida Municipal fue declarada en 2009, el Parque Central de Hermosillo (PCH) quedó oficialmente a cargo de la Coordinación de Infraestructura, Desarrollo Urbano y Ecología (CIDUE) del Municipio de Hermosillo desde 2006. En la actualidad, el PCH no ha recibido todavía la administración y protección correspondiente, ni cuenta con personal encargado de su gestión y los objetivos descritos en su Acuerdo de Declaratoria tampoco han sido llevados a cabo, entre ellos, la elaboración del plan de manejo (Murrieta 2020; Joel Zepeda, com. pers. 2021).

Por otro lado, algunas organizaciones de la sociedad civil entre las que podemos destacar al Colectivo Caminantes del Desierto (CCD) y Amigos del Cerro Johnson, han trabajado en la restauración y conservación del lugar por medio de: rehabilitar senderos, reforestar con árboles nativos entre ellos el guayacán (*Guaiacum coulteri*) y el palo fierro (*Olneya tesota*); además, con apoyo del municipio, han realizado campañas para remover tanto el zacate buffel como basura y escombros (Sergio Müller y Fabián Urías, com. pers. 2021). Además, el CCD recientemente fue financiado para construir gaviones, para reducir la erosión, restaurar el suelo, y así retener el agua de lluvia. (Sergio Müller, com. pers. 2021). Otros grupos conservacionistas, como el Colectivo Sonora Silvestre, también han plantado *Agave angustifolia* en un proyecto binacional para la conservación del murciélago magueyero (*Leptonycteris yerbabuenae*; Murrieta 2020).

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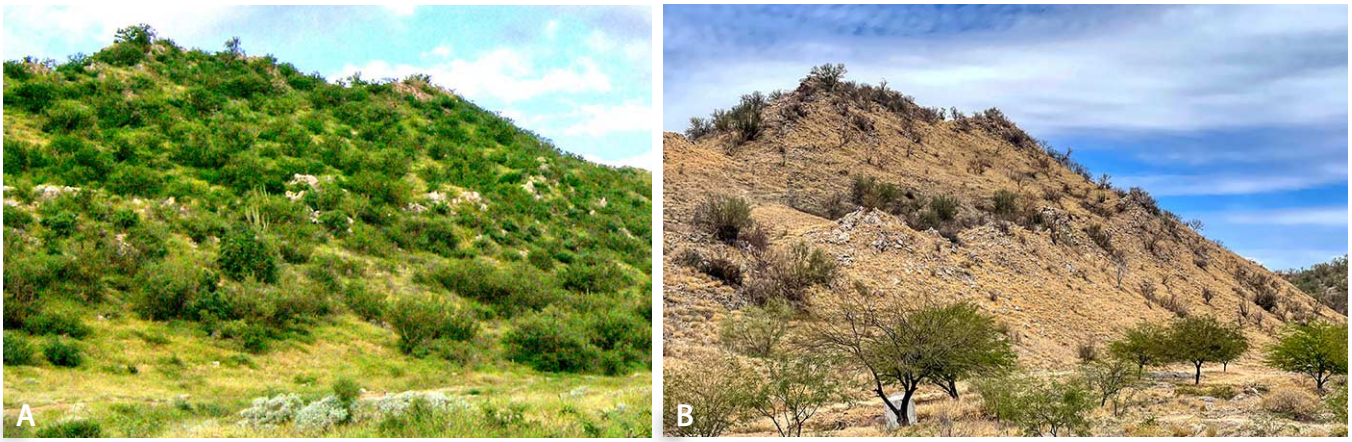

Figura 10. Aquí se puede apreciar el deterioro de la vegetación de la ladera poniente del PCH por los incendios. A. Una densidad alta de vegetación en 2006. *Foto por Cristina Vergara-Sánchez.* B. Impacto dramático sobre el matorral después del incendio. *Foto por J. J. Sánchez-E.*

Plants of the Central Park of Hermosillo *continued*

Non-native species

The CPH flora has 16 non-native species, 9.7% of the flora. They include six species that were deliberately planted in the park. The other species are mostly on roadsides near the entrance of the park. Except for white lead tree/*guaje* (*Leucocephala leucocephalum*), they are all herbs, including nettleleaf goosefoot/*chual* (*Chenopodiastrum murale*), sour clover/*trébol* (*Melilotus indica*), Bermuda grass/*zacate bermuda* (*Cynodon dactylon*), wild lettuce/*lechuga silvestre* (*Lactuca serriola*), London rocket/*pamitón* (*Sisymbrium irio*), common sowthistle/*chinita* (*Sonchus oleraceus*), and puncture vine/*toritos* (*Tribulus terrestris*). In the spring of 2021, tumbleweed/*chamizo volador* (*Salsola tragus*) was recorded for the first time but is not as invasive in desertscrub as elsewhere. A watermelon plant/*sandía* (*Citrullus lanatus*) recorded in 2006 possibly grew from seeds of fruit consumed by visitors. White lead tree is an invasive tree in tropical areas worldwide. Some non-native species were introduced as shade trees near the park entrance, including neem (*Azadirachta indica*), date palm/*palma datilera* (*Phoenix dactylifera*), and Chilean mesquite/*mezquite chileno* (*Prosopis chilensis*).

Feather bush/*tepeguaje* (*Lysiloma watsonii*), planted near the entrance, is native to southern Sonora, reaching as far north as Arizona, but not in the Sonoran Desert. A Mexican paloverde/*bagote* (*Parkinsonia aculeata*) may have been planted or reached the area by itself. It is a tropical species typically found in disturbed and riparian habits from South America to southern Sonora but is adventive in much of the rest of the state. Native Sonora species such as *brea* (*Parkinsonia praecox*) and Manila tamarind/*guamúchil* (*Pithecellobium dulce*) that do not belong in this habitat have been introduced and planted near the park entrance. The only non-native species that is a serious invasive is buffelgrass Also, at the entrance to the park, several native species are present on disturbed roadsides, including Mexican prickly poppy/*cardo* (*Argemone ochroleuca* var. *ochroleuca*), whitescale saltbush/*chamiso cenizo* (*Atriplex elegans*), peppergrass/*lentejilla* (*Lepidium lasiocarpum*), blazingstar/*pega pega* (*Mentzelia multiflora*), green carpetweed/*anisillo* (*Mollugo verticillata*), and Spanish needles/*agujitas* (*Palafoxia arida*).

Conservation

Since the Municipal Natural Protected Area was declared by the Municipality of Hermosillo in 2009, the Central Park Hermosillo (CPH) has been managed by the Department of Infrastructure, Urban Development, and Ecology. The CPH has not yet received the appropriate management and protection, or staff responsible for management and the objectives described in the Declaratory Agreement have not been carried out, including the development of the management plan (Murrieta 2020; Joel Zepeda, pers. comm. 2021).

Private organizations such as the Desert Hikers Group (DHG) and the Friends of Cerro Johnson have for several years been working to restore and preserve the site by rehabilitating trails and planting native trees, including *guayacán* and desert ironwood. With support from the municipality, they have removed buffelgrass, trash, and debris (Sergio Fabian-Urias, pers. comm. 2021). The DHG recently obtained financial support for the construction of gabions (wire and rock check dams) to reduce erosion, restore the soil, and retain rainwater (Sergio Müller, pers. comm. 2021). Other conservation groups, such as the Collectivo Sonora Silvestre, have planted *Agave angustifolia* in a binational project for the conservation of the Lesser Long-nosed Bat/*murciélago magueyero* (*Leptonycteris yerbabuenae;* Murrieta 2020).

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Las Plantas del Parque Central de Hermosillo *continúa*

El zacate buffel, es un zacate africano que fue introducido a Sonora a finales de los años 50 s como alimento para ganado bovino (Figura 9A; Alcalá, 1995). Está muy bien adaptado a incendios recurrentes (Figura 9B), un proceso ecológico ausente en el Desierto Sonorense y la vegetación más tropical hacia el este y sur. La introducción del buffel transforma el matorral desértico y el matorral espinoso en una sabana africana, mantenida por el fuego. Las especies nativas son destruidas por el fuego. Otro daño de igual magnitud es la capacidad del buffel de eliminar la presencia de nativas al ocupar su espacio y uso de agua, reduciendo de forma dramática la biodiversidad.

En el año 2006, muchas especies nativas fueron registradas inicialmente en el área que le llaman la explanada (Figuras 2, 10A). El zacate buffel apenas comenzaba su aparición en esta zona y la vegetación estaba intacta con la presencia de diversas plantas nativas. En 2018, gran parte del área se quemó por incendios atizados por zacate buffel. Actualmente esta área está completamente invadida por el buffel y muchas especies nativas ya han sido o serán extirpadas por su competencia e incendios. (Figura 10B). Los incendios del buffel principalmente impactan a las enredaderas y las hierbas perennes y anuales.

Teniendo en cuenta la dificultad de eliminar esta agresiva invasora, se recomienda la frecuente remoción de buffel alrededor de importantes plantas que podrían ser impactados por el fuego: *Adelia obovata,* chuparrosa, guayacán, palo fierro, palo verde, papelillo, *Paulinia sonorensis,* palo santo, salvia, torote, torote blanco, torote prieto, y sangrengado, entre otros (Figura 10B).

Conclusiones

Esta flora local es una contribución al conocimiento de la diversidad biológica del Desierto Sonorense y el estado de Sonora. Este documento contabiliza y muestra la diversidad de plantas del Parque Central de Hermosillo, un área natural protegida municipal de casi 30 hectáreas en el Cerro Johnson de la Sierra Espinazo Prieto. Se intersectan dos ecosistemas de Sonora: El Matorral Desértico Sonorense y el Matorral Espinoso. El listado de plantas puede servir como información de base para la elaboración del Plan de Manejo del parque. Este artículo podrá utilizarse como una fuente de consulta por organizaciones de la sociedad civil que apoyen las actividades de conservación y educación ambiental en el parque, y también por científicos que realicen sus estudios sobre flora, fauna, entre otras investigaciones. Estudiantes de biología, ecología, entomología y otras carreras de las universidades locales y de la entidad podrán consultar este trabajo para apoyarse en la planificación de sus prácticas de campo en el PCH. Finalmente, este artículo puede servir como material de divulgación y una guía para que los visitantes adquieran conocimiento sobre la alta diversidad del PCH; sobre todo para que conozcan y aprecien las plantas nativas que pueden observar cuando visiten el parque durante las diferentes épocas del año y que forman parte de nuestra identidad como habitantes de esta región, además de servir como refugio y alimentación entre otros servicios que prestan a diversas especies de animales que viven en este entorno natural.

Agradecimientos

Le agradecemos a Ana Lilia Reina-Guerrero su ayuda por sus traducciones para ambas versiones en inglés y español.

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Acuerdo por el que se declara Área Natural Protegida Municipal, con carácter de Parque Urbano, una superficie de 29-69-55.35 hectáreas, ubicada en el centro de Población de la ciudad de Hermosillo, Estado de Sonora, con el Nombre de Parque Central de Hermosillo de 2009 [H. Ayuntamiento de Hermosillo]. 22 de enero de 2009. Boletín Oficial del Gobierno del Estado de Sonora. Tomo CLXXXIII. Número 7.

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Plants of the Central Park of Hermosillo *continued*

Buffelgrass is a robust African grass that was introduced to Sonora as a food source for cattle in the 1950s (Figure 9A; Alcalá 1995). It is very well adapted to recurrent fires (Figure 9B), an ecological process absent from Sonoran Desert and more tropical vegetation to the east and south. Introduction of buffelgrass transforms desertscrub and thornscrub to an African savannah maintained by fire. Native species are killed by fires. But equally damaging is that buffelgrass out-competes native species for space and water causing dramatic reductions in species diversity.

In 2006, many native species were first recorded in the open area near an activity shade structure (Figures 2, 10A). Buffelgrass was just beginning to appear and the vegetation was intact with diverse native plants present. Today this area is completely invaded by buffelgrass and many species have been or will be locally extirpated by competition and fire (Figure 10B). Especially impacted by buffelgrass fires are vines and herbaceous plants.

Considering the difficulty of removing this aggressive invasive, we recommend the frequent removal of any buffelgrass near important plants that would be impacted by fire, including *Adelia obovata, chuparrosa*, desert lavender, desert ironwood, fragrant bursera, *guayacán*, limberbush, littleleaf paloverde, *Paulinia sonorensis,* tree limberbush, tree morning glory, *torote blanco, torote prieto*, among others (Figure 10B).

Conclusions

This local flora is a contribution to the knowledge of the biological diversity of the Sonoran Desert and the state of Sonora. It documents the diversity of the plants of Cerro Johnson in the Central Park of Hermosillo, a protected area of about 30 hectares. In this area, Sonoran desertscrub merges with foothills thornscrub. The plant list serves as basic information for the development of a Park Management Plan and as a reference for conservation and environmental education activities in the Park by private organizations and schools. Students of biology, ecology, and entomology at local universities may use this publication to plan their field activities. This article can serve as a guide for visitors to learn more about and to appreciate the plants of the Sonoran Desert.

Acknowledgments

We thank Ana Lilia Reina-Guerrero for her help with both English and Spanish translations.

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CHECKLIST: Parque Central de Hermosillo

* = especies no-nativa ** = especies nativa a Sonora, pero plantado fuera de la distribución
* = non-native status ** = Sonoran native species planted out of range

Pteridophytes

PTERIDACEAE

Astrolepis cochisensis (Goodd.) D.M. Benham & Windham, helecho. Cochise scaly cloak fern

Notholaena lemmonii D.C. Eaton *var. lemmonii,* helecho. Lemmon's cloak fern.

Eudicots

ACANTHACEAE

Carlowrightia arizonica A. Gray, rama toro, palomitas. Arizona wrightwort.

Dicliptera resupinata (Vahl) Juss., alfalfilla. Arizona foldwing.

Elytraria imbricata (Vahl) Pers., cordoncillo. Purple scalystem.

Holographis virgata (Harv. ex Benth. & Hook. f.) T.F. Daniel

Justicia californica (Benth.) D. Gibson, chuparrosa.

Justicia candicans (Nees) L.D. Benson, Red justicia.

Tetramerium nervosum Nees., tapachorro. Hairy fournwort.

ACHATOCARPACEAE

Phaulothamnus spinescens A. Gray, ojo de víbora, putia. Devilqueen.

AMARANTHACEAE

Amaranthus fimbriatus (Torr.) Benth, quelite. Fringed amaranth.

Amaranthus palmeri S. Watson, quelite, bledo. Pigweed.

Amaranthus watsonii Standl. quelite, bledo.

Atriplex elegans (Moq.) D. Dietr. chamizo cenizo. Whitescale saltbush.

**Chenopodiastrum murale* (L.) S. Fuentes, Uotila & Borsch, chual. Nettleleaf goosefoot.

**Salsola tragus* L., chamizo volador. Tumbleweed.

Tidestromia lanuginosa (Nutt.) Standl., hierba ceniza. Woolly tidestrom.

APOCYNACEAE

Asclepias subulata Decne., jumete. Rush milkweed.

Funastrum heterophyllum (Engelm. ex Torr.) Standl., huirote lechoso. Milkweed vine.

Marsdenia edulis S. Watson, talayote. Milkweed vine.

Polystemma cordifolium (A. Gray) McDonnell & Fishbein, talayote. Milkweed vine.

ASTERACEAE

Ambrosia ambrosioides (Cav.) W.W. Payne, chicura, canyon ragweed

Ambrosia confertiflora DC., estafiate. Slimleaf ragweed.

Baccharis sarothroides A. Gray, romerillo. Desert broom.

Bebbia juncea (Benth.) Greene. Sweetbush.

Brickellia coulteri A. Gray. Coulter brickellbush.

Encelia farinosa A. Gray, rama blanca, incienso. Brittlebush.

**Lactuca serriola* L., lechuga silvestre. Wild lettuce.

Lagascea decipiens Hemsl., confiturilla grande.

Palafoxia arida B.L. Turner & M.I. Morris *var. arida,* agujitas. Spanish needles.

Pectis filipes Harv. & A. Gray *var. filipes*. manzanilla. Fivebract cinchweed.

Perityle californica Benth., manzanilla. California rock daisy.

**Sonchus oleraceus* L., chinita. Common sowthistle.

Thymophylla concinna (A. Gray) Strother, manzanilla de coyote.

Trixis californica Kellogg, hierba del aire, santa lucía. Trixis.

Viguiera dentata (Cav.) Spreng. Goldeneye.

BORAGINACEAE

Cordia parvifolia DC., Vara prieta. Littleleaf cordia.

Cryptantha barbigera (A. Gray) Greene, peludita. Popcorn flower.

Cryptantha maritima (Greene) Greene, peludita. Popcorn flower.

Eucrypta micrantha (Torr.) A. Heller. Desert eucrypta.

Heliotropium procumbens Mill., peludita. Popcorn flower.

Johnstonella angustifolia (Torr.) Hasenstab & M.G. Simpson, peludita, Bristlelobe cryptantha.

Nama hispida A. Gray *var. sonorae* L.C. Hitchc., moradita. Sand bells.

Nama jamaicense L.

Phacelia crenulata Torr. ex S. Watson. Wild heliotrope.

Phacelia distans Benth. Wild heliotrope.

BRASSICACEAE

Descurainia pinnata (Walter) Britton, pamita. Tansy mustard.

Lepidium lasiocarpum Nutt., lentejilla. Peppergrass.

Lyrocarpa coulteri Hook. & Harv., Coulter's lyrepod.

**Sisymbrium irio* L., pamitón. London rocket.

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CHECKLIST: Parque Central de Hermosillo

* = especies no-nativa ** = especies nativa a Sonora, pero plantado fuera de la distribución
* = non-native status ** = Sonoran native species planted out of range

BURSERACEAE

Bursera fagaroides (Kunth) Engl. *var. elongata* McVaugh & Rzed., torote papelillo. Fragrant bursera.

Bursera laxiflora S. Watson, torote prieto.

Bursera microphylla A. Gray, torote blanco. Elephant tree.

CACTACEAE

Cylindropuntia fulgida (Engelm.) F.M. Knuth, choya. Chainfruit cholla.

Cylindropuntia leptocaulis (DC.) F.M. Knuth, tasajillo. Desert Christmas cactus.

Cylindropuntia thurberi (Engelm.) F.M. Knuth subsp. *versicolor* (Engelm. ex J.M. Coult.) M.A. Baker, siviri. Staghorn cholla.

Ferocactus emoryi (Engelm.) Orcutt, biznaga. Emory's barrel cactus.

Lophocereus schottii (Engelm.) Britton & Rose var. *schottii,* sinita. Oldman cactus.

Mammillaria grahamii Engelm. var. *grahamii,* viejitos, cabeza de viejo. Fishhook cactus.

Mammillaria mainiae K. Brandegee, viejitos, cabeza de viejo. Fishhook cactus.

Opuntia gosseliniana Weber, duraznilla, nopal. Pricklypear cactus.

Peniocereus striatus (Brandegee) F. Buxbaum, sacamatraca. Gearstem cactus.

Stenocereus alamosensis (J.M. Coult.) A.C. Gibson & K.E. Horak, sina.

Stenocereus thurberi (Engelm.) F. Buxbaum, pitayo, pitahaya. Organpipe cactus.

CANNABACEAE

Celtis pallida Torr., garambullo. Desert hackberry.

CARYOPHYLLACEAE

Achyronychia cooperi Torr. & A. Gray. Frost-mat.

CLEOMACEAE

**Arivela viscosa* (L.) Raf. Asian spider flower.

Cleome tenuis S. *Watson.*

CONVOLVULACEAE

Cuscuta legitima Costea & Stefanov, fideo. Dodder.

Evolvulus alsinoides L., fulgencia. Slender dwarf morning glory.

Ipomoea arborescens (Humb. & Bonpl.) G. Don, palo blanco, palo santo. Tree morning glory.

Ipomoea hederacea Jacq., trompillo. Morning glory.

Ipomoea ternifolia Cav. var. *leptotoma* (Torr.) J.A. McDonald, trompillo. Morning glory.

Merremia palmeri Hallier f., trompillo. Morning glory.

CUCURBITACEAE

Apodanthera palmeri S. Watson, calabaza silvestre.

**Citrullus lanatus* (Thunb.) Matsum. & Nakai, sandía. Watermelon.

Ibervillea sonorae (S. Watson) Greene, güereque.

EUPHORBIACEAE

Acalypha californica Benth., hierba del cáncer.

Adelia obovata Wiggins & Rollins

Argythamnia lanceolata (Benth.) Müll. Arg. Narrow-leaf silverbush.

Argythamnia serrata (Torr.) Müll. Arg. Sawtooth ditaxis.

Croton sonorae Torr., vara prieta. Sonoran croton.

Euphorbia californica Benth., sipehui. California spurge.

Euphorbia florida Engelm., golondrina. Spurge.

Euphorbia gracillima S. Watson, golondrina. Spurge.

Euphorbia pediculifera Engelm,. golondrina. Spurge.

Euphorbia polycarpa Benth., golondrina. Spurge.

Jatropha cardiophylla (Torr.) Müll. Arg., sangrengado. Limberbush.

Jatropha cordata (Ortega) Müll. Arg., torota. Tree limberbush.

Manihot angustiloba (Torr.) Müll. Arg., pata de gallo. Desert mountain manihot.

Pleradenophora tikalana (Lundell) A.L. Melo & Esser, hierba de la flecha. Arrow poison plant.

FABACEAE

Caesalpinia palmeri S. Watson, palo piojo.

Calliandra eriophylla Benth., cósahui del norte. Fairyduster.

Coursetia glandulosa A. Gray, sámota. Rosary babybonnets.

Dalea mollis Benth. Hairy prairie clover.

Eysenhardtia orthocarpa (A. Gray) S. Watson, palo dulce. Kidneywood.

**Leucaena leucocephala* (Lam.) de Wit, guaje. White lead tree.

***Lysiloma watsonii* Rose, tepeguaje. Feather bush.

Marina parryi (Torr. & A. Gray) Barneby. Parry's false prairie-clover.

Mariosousa russelliana (Britton & Rose) Seigler & Ebinger, guayabilla.

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* = especies no-nativa ** = especies nativa a Sonora, pero plantado fuera de la distribución
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**Melilotus indica* (L.) All., trébol agrio. Sour clover.

Mimosa laxiflora Benth., gatuño, gatillo. Mexican mimosa.

Nissolia schottii (Torr.) A. Gray. Schott's yellowhood.

Olneya tesota A. Gray, palo fierro. Desert ironwood.

Parkinsonia aculeata L., bagote, retama. Mexican paloverde.

Parkinsonia florida (Benth. ex A. Gray) S. Watson, palo verde azul. Blue paloverde.

Parkinsonia microphylla Torr., palo verde. Littleleaf paloverde.

***Parkinsonia praecox* (Ruiz & Pav. ex Hook.) J. Hawkins, brea, palo brea.

***Pithecellobium dulce* (Roxb.) Benth., guamúchil. Manila tamarind.

***Prosopis chilensis* (Molina) Stuntz, mezquite chileno. Chilean mesquite.

Senna covesii (A. Gray) H.S. Irwin & Barneby, hojasén. Desert senna.

Tephrosia vicioides Schltdl. Red hoarypea.

Vachellia farnesiana (L.) Wight & Arn., huizache. Sweet acacia.

Zapoteca formosa (Kunth) H.M. Hern. subsp. *schottii* (Torr. ex S. Watson) H.M. Hern., guaje de caballo. Schott's sickpea.

KRAMERIACEAE

Krameria erecta Willd. ex Schult., cósahui. Littleleaf ratany.

Krameria sonorae Britton, cósahui.

LAMIACEAE

Condea albida (Kunth) Harley & J.F.B. Pastore, salvia. Desert lavender.

LOASACEAE

Mentzelia multiflora (Nutt.) A. Gray, pega pega. Blazingstar.

MALPIGHIACEAE

Callaeum macropterum (Moc. & Sessé ex DC.) D.M. Johnson, gallinita, batanene. Yellow orchid vine.

Cottsia californica (Benth.) W.R. Anderson & C. Davis. Desert vine.

Cottsia gracilis (A. Gray) W.R. Anderson & C. Davis. Desert vine.

Cottsia linearis (Wiggins) W.R. Anderson & C. Davis. Desert vine.

Echinopterys eglandulosa (A. Juss.) Small.

MALVACEAE

Abutilon abutiloides (Jacq.) Garcke ex Britton & Wilson, pintapán. Shrubby Indian mallow.

Abutilon incanum (Link) Sweet, rama escoba. Hoary Indian mallow.

Ayenia filiformis S. Watson

Herissantia crispa (L.) Brizicky, pelotazo. Bladder mallow.

Sphaeralcea coulteri (S. Watson) A. Gray, anaranjadita, malva anaranjada. Coulter's globemallow.

MARTYNIACEAE

Proboscidea parviflora (Wooton) Wooton & Standl., cuernitos. Devil's claw.

MELIACEAE

***Azadirachta indica* A. Juss., Neem.

MOLLUGINACEAE

Mollugo verticillata L. Green carpetweed.

NYCTAGINACEAE

Allionia incarnata L. Windmills.

Boerhavia coccinea Mill., juaninipili. Scarlet spiderling.

Boerhavia coulteri (Hook. f.) S. Watson, mochis, juaninipili. Coulter's spiderling.

Commicarpus scandens (L.) Standl., miona. Climbing wartclub.

ONAGRACEAE

Eulobus californicus Nutt. ex Torr. & A. Gray. California suncup.

PAPAVERACEAE

Argemone ochroleuca Sweet subsp. *ochroleuca,* cardo. Mexican prickly poppy.

PASSIFLORACEAE

Passiflora arizonica (Killip) D.H. Goldman. Arizona passionflower.

PLANTAGINACEAE

Plantago ovata Forssk., pastora. Desert indianwheat.

Pseudorontium cyathiferum (Benth.) Rothm. Dog's mouth.

POLEMONIACEAE

Ipomopsis sonorae (Rose) A.D. Grant.

RESEDACEAE

Oligomeris linifolia (Vahl) J.F. Macbr. Lineleaf whitepuff.

RHAMNACEAE

Condalia globosa I.M. Johnst., crucecilla. Bitter snakewood.

Karwinskia humboldtiana (Willd. ex Roem. & Schult.) Zucc., tullidora, coyotillo.

RUBIACEAE

Randia thurberi S. Watson, papache borracho.

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SANTALACEAE

Phoradendron californicum Nutt., toji. Desert mistletoe.

SAPINDACEAE

Cardiospermum corindum L., farolitos. Balloon vine.

Paullinia sonorensis S. Watson

SOLANACEAE

Datura discolor Berhn., toloache. Desert thorn-apple.

Lycium berlandieri Dunal, salicieso. Berlandier's woldberry.

Nicotiana clevelandii A. Gray, tabaco de coyote. Cleveland's tobacco.

Nicotiana obtusifolia M. Martens & Galeotti, tabaco de coyote. Desert tobacco.

Physalis crassifolia Benth., tomatillo. Yellow nightshade groundcherry.

STEGNOSPERMATACEAE

Stegnosperma halimifolium Benth., chapacolor, hierba de la víbora, tinta.

VERBENACEAE

Lantana camara L., confiturilla. Common lantana.

ZYGOPHYLLACEAE

Guaiacum coulteri A. Gray, guayacán.

Kallstroemia grandiflora Torr. ex A. Gray, baiburina, mal de ojo. Summer poppy.

**Tribulus terrestris* L. toritos, toboso. Puncture vine.

Monocots

ARECACEAE

***Phoenix dactylifera* L., palma datilera. Date palm.

ASPARAGACEAE

Agave angustifolia Haw., maguey. Narrowleaf century plant.

POACEAE

Aristida ternipes Cav. var. *ternipes,* zacate araña. Spider Grass.

Bouteloua aristidoides (Kunth) Griseb., aceitilla. Six-weeks needle grama.

Bouteloua barbata Lag. *var. barbata,* navajita. Six-weeks grama.

Bouteloua diversispicula Columbus, zacate borreguero. False grama.

**Cynodon dactylon* (L.) Pers., zacate Bermuda. Bermuda grass

**Pennisetum ciliare* (L.) Link, zacate buffel. Buffelgrass.

Setaria liebmannii E. Fourn. Liebmann's brittlegrass.

Urochloa arizonica (Scribn. & Merr.) Morrone & Zuloaga, piojillo de Arizona. Arizona signalgrass.

THE ARIZONA NATIVE PLANT SOCIETY
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