Persicaria amphibia, Longroot Smartweed

Cora Estelle Mosher

Plant Press Arizona

THE ARIZONA NATIVE PLANT SOCIETY

Volume 48, Number 1 **Summer 2025**

Highlights from Botany 2025

Plus

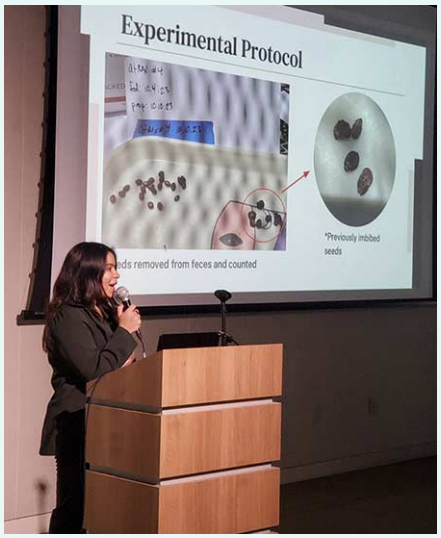
With Regular Features

Queen of the Night *(Peniocereus greggii)* is featured in this issue's "Spotlight" (see page 9). *Photo by Doug Ripley.*

Highlights from Botany 2025

by J. Douglas Ripley, President Arizona Native Plant Society

This issue of *Plant Press Arizona* highlights some of the presentations made at the Arizona Native Plant Society's most recent annual botany conference which was held in March at the Desert Botanical Garden in Phoenix. One paper by Tom Van Devender discusses some of the very interesting strategies developed by various Sonoran Desert animals to facilitate the distribution of palo verde seeds. A second paper by Tom Van Devender and others provides a detailed account of the trans-border flora and history of the San Bernardino National Wildlife Refuge in Arizona and Rancho San Bernardino in Sonora, Mexico. Other papers by Ries Lindley and Louise Fleurs provide individual perspectives on Arizona's native flora. As always, our regular features "Spotlight on a Native Plant" and book review provide interesting insights to native plant subjects.



Above, from left: Presentation by Maria Acevedo Garcia. Sara Hunkins, Collection Manager for the DBG's Lois Porter Earle Herbarium, provided tours of the Herbarium. *Photos by Doug Ripley.* Inset: The Desert Botanical Garden. *Photo by The Desert Botanical Garden.*

President's Note

by Douglas Ripley jdougripley@gmail.com

As we have entered an exceptionally hot and dry summer, I extend all best wishes to the members of the Arizona Native Plant Society as well as my sincere thanks to all for your continued support and participation in the Society. Unfortunately, this has been a rather gloomy winter and spring for native plant enthusiasts due to the incredibly dry conditions since last year. With the recent start of the monsoon season, a few areas of the state have started to receive rain but many areas remain parched so we can only hope that moisture levels will increase as the season progresses.

Notwithstanding the grim climatic situation so far this year, the Society has successfully continued its activities at many of its chapters, through state level committees, and at the state level. For example, volunteers from the Tonto Basin Chapter, led by chapter president Becky Settje and the Tonto Basin Stinknet Patrol, joined forces with the Gila County Extension and the Tonto Basin Forest Service to pull Stinknet along the receded shoreline of Roosevelt Lake at Schoolhouse Point and Indian Point. In total, the volunteers removed over four hundred pounds of Stinknet!

The State Conservation Committee, under the outstanding leadership of Chairman John Scheuring, accomplished many worthwhile projects, including helping to facilitate the Arizona Department of Transportation's erection of a road sign directing visitors to the Waterman restoration site; hosting a Waterman restoration field day for the National Native Seed Conference in February with 32 people in attendance; continuing a long established program for directing simultaneous invasive control and native rewilding efforts over four miles in three canyons in the west Catalinas; leading volunteers to manually remove Lehmann lovegrass at two threatened *Calochortus kennedyii* populations in Catalina State Park; and, undertaking several invasive species control initiatives in Madera Canyon.

Accomplishments of the Education and Outreach Committee included the publication by Timber Press of a Society-sponsored book entitled the *Southwest Native Plant Primer* prepared by Jack Dash and Luke Takata, a most impressive accomplishment!

Another accomplishment of the Education and Outreach Committee was the Botany Conference 2025 that was held on March first and second at the Desert Botanical Garden in Phoenix. Attended by approximately 150 people, the first day the conference included guided tours of the gardens and some of its new research facilities. The second day was devoted to interesting presentations on a wide range of botanical topics in Dorrance Hall. We have included in this issue of *Plant Press Arizona* some of the papers presented at this year's conference. Thanks to member Andrew Salywon, the Society will be able to hold its 2026 Conference again in the spectacular Desert Botanical Garden.

With hopes for a magnificent monsoon season, I wish you a pleasant summer and fall with many opportunities to enjoy the wonderful Arizona flora.

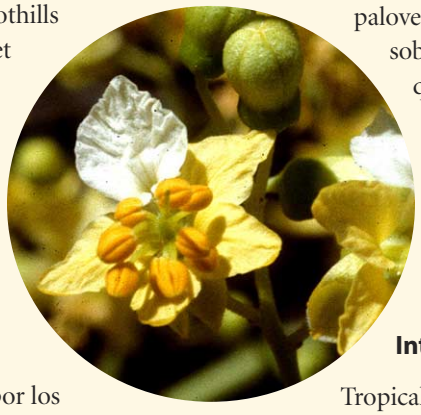
Palo Verdes, Seed Beetles, and Pocket Mice

by Thomas R. Van Devender[1]

Figure 1. Foothills palo verde. *Photos by Mark A. Dimmitt.* A. Flowering tree. B. Flowers.

Abstract

Foothills palo verde likely evolved in the Miocene when the Sonoran Desert formed. Seedling establishment is limited by herbivores (cottontail and jackrabbits) and seed predators (ground squirrels, packrats, and seed [bruchid] beetles). Larvae of seed beetles directly kill seeds. Bruchids (*Algarobius prosopis, Mimosestes amicus, M. nubigens, M. ulkei,* and *Stator limbatus*) and the parasitic wasp (*Urosigalphus bruchi*, Braconidae) emerged from the Waterman Mountains foothills and blue palo verde pods in an Arizona-Sonora Desert Museum study. Pocket mice bury seeds in soil caches to eat later. Surviving seeds may germinate during the summer rain. Hard-coated seeds of many desert cacti and herbs are likely dispersed in desert tortoise scat. Palo verde seeds in rodent cheek pouches eaten by snakes that survive digestion are transported away from the tree. Fossils of foothills and blue palo verdes, seed beetles, and pocket mice were identified in Sonoran Desert packrat middens. Periodic reproductive success is sufficient to ensure the survival of long-lived plants.



Resumen

El paloverde de hojas diminutas probablemente evolucionó en el Mioceno, cuando se formó el Desierto Sonorense. El establecimiento de plántulas se ve limitado por los herbívoros (conejos y liebres) y los depredadores de semillas (juancitos, ratas cambalacheras y escarabajos de semillas [brúquidos]). Las larvas de los escarabajos matan las semillas. Los brúquidos (*Algarobius prosopis, Mimosestes amicus, M. nubigens, M. ulkei* y *Stator limbatus*) y una avispa parásita (*Urosigalphus bruchi*, Braconidae) emergieron de las vainas de paloverdes de hojas diminutas y azul de Waterman Mountains en un estudio del Arizona-Sonora Desert Museum. Los ratones de abazones entierran las semillas en depósitos de tierra para comerlas más tarde. Las semillas supervivientes pueden germinar con las lluvias de verano. Es probable que las semillas de cubierta dura de muchas cactáceas y hierbas del desierto se dispersen en los excrementos de las tortugas del desierto. Las semillas de paloverde en los abazones de roedores que sobreviven a la digestión de las serpientes quedan lejos del árbol. Se identificaron fósiles de paloverdes de hojas diminutas y azul, escarabajos de semillas y ratones de abazones en los depósitos de *Neotoma* del Desierto Sonorense. El éxito reproductivo periódico es suficiente para garantizar la supervivencia de las plantas de vida larga.

Introduction

Tropical deciduous forest was first discerned in the fossil record in the Eocene (54 to 35 mya [million years ago], Graham 1993, Graham & Dilcher 1995). The Miocene Revolution followed the uplift of the Sierra Madres Occidental and Oriental in the late Oligocene 25 to 15 mya. Tropical forests were restricted to the continental coasts, new oak woodlands and pine-oak forests formed in high elevations, and new species evolved (Van Devender 2002). During a drying trend in the middle Miocene, tropical deciduous forest isolated west of the Sierra Madre Occidental at low elevation, changed to thornscrub and then Sonoran Desert by 10 mya. Many modern Sonoran desertscrub dominants evolved in tropical vegetation before the desert existed. Others, including foothills palo verde (*Parkinsonia microphylla,* Figure 1A), apparently evolved after the desert formed. An important exception is creosotebush (*Larrea divaricata*), which evolved

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Figure 2. Palo verde root borer. *Photo by Susan D. Carnahan.*

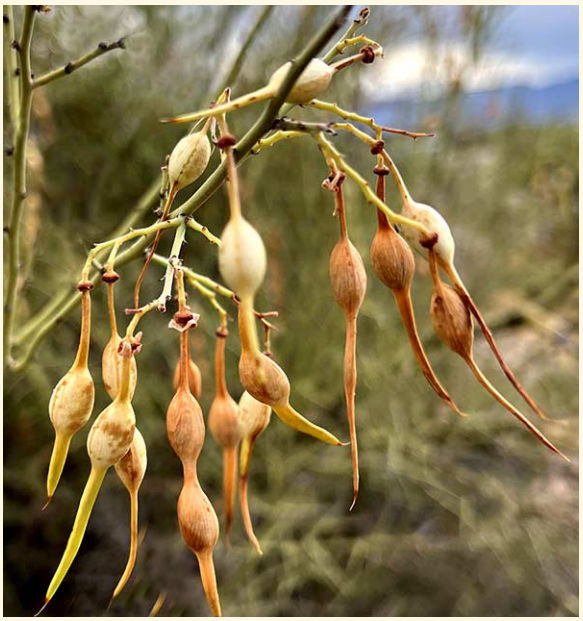

Figure 3. A. Round-tailed ground squirrel feeding in a shrub. *Photo by Diane Drobka.* B. Foothills palo verde pods. *Photo courtesy of Rebecca Johnstone, Tucson Clean & Beautiful, Inc.*

Palo Verdes, Seed Beetles, and Pocket Mice *continued*

in South America before immigrating north to conquer the deserts of North America.

Foothills palo verde is an interesting example of the complicated reproductive ecology of a long-lived, woody desert plant and the important roles played by animals. Dimmitt (2002) estimated that foothills palo verde lives up to 400 years, surviving climate extremes in drought, cold, heat, and violent summer rainstorms with high winds. In drought years, there are few flowers, little seedling survival, and dramatic population crashes of insects, rodents, and reptiles. Palo verdes self-prune entire branches to survive drought. Hard freezes kill the growing tips of branches, severely reducing spring flowering and seed production as well as secondary impacts on insects, insectivorous and pollen-feeding birds, and herbivorous and seed-eating rodents, and snake populations.

Foothills Palo Verde Reproduction

The reproduction of foothills palo verde reflects its long-term climate with only periodic recruitment in wet periods following mild winters. Flowers are in April and May (Figure 1A & B) timed to have seeds on the ground when summer monsoon rains begin in late July or early August. The palo verde root borer (*Derobrachus hovorei*, Cerambycidae, Figure 2), one of the largest beetles in North America, attacks palo verdes (*Parkinsonia* spp.), especially the Mexican palo verde (*P. aculeata*), and other trees. Its big white larvae eat the roots, weakening or killing the tree.

Joe McAuliffe, a post-doctoral researcher at the University of Arizona Desert Laboratory on Tumamoc Hill, gave a presentation on the interactions between palo verdes and animals in ca. 1990. His research showed that the establishment of foothills palo verde seedlings is limited by herbivores, especially cottontail rabbits (*Sylvilagus audubonii*) and antelope and black-tailed jackrabbits (*Lepus alleni* and *L. californicus*, McAuliffe 1986). Palo verde seeds are produced in mass to offset losses due to seed predation. Round-tailed ground squirrels or *juancitos* (*Xerospermophilus tereticaudus*, Figure 3A) climb into the trees to eat 25-44% of the seeds (Figure 3B). Packrats (*Neotoma albigula*) and Harris' ground squirrels (*Ammospermophilus harrisi*) eat seeds on the ground but do not store them in caches in the soil.

Seed Beetles and Pocket Mice

Seed (bruchid) beetles (Chrysomelidae: Bruchinae) are a serious threat to seeds of many plants, although some plants produce toxic chemicals to kill their larvae (Bridwell 1920). Foothills palo verde pods ripen in June and then fall off the tree. The arid fore-summer season of hot, dry conditions is from May to mid-July before the summer monsoon rains. Soil surface temperatures are as high as 60°C (=140°F) (Hanson & Hanson 2002). The larvae feed inside the seeds and emerge through holes in the seed coat. The pods dehisce when they fall to the ground, allowing pocket mice easy access. Multiple generations of bruchids will consume seeds in pods left on trees, but they do not lay eggs on seeds on the ground (McAuliffe 1990).

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Palo Verdes, Seed Beetles, and Pocket Mice *continued*

Figure 4. Seed beetles reared from Waterman Mountains foothills palo verde pods. *Photos: https://bugguide.net/node/view/15740.*

A. *Mimosestes amicus*. B. *Stator limbatus.* C. *Algarobius prosopis*.

McAuliffe's (1990) research on the roles of seed beetles and pocket mice in palo verde reproduction (McAuliffe 1990) inspired me, John F. Wiens, and W. Eugene Hall to study seed beetles at the Arizona-Sonora Desert Museum. In 1990–1991, ripe palo verde pods (Figure 3B) were collected from trees in the Waterman Mountains (now Ironwood National Monument) west of Tucson in Pima County, Arizona, and kept indoors in jars into December to see which bruchid species and how many individuals emerged. Two species of bruchids (*Mimosestes amicus* and *Stator limbatus*, Figures 4A & B) emerged from both foothills and blue (*Parkinsonia florida*) palo verde pods as well as a parasitic wasp in the Braconidae (*Urosigalphus bruchi*). Additional bruchid species emerged from foothills palo verde (*M. nubigens* and *M. ulkei*) and blue palo verde (*Algarobius prosopis,* Figure 4C) pods. In McAuliffe's study, 9.4% of the palo verde seeds were infected by bruchids at time of maturation.

Some squirrels (chipmunks, ground squirrels, and marmots) and heteromyid rodents (kangaroo rats and pocket mice) have cheek pouches that help transport food. Pocket mice specialize in foothills palo verde seeds, rarely collecting seeds of other plants. They forage at night, carry a single seed in each cheek pouch, and bury 1 to 17 seeds in soil caches 1.5 to 7.8 m away from the tree (McAuliffe 1990, Dimmitt 2002, Tyburec et al. 2002). By early July, 95% of the fallen palo verde seeds were collected by rodents. McAuliffe (1990) trapped four species of pocket mice in the Waterman Mountains (*Chaetodipus baileyi, C. intermedius, C. penicillatus* [Figure 5A], and *Perognatus amplus* [Figure 5B]).

Bruchid larvae may mature inside seeds buried in the ground but do not reproduce. Some seeds survive to germinate during the summer rain, with nearly half of palo verde seedlings in tight clusters from seed caches (McAuliffe 1990). Seedlings are readily eaten by rabbits but not seed-eating pocket mice. Their chances of survival are better in small caches under triangleleaf bursage (*Ambrosia deltoidea)* than under trees or in the open — a new meaning for the concept of nurse plant!

Other Animal Seed Dispersers

The most important seed disperser in the foothills palo verde habitat is the Sonoran desert tortoise (*Gopherus morafkai*).

Van Devender et al. (2002) recorded 199 species of plants in its diet, including foothills palo verde. Tortoise fecal pellets are plant materials loosely held together with twigs and grass stems that soon disaggregate. Plant materials were identified in tortoise scat from the Silverbell and Waterman Mountains west of Tucson, Sand Tank Mountains near Gila Bend, and the Four Peaks area near Phoenix. Of the 104 species identified,

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Figure 5. Pocket mice in foothills paloverde habitat in the Waterman Mountains. *Photos by Doug Backlund.*

A. Desert pocket mouse (*Chaetopdipus penincillatus*). B. Arizona pocket mouse (*Perognathus amplus*).

Palo Verdes, Seed Beetles, and Pocket Mice *continued*

Figure 6. Sonoran desert tortoise eating prickly-pear (*Opuntia engelmannii*) fruit. *Photo by Tom Wiewandt.*

39 were hard seeds in pristine condition, including cacti (*Cylindropuntia, Echinocereus, Ferocactus, Mammillaria*, and *Opuntia*, Figure 6) and annual and perennial herbs (*Amsinckia, Argythamnia, Astragalus, Boerhavia, Cryptantha, Euphorbia, Kallstroemia, Lepidium, Lupinus, Pectocarya, Phacelia, Physalis*, and *Sphaeralcea*). Considering that the seeds of these plants survive in the soil for many years, tortoises wander all over rocky upland habitats, and live 50–100 years, the importance of this humble master gardener is underappreciated.

Reiserer et al. (2018) found seeds in heteromyid rodent pouches in preserved rattlesnake specimens in museum collections. Schuett et al. (2022) demonstrated that foothills palo verde seeds passing through the digestive tracks of the desert grassland kingsnake (*Lampropeltis getula* subsp. *splendida*), the gopher snake (*Pituophis catenifer*), and the western diamondback rattlesnake (*Crotalus atrox*, Figures 7A & B) are still viable. They inferred that seed rescue and dispersal by snakes is an important evolutionary process in plants. The gopher snake and the western diamondback rattlesnake as well as the black-tailed (*C. molossus*) and the tiger (*C. tigris*, Figure 7C) rattlesnakes live in foothills palo verde habitat in the Waterman Mountains. Considering that snakes often defecate on the surface, seeds germinate in the soil, and snake activity is low when the seeds fall in hot, dry June, snake seed dispersal is likely not important in palo verde recruitment.

Packrat Midden Records

Plant macrofossils preserved in radiocarbon-dated packrat (*Neotoma* sp.) middens documented changes in vegetation in the Sonoran Desert for the last 40,000 years (Van Devender 1990). In the Late Wisconsin glacial period ending 11,000 years ago, a pinyon-juniper-oak woodland was widespread in the desert lowlands. A transitional juniper-oak woodland with saguaro (*Carnegiea gigantea*) and brittlebush (*Encelia farinosa*) was present in the Early Holocene (the current interglacial period) 11,000 to 8,000 years ago. Sonoran desertscrub has been in the area since then.

In the Waterman Mountains, blue palo verde was in middens dated from 8,360 to 5,190 yr B.P. (years before 1950) in the Middle Holocene and foothills palo verde at 2,600 and 1,320 yr B.P. in the Late Holocene (Anderson & Van Devender

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Figure 7. Pocket mice predators in foothills paloverde habitat in the Waterman Mountains. A. & B. Western diamondback rattlesnake. *Photos by R. Wayne Van Devender and Diane Drobka.* C. Tiger rattlesnake. *Photo by R. Wayne Van Devender.*

Figure 8. Arizona Upland Sonoran desertscrub formed about 4,000 years ago in the Late Holocene. Similar communities likely developed in each of 15–20 interglacial periods in the Pleistocene and earlier in the Miocene and Pliocene. Visible dominants are desert ironwood, saguaro, foothills palo verde, ocotillo (*Fouquieria splendens*), chainfruit cholla (*Cylindropuntia fulgida*), brittlebush, and creosotebush. *Photo by Tom Van Devender.*

Palo Verdes, Seed Beetles, and Pocket Mice *continued*

1991). Similarly in the Puerto Blanco Mountains in Organ Pipe Cactus National Monument, blue palo verde was common from 7,970 to 5,240 yr B.P. (Van Devender 1987). Desert riparian trees such as catclaw acacia (*Senegalia* [= *Acacia*] *greggii*), velvet mesquite (*Neltuma* [=*Prosopis*] *velutina*), and blue palo verde grew on dry, south-facing slopes. Foothills palo verde along with desert ironwood (*Olneya tesota*), Mexican jumping bean (*Pleradenophora bilocularis*), and organ pipe cactus (*Stenocereus thurberi*) appeared in relatively modern desertscrub (Figure 8) middens dated from 5,240 to 30 yr B.P.

Middens in the Ajo Mountains in Organ Pipe Cactus National Monument yielded remains of two Waterman Mountains bruchids: *Algarobius prosopis* dated at 8,139 yr B.P. and *Stator limbatus* at 8,590 and 1,150 yr B.P. (Hall et al. 1989). Fossils tentatively identified to the four Waterman Mountains pocket mice (*Chaetodipus baileyi, C. intermedius, C. penicillatus*, and *Perognathus amplus*) were in middens dated at 14,500 yr B.P. in the Ajo Mountains and 9,870, 3,200, and 990 yr B.P. in the Puerto Blanco Mountains (Van Devender et al. 1991).

Conclusions

Catastrophic climate events and seed predation dramatically impact seed germination and seedling survival in foothills palo verde. Yet, it appears to be a Sonoran Desert species that evolved in the Miocene 10 million years ago and has survived fluctuating environments since, including huge contractions and expansions of its geographic range and populations during the 15–20 glacial-interglacial cycles in the last two million years of the Pleistocene. In conclusion, only periodic reproductive success is sufficient to ensure the survival of long-lived plants.

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Palo Verdes, Seed Beetles, and Pocket Mice *continued*

Acknowledgments

Joe McAuliffe's pioneering research on the plant-animal interactions in Sonoran desertscrub is still insightful and inspirational. John Wiens and Gene Hall participated in the Arizona-Sonora Desert Museum seed beetle study. Mariana Acevedo-García's presentation at the Arizona Native Plant Society 2025 annual meeting on rattlesnakes as seed dispersers research at the Desert Botanical Garden stimulated this discussion of 40 years of relevant studies. Pinau Merlin, Don Swann, and Cecil Schwalbe helped with pocket mice natural history and images. Photos were provided by Doug Backlund, Susan D. Carnahan. Mark A. Dimmitt, Diane Drobka, Rebecca Johnstone of Tucson Clean & Beautiful, Inc., R. Wayne Van Devender, and from Bugguide online. Ana Lilia Reina-Guerrero translated the Resumen. Support of Sonoran Desert natural history studies by Greater Good Charities, Inc. is greatly appreciated.

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SPOTLIGHT ON A NATIVE PLANT *by Jack Dash*[1]

Queen of the Night (*Peniocereus greggii*)

Of all the grotesque and unusual botanical inhabitants of the Sonoran Desert, few are as mysterious and surprising as the Queen of the Night cactus (*Peniocereus greggii*). Occurring across the southern portion of Arizona into New Mexico and Texas, these plants are nearly impossible to find when not in flower or fruit. Unlike other cacti that arm themselves with barbed spines and wooly glochids, the Queen of the Night defends itself using camouflage. For most of the year your typical Queen of the Night is a dull ash-colored twig twining into the base of a creosote shrub or palo verde tree. But as summer sets in like a heated blanket enveloping the desert, the thin branches begin to sprout tear-drop shaped buds covered in whiskery silver hairs.

The buds start slowly, growing just a few millimeters at a time until something, perhaps the spike in humidity preceding the monsoons, causes the buds to switch into overdrive. Buds quickly go from just a couple dozen millimeters to well over a hundred. The buds swell until one morning the creamy white petals begin to poke out from under their dark hood. As the sun sets that night, the flowers unfurl like an origami blossom, revealing an exuberant white bloom that reflects moonlight and exudes a slight melony aroma. Moths, attracted to the scent, will hover over the flower, dipping long proboscises into sweet pools of nectar. These plants are synchronous bloomers, so almost all individuals in an area will bloom over the course of just a few days with each flower lasting only one night before withering as the summer sun rises. Over the course of a few weeks, the ovary of the flower will grow, and a fruit develops that soon turns a vibrant red, holding tiny seeds that will sprout in the shade of an overhanging nurse shrub.

While the flower is the most compelling part of the Queen of the Night, it's worth noting what you can't see of this plant. For most cactus species 80+% of their biomass is above ground in the form of stems or pads. But the Queen of the Night is just the opposite, with most of its biomass underground in the form of a turnip-like tuber that can weigh several dozen pounds. If you want to see this plant in its native habitat look for it along sandy, gravelly wash margins after the bloom when the red fruit distinguishes the Queen of the Night from the shrubs it's hidden among. These plants may also be available from your local native plant nursery, and they can make a spectacular garden plant. In fact one well-watered Queen of the Night in Tucson was reputed to have three-hundred flowers in one night!

Though harder to find in habitat than more charismatic cacti like saguaros and barrels, Queen of the Night puts on one of the most riveting floral displays of any plant in the deserts of Arizona.

Peniocereus greggiio. From top: Figure 1. Fruit. *Photo credit Jack Dash*. Figure 2. Flower. *Photo credit Doug Ripley.*

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Parkinsonia florida. From top: Figure 1. *Photo by Liz Makings.* Figure 2. *Photo by Max Licher.*

Parkinsonia microphylla. From top: Figure 3. *Photo by Anthony Mendosa.* Figure 4. *Photo by Max Licher.*

A Way of Thinking *by Ries Lindley*[1]

According to the Arizona Meteorological Monthly Survey data (azmet.arizona.edu), the total precipitation for 2025 in Tucson at the end of May was 0.59 inches. This is abysmal, even to desert dwellers. The paloverde bloom was spectacular on the west side of town, just as though the trees didn't know about the drought. First, there were the deep golden yellows of the blue paloverdes (*Parkinsonia florida*), and as the blue paloverde blooms dropped away, the foothills paloverdes (*Parkinsonia microphylla*) started blooming, the flowers a light yellow and the banner petal snowy white. It was beautiful.

It all seemed so normal I gave it no thought until a query came from a friend who lives a little higher up at the base of the Rincon Mountains. By the time his call came, most of the bloom was over near my house. His question was: "Have the foothills paloverdes started blooming where you live?" This set off a whole chain of thoughts about what hath this drought wrought? A quick and dirty survey of the blue and foothills paloverdes near my house revealed that most of the blues had set a fairly normal looking amount of fruit. The foothills paloverdes had set almost none at all.

The fruit on the blue paloverdes argued against a failure of pollinators. The puzzle seemed to be why the foothills paloverdes would expend so many precious resources for a bloom and then set almost no fruit. I emailed Frank Reichenbacher, who spends inordinate amounts of time thinking about these sorts of questions. His answer was astonishing to me, so much so that I share it here.

"Local areas have their own unique histories, both long and short term . . . each plant relies on its own tracking of temperature, moisture availability, and metabolic resources stored in stem, leaf, and roots to figure out when to flower, when to not flower at all, and then how much to invest in maturing fruits. Plants seem to calculate wrong a lot. Abundant flowers that lead to little or no fruit production is one such example.

"The local history experienced by the plant is all it has to go on. You already know that the same plant doesn't just put out the same number of flowers and fruits every single year, even allowing for growth it's obvious that they don't. This is because the plant is making resource allocation decisions all the time in a wildly varying environment. Never forgetting that for an insect pollinated plant like the paloverde, it is really important to maintain a predictably available reward that supports, attracts, and enhances the pollinator service.

"The landscape is a kaleidoscope of histories experienced by every organism running at thousands of frames per second. Yet, the primary, indeed, the only requirement, is to do everything possible, to the point of death, to reproduce. If they don't flower, it's because they can't. They just can't."

Frank has given me a whole new toolkit for thinking about the life of plants. What a gift.

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

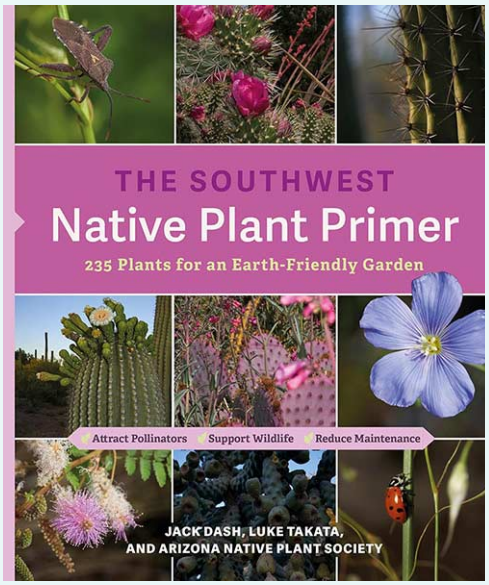
The Southwest Native Plant Primer: 235 Plants for an Earth-friendly Garden

by Jack Dash and Luke Takata. Timber Press, 2025. ISBN-13: 9781643263335.

Available from **www.hachettebookgroup.com** ($24.99 or ebook $13.99) and Amazon.com.

Books about planting the perfect garden are a bit like cookbooks, which is to say, there are hundreds of them with murky advice, untested recipes, and written more for looky-loos than actual readers. Books don't come with guarantees, and if all you want is coffee-table décor, then buy whatever catches your eye.

Gardening advice is also like cookbooks in another way; there are real gems to be found, and *The Southwest Native Plant Primer* is one of them. Yes, the *Plant Primer* is sponsored by the Arizona Native Plant Society, not because we needed clicks, but because we advocate for native plants, and there is a real need for a book with expert advice that is clearly written, beautifully illustrated, and meant for the whole southwest. Is that even possible? Yes, with very carefully thought-out organization and authors tuned into readers' needs.



The Primer is divided into three sections. The first 71 pages include the authors' philosophy, an explanation of the Southwest's bioregions, a detailed explanation of what constitutes a native plant, how to use the book, and how to get started. The second section has detailed information on 235 plant species for the Southwest, and the last section is the one that includes resources like a plant guild list (a group of plants that grow together in their natural environment), additional online and print references, and a thorough index.

There is a warm, comfortable feel to the fine coordination of the text with the photographs. There is a philosophy to this primer that goes something like this: A garden should fit snugly in its bioregion, contribute to the environment (all of it), and invite the viewer in. And most of all, it should be attainable. That is quite a lot of philosophy to pack in one book and might leave readers wondering, "How do I do all that?" To answer that question, there are hundreds of beautiful color photographs. Where native gardens are shown, the gardens are lush, and every plant appears to have chosen where it wants to grow. This may be the key that separates this primer from the less realistic wonder-garden with plants in crowded juxtaposition to a collection of non-natives for the sole purpose of having five colors of flowers in one flower bed all blooming at once. A garden is an extension of the gardener and the gardener's living space.

If a gardener really wants to stand out, it might be a good idea to know how to look for natives that aren't necessarily available at the Garden Maximart. The plant profiles include new ideas as well as commercially available plants. Each profile includes critical information, such as the plant's water needs, its potential size at maturity, flowering dates, and sun exposure needs. A short field guide section describes the plant's normal elevational range, biotic community preference, and its overall range. There is a description for each entry, which may include planting suggestions, and insects and animals the plant supports. (Yes, your garden is intended to support all the environment.)

For every plant in the profiles, there is a color photograph, and many of those photos invite the gardener to step outside the confines of the Maximart offerings. For example, the plant profiles include grasses, an often-neglected source of beauty and unification for native gardens. For all the raves big spring blooms get in the Southwest, there is nothing more beautiful than a stand of purple threeawn swaying in a September breeze.

The last few pages of the primer are a collection of further gardening resources, and because the gardener is armed with knowledge from the primer, she now knows how to best

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Southwest Native Plant Primer *continued*

make use of those resources. There are suggested plant guilds with names that make them useful to the reader, e.g., Chihuahuan Bird and Bug. This guild is a list of plants commonly found growing together in the high desert of the Chihuahuan bioregions. It includes suggestions for a native tree (honey mesquite), shrubs, grasses, cacti, and vines; in other words, suggestions from every section of the plant profiles. The inclusion of plants from every category of the plant profiles makes the application of the primer scalable; it can be used to design a big space or a container garden on the back patio.

There are lists of plants for bird food and shelter, butterflies, hummingbirds, and desert tortoises. The primer includes a list of online resources and more books on natural history and gardening. And finally, there is an index, a rather extensive one. This index includes common and scientific names for plants and names of Southwest critters mentioned in the book. If it's hard to remember *Aristida purpurea*, then look up purple threeawn instead.

This book will be very useful to both long-time residents with native-plant experience and newcomer gardening novices. There are no recipes, but it has all the information to create one. This book will spend more time in the garden shed or on nightstands than it will on any coffee table. Once the pages are sprinkled with leaf litter and desert grit, the book will take root in the gardener's home and grow into a garden staple, and the garden will look like part of the home where people actually live.

Southwest Native Plant Primer Book Tour Dates: 2025–2026

Jack Dash will be discussing his new book at these locations/events in Arizona and New Mexico:

1 AUG 2025 Silver City, NM: Gila Chapter of the New Mexico Native Plant Society **https://www.npsnm.org/gila/**

16 AUG 2025 Flagstaff, AZ: Museum of Northern Arizona **https://musnaz.org/**

5 SEP 2025 Tucson, AZ: Desierto Books **https://www.desiertobooks.com/**

4 OCT 2025 Las Cruces, NM: New Mexico Native Plant Society State Conference **https://www.npsnm.org/las-cruces-2025-conference-home-page/**

10 OCT 2025 Tucson, AZ: Tohono Chul Botanical Garden **https://tohonochul.org/**

7 MAR 2025 Payson, AZ: Tonto Basin Chapter of the Arizona Native Plant Society **tontobasinnativeplants@gmail.com**

8 MAR 2025 Phoenix, AZ: Central AZ Cactus and Succulent Society **https://centralarizonacactus.org/**

Watercolors by Louise Fleurs, clockwise from top left. *Opuntia basilaris* (2021), *Carnegiea gigantea* (2023), *Strombocarpa pubescens* (2024), *Oenothera primiveris* (2021), and *Larrea tridentanta* (2023).

Botanical Illustration: Blooming in the Desert

by Louise Fleurs[1]

The desert is sometimes overlooked and misunderstood by people who have not experienced it firsthand. If you ask such a person to think about the desert, their mind will probably conjure images of barren and lifeless landscapes. But for those of us who live in Arizona, we know it is in fact rich in biodiversity and teeming with life.

Arizona boasts high native biodiversity and a wealth of endemic species. The plant life here is anything but ordinary. While it may not always be lush or filled with showy flowers, it has evolved remarkable adaptations to thrive in extreme conditions—intense heat followed by cold nights, high winds, and low humidity. Those adaptations include protective spines, reflective hair-covered surfaces, compact growth forms to reduce water loss, and leaf shedding to conserve energy. The result is a stunning array of uniquely adapted plants.

Among all regions of Arizona, Yuma is the hottest and driest corner of the state. Here, life is pushed to the limit and yet, life is thriving.

In an effort to share this remarkable biodiversity, I began a series of botanical illustrations featuring native plants I've encountered during my hikes around the Yuma Desert. At first, I did not think I would find many interesting or beautiful species, but I was wrong. With every new hike, I continue to discover new and fascinating plants.

Displayed here are some of my most popular watercolor illustrations of the beautiful plant diversity in Yuma.

[1]Yuma Chapter, Arizona Native Plant Society.
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Figure 1. View southeast from San Bernardino National Wildlife Refuge overlook. A remnant of the ciénega is yellow area at far right just north of the border wall. A larger portion of the ciénega system lies to the south in Cuenca Los Ojos, Rancho San Bernardino, in Mexico. Black Draw is visible as the cottonwood-willow forest running from north to south (left to right in the photo). Mountains in the distance are the Sierra Pan Duro-San Luis Sky Island complex in Sonora. *Photo by Chris Roll.*

Trans-border Flora and History of San Bernardino, Arizona–Sonora

by Thomas R. Van Devender[1], Chris Roll[2], Ana Lilia Reina-Guerrero[1], George M. Ferguson[3], Robert L. Minckley[4], T'ai H. Roulston[5], Joseph Barron, II[6], Jorge A. Valenzuela-Chacon[7], and Anays C. Blanco-Gutierrez[7]

Abstract

The trans-border flora of the San Bernardino National Wildlife Refuge in Arizona and Rancho San Bernardino in Sonora has 548 taxa in 320 genera and 88 families. The most diverse families are Poaceae (88 taxa), Asteraceae (85 taxa), Fabaceae (29 species), Euphorbiaceae (22 species), Amaranthaceae (18 species), Solanaceae (17 species), Boraginaceae and Brassicaceae (16 species each), and Malvaceae (15 species). The most speciose genera are *Euphorbia* (17 species), *Bouteloua* and *Eragrostis* (7 species each), and *Aristida, Boerhavia, Ipomoea, Oenothera, Opuntia,* and *Phacelia,* (6 species each). A total of 71 taxa (13.0%) are non-native, dominated by grasses (31 taxa).

After the conquest of the Aztec Empire in 1521, New Spain was explored along the Pacific coast by ships and with soldiers, miners, and missionaries inland. In the 1620–1640s, Jesuit priests introduced cattle in Sonora at more than 20 missions they established. An estimated 10,000 cattle were in northern Sonora when Padre Eusebio Kino visited in 1694. Cattle ranching thrived in this part of New Spain (Mexico after Independence in 1821) but was repeatedly interrupted by Apache depredations. The wetlands at San Bernardino were visited by Spanish explorers in the early 1500s. Later it was on the route from the Santa Rita Mines, New Mexico, to the Spanish Presidio at Fronteras, Sonora. In the mid-1800s, the Mormon Battalion in the Mexican-American War and California-bound miners in the 1849 Gold Rush passed through. The U.S. Mexico Boundary Expedition camped there in 1851–1853. Besides the wetlands, travelers recorded lush grassland and herds of feral cattle. The U.S.-Mexico Boundary went through San Bernardino. In 1884, John Slaughter bought the 1822 Mexican San Bernardino Land Grant to establish Rancho San Bernardino in Arizona and Sonora. In 1982, the San Bernardino National Wildlife Refuge was established in Arizona to protect the ciénega and endangered Río Yaqui fishes. Valer Clark created Cuenca Los Ojos Preserve to protect nine ranches in Sonora, including San Bernardino. In 2018, it was registered as a Mexican non-profit organization.

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Resumen

La flora transfronteriza del San Bernardino National Wildlife Refuge en Arizona y el Rancho San Bernardino en Sonora cuenta

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Trans-border Flora and History of San Bernardino *continued*

con 545 taxones en 320 géneros y 88 familias. Las familias más diversas son Poaceae (88 taxones), Asteraceae (85 taxones), Fabaceae (29 especies), Euphorbiaceae (22 especies), Amaranthaceae (18 especies), Solanaceae (17 especies), Boraginaceae y Brassicaceae (16 especies cada una) y Malvaceae (15 especies). Los géneros con mayor diversidad son *Euphorbia* (17 especies), *Bouteloua* y *Eragrostis* (7 especies cada una), y *Aristida*, *Boerhavia*, *Ipomoea*, *Oenothera*, *Opuntia* y *Phacelia* (6 especies cada una). Un total de 71 taxones (13.0%) son introducidos, dominados por gramíneas (31 taxones).

Tras la conquista del Imperio Azteca en 1521, Nueva España fue explorada a lo largo de la costa del Pacífico por barcos y con soldados, mineros y misioneros en el interior. Entre 1620 y 1640, los sacerdotes jesuitas introdujeron ganado en más de 20 misiones que establecieron en Sonora. Se estima que había 10,000 cabezas de ganado en el norte de Sonora cuando el Padre Eusebio Kino la visitó en 1694. La ganadería prosperó en esta parte de Nueva España (México después de la Independencia en 1821), pero se vio interrumpida repetidamente por los ataques de los apaches. Los humedales de San Bernardino fueron visitados por exploradores españoles a principios del siglo XVI. Más tarde, San Bernardino estuvo ubicado en la ruta de las minas de Santa Rita, Nuevo México, al presidio español en Fronteras, Sonora. A mediados del siglo XIX, también pasaron por allí el Batallón Mormón en la Guerra México-Estados Unidos y los mineros con destino a California en la Fiebre del Oro de 1849. La expedición estadounidense para trazar la frontera entre México y Estados Unidos acampó allí entre 1851 y 1853. Además de los humedales, los viajeros registraron exuberantes pastizales y manadas de ganado salvaje. Así la frontera entre Estados Unidos y México dividió a San Bernardino. En 1884, John Slaughter adquirió la concesión de tierras mexicana de San Bernardino de 1822 para establecer el Rancho San Bernardino en Arizona y Sonora. En 1982, se estableció el San Bernardino National Wildlife Refuge en Arizona para proteger la ciénega y los peces en peligro de extinción del río Yaqui. Valer Clark creó la Reserva de la Cuenca de los Ojos para proteger nueve ranchos en Sonora, incluyendo San Bernardino. En 2018, se registró como una organización mexicana sin fines de lucro.

Introduction

The northern limit of the New World tropics is in Sonora, not as often stated at the Tropic of Cancer (23.37°N) just north of Mazatlán, Sinaloa. The northernmost tropical deciduous forest is in the Sierra San Xavier, Sonora (28.6°N), 680 km north-northwest of Mazatlán and 300 km south of the Arizona border. Thornscrub is the tropical vegetation transitional between tropical deciduous forest and other vegetation types in Sonora (Van Devender & Reina-G. 2021). Coastal thornscrub is on the coastal plain of the Gulf of California from the Sinaloan border north to Guaymas, Sonora. Foothills thornscrub is inland on rocky slopes north to ca. 30.4°N near Arizpe on the Río Sonora and Angostura on the Río Bavispe, 96 to104 km south of the Arizona border (Van Devender & Reina-G. 2021). There it merges into more temperate desert grassland as winters become colder.

The Sierra Madre Occidental reaches its northern limit in the Sierra de Huachinera in northeastern Sonora (30.25°N). Between the Sierra Madre and the Mogollon Rim in central Arizona, there are 55 isolated Sky Island mountain ranges, or complexes of several ranges connected by oak woodland corridors in the Madrean Archipelago (= Sky Island Region), 32 of them in northeastern Sonora (Deyo et al. 2013; Van Devender et al. 2013a). These Sky Islands, crowned with oak woodland or pine-oak forest, emerge from lowland "seas" of desert grassland, foothills thornscrub, or tropical deciduous forest.

Here we present the first trans-border local flora for the wetlands between the San Bernardino National Wildlife Refuge (SBNWR) in Arizona and Rancho San Bernardino (RSB) in Sonora (Figures 1, 2) and discuss the history of the region.

Study Area

The San Bernardino Valley runs north-south at the Mexico-United States border in northeastern Sonora and southeastern Arizona (Minckley & Radke 2021). The elevations range from 1,161 m at the northern edge of the SBNWR and ca. 1,180 m along Silver Creek on the west side of RSB to 1,114 m where the Río San Bernardino crosses Mexican Federal Highway 2.

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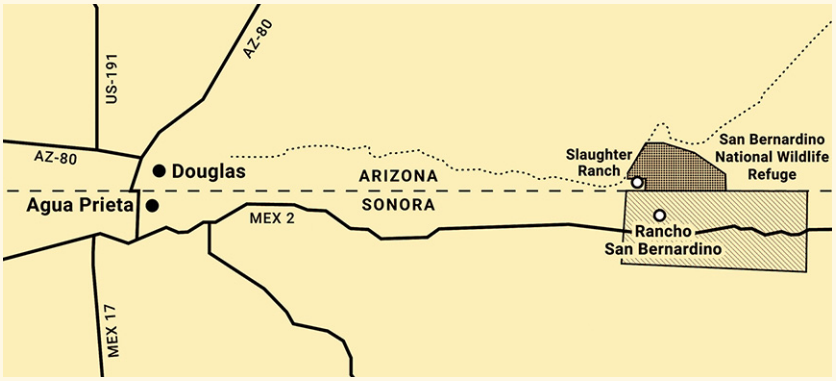

Figure 2. Map of the study area. *Drafted by Marina Maskaykina.*

Figure 3. Chihuahuan desertscrub in southeastern corner of Rancho San Bernardino. Dominants are *Larrea divaricata, Vachellia vernicosa*, and *Opuntia engelmannii*. *Photo by Ana Lilia Reina-G.*

Trans-border Flora and History of San Bernardino *continued*

Vegetation

The regional upland vegetation in the San Bernardino area is desert grassland with Chihuahuan desertscrub on limestone outcrops and alluvial surfaces (Van Devender & Reina-G. 2021). Desert grassland is dominated by diverse perennial grasses, variable abundances of the shrubs *Neltuma* (= *Prosopis*) *velutina* (velvet mesquite), *Rhus microphylla* (littleleaf sumac), *Ephedra trifurca* (Mexican tea), and *Gutierrezia microcephala* (threadleaf snakeweed); and the succulents *Agave palmeri* (Palmer's agave), *Cylindropuntia imbricata* subsp. *spinosior* (cane cholla), *Opuntia chlorotica* (silver dollar prickly pear), *O. macrocentra* (purple prickly pear), *O. santa-rita* (Santa Rita prickly pear), *Yucca baccata* (banana yucca), and *Y. elata* (soaptree yucca).

Chihuahuan desertscrub is well-developed in the western and eastern parts of RSB (Figure 3). Dominants include *Larrea divaricata* (creosotebush), *Flourensia cernua* (black brush, tarbush), *Parthenium incanum* (mariola), and *Vachellia vernicosa* (Chihuahuan whitethorn) as well as the succulents *Echinocereus fendleri* subsp. *rectispinus* (Fendler's hedgehog cactus), *Opuntia engelmannii* (Engelmann prickly pear), and *O. phaeacantha* (brown-spine prickly pear). *Fouquieria splendens* (ocotillo) is locally abundant just west of RSB. The historically lush grassland has deteriorated with grazing and agriculture. Today, it is a heavily disturbed shrub-invaded desert grassland. Most of the desert grassland and Chihuahuan desertscrub dominants are present, plus *Atriplex canescens* (fourwing saltbush), *Baccharis sarothroides* (desert broom), and *Condaliopsis* (= *Ziziphus*) *obtusifolia* (lotebush). The only area of cold temperate Plains grassland in Sonora is in the southern extension of the Cloverdale-Animas Valley playa on Rancho El Valle, eastern Cuenca Los Ojos.

East of Rancho San Bernardino on Cuenca Los Ojos, oak woodland dominated by *Quercus arizonica* (Arizona oak) and *Q. emoryi* (Emory oak) is on rocky hills. A post-fire interior chaparral dominated by *Q. toumeyi* (Toumey oak) in Cajón del Diablo on the west side of the Sierra San Luis is a very unusual vegetation type in Sonora. Additional species in pine-oak forest at higher elevations in the Sierra San Luis near the Chihuahua border include *Pinus arizonica* (Arizona pine), *P. engelmannii* (Apache pine), *P. discolor* (border pinyon), *Q. hypoleucoides* (silverleaf oak), *Q. rugosa* (netleaf oak), and *Q. viminea* (willowleaf oak). *Quercus grisea* (gray oak) is a Chihuahuan oak woodland species that reaches its southwestern limit in the Sierra San Luis. *Quercus turbinella* (shrub live oak) is a winter-rainfall chaparral species that reaches its southeastern limit along the border in Cuenca Los Ojos. *Quercus pungens* is a shrub found on limestone outcrops in the Agua Prieta area (Van Devender et al. 2013).

Riparian habitats are linear mesic vegetation that transect upland habitats or local wetlands in areas where geologic or edaphic situations force water to the surface. In riparian drainages, water, seeds, and nutrients are harvested from the entire local watershed. These are high energy, unstable habitats with regular floods. Upland species are often found at low elevations in riparian habitats. The San Bernardino Ciénega and Río San Bernardino were historically considered the largest,

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Figure 4. Cottonwood-willow riparian forest at Rancho Ojos Caliente on Cajón Bonito. *Photo by Tom Van Devender.*
Figure 5. *Sambucus nigra* subsp. *cerulea* in the ciénega on Rancho San Bernadino. A. Plant. B. flowers. *Photos by Ana Lilia Reina-G.*

Trans-border Flora and History of San Bernardino *continued*

most extensive wetland in northwestern Mexico and southern Arizona (https://en.wikipedia.org/wiki/San Bernardino Ranch). *Populus fremontii* (Fremont cottonwood), *Salix gooddingii* (Goodding willow), and *Celtis reticulata* (netleaf hackberry) are dominants in cottonwood-willow riparian deciduous forest (Figure 4) along Black Draw and Hay Hollow in SBNWR and along the Río San Bernardino in Sonora. In 2007, Robert L. Minckley collected *Platanus wrightii* (Arizona Sycamore) on RSB, but it has not been seen since. *Sapindus drummondii* (wingleaf soapberry) is occasionally present. A few individual *Sambucus nigra* subsp. *cerulea* (blue elderberry) (Figure 5) are present but were possibly introduced or escaped as it is widely used medicinally and planted in gardens. An extensive cottonwood-willow forest lines Cajón Bonito in the adjacent Arroyo Guadalupe drainage which heads in the Sierra San Luis-Pan Duro, crosses Ranchos Pan Duro and La Victoria and most of Cuenca Los Ojos. Additional riparian species at Rancho Los Ojos Calientes include *Chilopsis linearis* (desert willow), *Juglans major* (Arizona walnut), and *Salix bonplandiana* (Bonpland willow). High-elevation riparian trees at low-elevation in Cajón Bonito are *Acer grandidenttum* (bigtooth maple), *Hesperocyparis arizonica* (Arizona cypress), *Juniperus deppeana* (alligator bark juniper), and *Prunus serotina* (wild cherry).

The Río Yaqui has one of the largest drainage basins in Sonora. Arroyo Guadalupe begins in southwestern New Mexico and flows across the southeastern corner of Arizona into Sonora. The Río Agua Prieta begins in Arizona west of Douglas and flows southeast to meet the Río San Bernardino at La Junta de dos Ríos. In between, Black Draw in SBNWR in southeastern Arizona becomes Río San Bernardino in Sonora, flows south to become the Río Batepito, and join the Río Bavispe at Colonia Morelos. The Ríos Áros and Bavispe, which begin in the Sierra Madre Occidental in Chihuahua, join 54 kilometers (by air) north of Sahuaripa to become the main Río Yaqui, and eventually flow into the Gulf of California west of Ciudad Obregón.

Methods

The botanical exploration of the borderlands began during the U.S.-Mexico Boundary survey of 1848-1853, when John M. Bigelow, Charles C. Parry, Arthur C. V. Schott, Edmund K. Smith, and George Thurber collected plants between Guadalupe Canyon and modern Nogales. The botany of the boundary survey was published in Torrey (1859) but localities were vague with only a few refences to San Bernardino (Marrs-Smith 1983, Van Devender & Reina-G. 2005). Thurber collected in San Bernardino in 1851–1852. His *Echites brachysiphon* collected at San Bernardino in 1852 was designated as the isolectotype of *Mandevilla brachysiphon*. Schott collected the rare Sonoran paintbrush *Castilleja minor* in Cajón Bonito; Reina-G. and Van Devender re-discovered it in the same area 114 years later in 2009! More plants were collected in the Sonoran borderlands in 1892–1894 on the second U.S.-Mexico International Boundary Survey led by Edgar A. Mearns.

In 1978, Lyle A. McGill collected 29 species of plants in the same area. In 1980, Elinor Lehto and Donald J. Pinkava sampled aquatic plants at San Bernardino. All three were from Arizona State University (ASU). In 1980–1981, Laurence J. Toolin, Van Devender, Paul S. Martin, Barbara G. Phillips, and Vera Markgraf collected 69 species of plants on an inventory for The Nature Conservancy and the University of Arizona. The most important botanical study at SBNWR was Gayle E. Marrs-Smith's 1980–1982 master's degree thesis at ASU on the flora and vegetation of the refuge (Marrs-Smith 1983). She was assisted by botanists Thomas Clark, Thomas F. Daniel, Phil Johnston, and Sandra Limerick. Daniel and Mary Butterwick returned to

continued next page

Figure 6. *Coryphantha robbinsorum*. A. Plants. B. Flower. *Photos by Erik F. Enderson.*

Trans-border Flora and History of San Bernardino *continued*

collect in 1983. Robert Hastings collected in the area in 2015. Chris Roll surveyed plants on SBNWR on over 80 trips in 2023–2025.

In 1993, Richard S. Felger collected a few specimens on Rancho San Bernardino in Sonora with Rubén Layne-Ruiz in route to his Rancho Pan Duro. In 2000, Alberto Búrquez-Montijo collected 85 species on SBNWR and 137 species on RSB. In 2002–2005 and 2007–2008, Minckley collected 20 plant species on SBNWR and 127 species on RSB; T'ai H. Roulston collected four species on SBNWR and 49 species on RSB; and Noelia la Torre 18 species on SBNWR and 60 species on RSB. They were members of Minckley's team studying composition and species richness of bees in the San Bernardino Valley (Minckley & Radke 2021).

In 2007, Van Devender, Reina-G., John F. Wiens, and Jeffrey Moore from the Arizona-Sonora Desert Museum (ASDM) surveyed limestone areas from west of Agua Prieta across Cuenca Los Ojos into adjacent Chihuahua under a U.S. Fish and Wildlife Service (FWS) Section 6 Contract in search of the Cochise foxtail cactus (*Coryphantha robbinsorum*) which was described from Cochise County near the Slaughter Ranch (Figure 6). It was listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 1975 and given Threatened status by the U.S. Fish and Wildlife Service in 1986. They failed to find it and concluded in the final report that Lopresti's (1984) report of *C. robbinsorum* in Sonora was a fabrication and the species does not occur in Mexico (Van Devender & Reina-G. 2007). The flora of Chihuahuan desertscrub on limestone in northeastern Sonora was published in Van Devender et al. (2013). Many of the records in the Municipality of Agua Prieta helped document the forgotten flora of the borderland (Van Devender & Reina-G. 2005) for Curator J. Jesús Sánchez-E.'s Herbario Universidad de Sonora (USON) inventory project funded by the Comisión Nacional de Ciencia y Tecnología (CONACYT).

In 2007, Van Devender, Reina-G., and Erik F. Enderson surveyed plants on Rancho El Valle in eastern Cuenca Los Ojos, while searching for the Prairie Rattlesnake (*Crotalus viridis*, Enderson 2010). In 2010, Van Devender, Reina-G., and Roll inventoried plants in the area. In 2011, David A. Delgado from USON collected plants on RSB. Plants were intensely studied in many areas on Cuenca Los Ojos, including RSB, on the Madrean Archipelago Biodiversity Assessment Cuenca Los Ojos Expedition in 2009 and the Madrean Discovery Expedition Cajón Bonito Expedition in 2017 (Van Devender & Reina-G. 2017).

The specimens collected on these trips are deposited in the University of Arizona (ARIZ), ASDM, ASU, the Robert L. Minckley Private Collection (now in ARIZ), USON, and other herbaria. The records and observations from the more recent plant inventories in Cuenca Los Ojos are publicly available in the Madrean Discovery Expeditions (madreandiscovery.org) and linked databases in the SEINet/SYMBIOTA herbarium network. The San Bernardino plant records from SBNWR and RSB summarized here were compiled from the SEINet database and iNaturalist.

Sonoran Local Floras

Detailed local floras are crucial to understanding regional plant distributions, ecology, and biogeography. They are always preliminary with composition increasing with additional fieldwork and losing and gaining species with time. Stephen S. White's doctoral research in 1938–1942 along the Río Bavispe and in the Sierra El Tigre was the first systematic study of flora and vegetation in the Sonoran borderlands (northernmost point

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Trans-border Flora and History of San Bernardino *continued*

55 km south of RSB, White 1948). In Arizona, the floras of the Chiricahua (Bennett et al. 1996) and Huachuca Mountains (Bowers & McLaughlin 1996) to the north and northwest are well known.

Since 2000, preliminary local floras have been published in many areas in Sonora (Figure 7). Local floras in tropical areas began with tropical deciduous forest along the Río Cuchujaqui near Álamos (Van Devender et al. 2000); foothills thornscrub at Ojo de Tonibabi in the Sierra de la Madera near Moctezuma (Valenzuela et al. 2013) and the lower Río Bavispe Valley (Van Devender et al. 2018); foothills thornscrub-oak woodland in the Sierra Murrieta near Bacanora (Van Devender et al. 2024); and foothills thornscrub-desert grassland transition in the El Picacho de Bacoachi south of Cananea (Van Devender et al. 2023).

Local floras have been published about the temperate oak woodland or oak woodland-desert grassland transition in the Sierra Juriquipa southeast of Nacozari de García (Makings et al. 2018), Sierra Buenos Aires east of Bacoachi (Ferguson et al. 2018), Rancho El Aribabi in the Sierra Azul west of Cananea (Sánchez-E. et al. 2013), and Sierra Chivato east of Nogales (Van Devender et al. 2019). Local floras in higher mountain ranges with pine-oak forest above oak woodland were in the Sierras Bacadéhuachi (Van Devender et al. 2013b), La Púrica northwest of Nacozari de García (Sánchez-E. et al. 2018), and Elenita west of Cananea (Carnahan et al. 2018).

Local floras were reported in Chihuahuan desertscrub in the Agua Prieta area in northeastern Sonora (Reina-G. & Van Devender 2013, Van Devender et al. 2013c) and Sonoran desertscrub in the Sierra Bachoco at Hermosillo in central Sonora (Sánchez-E. & Van Devender 2021). The San Bernardino local flora here includes desert grassland, Chihuahuan desertscrub, a very large ciénega, and riparian gallery forest.

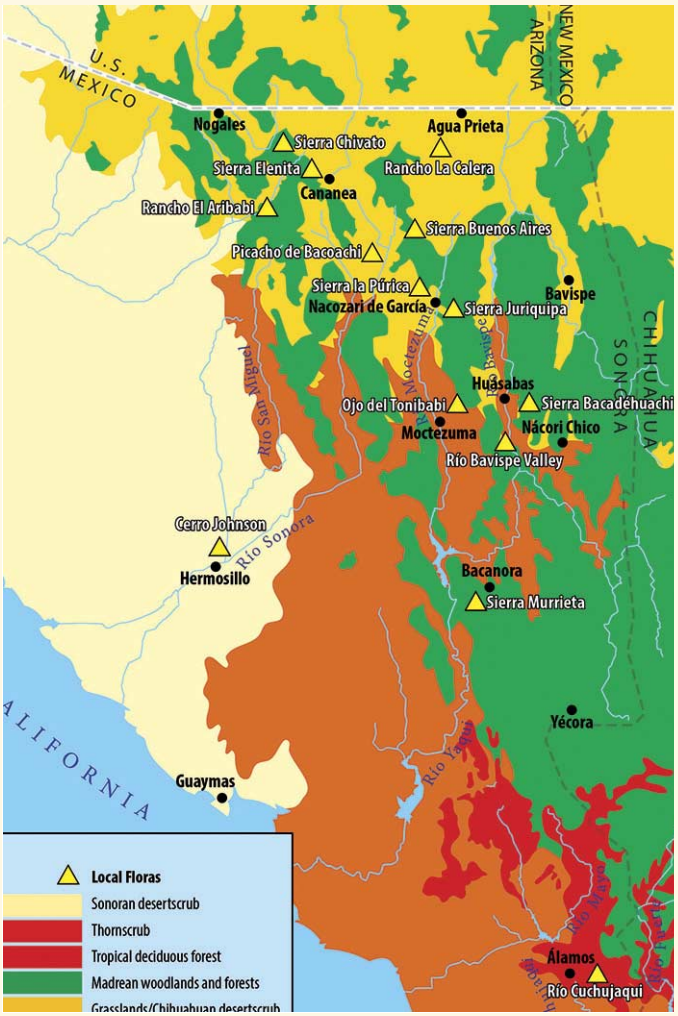

Figure 7. Map of local floras in Sonora. Vegetation modified from Brown & Lowe (1982). *Drafted by Marina Maskaykina.*

Results

Marrs-Smith (1983) reported 343 plant taxa (species plus additional subspecies, varieties, and hybrids) in 230 genera and 72 families for SBNWR. We report 450 taxa in 265 genera and 70 families for SBNWR (110 additional taxa). We report 346 taxa in 201 genera and 59 families for the RSB in Sonora. The greater diversity on SBNWR likely reflects less systematic collecting on RSB. The trans-border flora for both areas has 545 taxa in 320 genera and 88 families. The most diverse families are Poaceae (88 taxa), Asteraceae (85 taxa), Fabaceae (29 species), Euphorbiaceae (22 species), Amaranthaceae (18 species), Solanaceae (17 species each), Boraginaceae and Brassicaceae (16 species each), Malvaceae (15 species), Cactaceae and Cyperaceae (13 species each), Plantaginaceae and Verbenaceae (11 species each), and Convolvulaceae (10 species). The most speciose genera are *Euphorbia* (15 species), *Bouteloua* and *Eragrostis* (7 species each), and *Aristida, Boerhavia, Ipomoea, Oenothera, Opuntia,* and *Phacelia* (6 species each).

Non-native species. Plants often thrive and expand their ranges during periods of good climatic conditions and contract them during droughts or after catastrophic freezes. The abundances of common, non-native species such as *Descurainia sophia* (common tansy mustard), *Melilotus indicus* (Indian sweet-clover), and *Sisymbrium irio* (London rocket, *pamitón*) fluctuate dramatically tracking winter rainfall. *Salsola tragus* (tumbleweed) responds to summer rains. It is also important to recognize that only a relatively few non-native species are serious invasives that compete with native species or impact vegetation.

In 2007 and 2010, Reina-G. and Van Devender did an intensive survey of non-natives plants on various ranches in Cuenca Los Ojos and along Mexican Federal Highway 2. The results were

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Trans-border Flora and History of San Bernardino *continued*

included in a summary of Sonoran non-native plants (Van Devender et al. 2020). In addition to Roll's 2023–2025 surveys, refuge biologists inventoried non-native plants in 2013, 2020, and 2024 as part of management and eradication activities (U.S. Fish and Wildlife Service 2025a). Here we report a total of 71 non-native species (13.0%) in the trans-border San Bernardino flora. The families with the most exotic species are Poaceae (31 taxa), Brassicaceae (8 species), Asteraceae (5 species), and Fabaceae and Lamiaceae (3 species each).

Asparagus officinalis (asparagus), *Hordeum jubatum* (foxtail barley), and *Mirabilis jalapa* (marvel-of-peru, *maravilla*) are escaped garden plants. *Hordeum vulgare* var. *trifurcatum* and *Sorghum bicolor* are cultivated barley and sorghum. *Carya illinoiensis* (pecan, *nuez*), *Schinus molle* (Peruvian peppertree, *pimiento, pirul*), and *Ziziphus jujuba* (jujube, *datil chino*) were individuals of cultivated trees established away from houses or along highways. *Schinus molle* is an elegant urban tree that was brought to Mexico from Peru in 1550 by Antonio de Mendoza y Pacheco, the first Virrey (= Viceroy) of New Spain. It has become a serious invasive weed in Australia, South Africa, and southern Mexico but is rarely encountered in Sonora. The *Ziziphus jujuba* likely descended from fruit trees grown by Chinese immigrants in the late 1800s who were forced to flee northern Sonora in the early 1900s during the Mexican Revolution.

Berula erecta (cutleaf waterparsnip), *Echinochloa colona* (junglerice), *Nasturtium officinale* (water cress, *berro*), *Polygonum argyrocoleon* (silver-sheath knotweed), *Polypogon monspliensis* (rabbitsfoot grass), and *Rumex crispus* (curly dock) can be locally invasive in aquatic habitats or adjacent wet soil. *Cynodon dactylon* (Bermuda grass) is an Old World grass found worldwide which thrives in wet areas but is also found in drier arroyos and along highways. *Sorghum halepense* is a stout perennial grass native to Asia and northern Africa. In about 1840, Colonel William Johnson admired it in Africa and planted it on his plantation in Alabama. It has been introduced worldwide and is a serious invasive species. It is of special concern in SBNWR. *Nicotiana glauca* (tree tobacco, *juan loco*) is a South American species widely scattered in Sonora. Although it locally forms thick stands in wide sandy riverbeds, it does not seem to compete with native species and is an important food source for migrating hummingbirds (Van Devender et al. 2004).

Some of the trans-border San Bernardino non-native plants are serious invasives in other areas, including *Acroptilon repens* (Russian knapweed), *Bassia scoparia* (summer cypress, burningbush), *Bothriochloa ischaemum* (yellow bluestem), *Bromus rubens* (red brome), *B. tectorum* (cheatgrass), *Brassica tournefortii* (Sahara mustard), *Cenchrus ciliaris* (buffelgrass), *Centaurea melitensis* (Maltese star-thistle), and *Eragrostis lehmanniana* (Lehmann lovegrass). *Acroptilon repens, B. scoparia, B. rubens, B. tectorum,* and *C. melitensis* are invasive in winter rainfall areas to the north that are only recently reaching Sonora. *Bromus rubens* and *B. tectorum* are fire-prone winter annual grasses native to Eurasia and Africa that cause extensive damage to natural communities in the western United States. In Sonora, *B. rubens* has been collected on Pinacate Peak in 1985–1987, Sonoyta in 1992, and the Sierra El Humo in 2005. Van Devender and Reina-G. collected it in 2007–2008 in Arroyo Guadalupe on Rancho Puerta Blanca. The only known Sonoran locality for *B. tectorum* is in the Pinacate region. Since the seeds of these bromes do not survive long in the soil, populations are dramatically reduced in dry winters. Marrs-Smith collected both *B. rubens* and *B. tectorum* on SBNWR in 1981 but they have not been seen since. *Brassica tournefortii* is an African winter annual that has invaded vast areas in the sandy desert lowlands of California, Arizona, and Sonora. It is expanding eastward but is not invasive at higher elevations on Cuenca Los Ojos (Van Devender et al. 2020).

During the Dust Bowl in the 1930s, severe drought and overgrazing resulted in massive erosion and livestock loss. Government agencies and land grant universities tried to reverse catastrophic land use failures by planting miracle or silver bullet grasses to control erosion and provide livestock forage. The U.S. Department of Agriculture Tucson Plant Materials Center cultivated and introduced a variety of grasses from other parts of the world. Some of them, including *Cenchrus ciliaris* and *Eragrostis lehmanniana*, are the most serious invasive species today. They were not concerned about introduced species becoming invasive.

By the summer of 2006, Ibarra-F. et al. (2009) estimated that ca. 1 million hectares of *Cenchrus ciliaris* had been planted in Sonora. It is now ubiquitous but not noticeably expanding its range. *Cenchrus ciliaris* is scattered in the border lands from Douglas to SBNWR in Cochise County and the Agua Prieta area in Sonora. In 2007 and 2010, Reina-G. and Van Devender only found it in two localities on Cuenca Los Ojos (45 and 46 km east of Agua Prieta). These localities at 1,420 and 1,616 m elevation were unusually high for the species. We recently recorded it in Silver Creek and the southeastern corner of RSB. It has expanded its range since 2010 but is only locally a serious invasive in the study area.

Eragrostis lehmanniana is an especially pervasive invader in desert grassland in the southwestern United States, especially in southeastern Arizona, but has not expanded far south of the

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Figure 8. *Lilaeopsis schaffneri* var. *recurva* population along Leslie Creek, Leslie Canyon and flower (inset). *Photos by William R. Radke.*

Trans-border Flora and History of San Bernardino *continued*

Arizona-Sonora borderlands. In Sonora, it is a serious invasive only in the foothills of the Sierras San José near Naco and Sierra San Luis in the eastern part of Cuenca Los Ojos (Van Devender et al. 2020). *Eragrostis echinochloidea* (African lovegrass) is a South African perennial grass that since its introduction in the 1940s has spread widely in the Tucson-Nogales area, but only recently into northern Sonora. *Eragrostis superba* (Wilman lovegrass) is another African grass that has a similar distribution in southern Arizona but is rare in Sonora. It was collected on SBNWR by Marrs-Smith in 1981 and Robert Hastings in 2015. It is expected to occur on RSB. *Bothriochloa ischaemum* from Eurasia and north Africa is widely invasive across the United States, including Arizona. In northern Sonora, it has been collected locally from Magdalena-Nogales east to Cajón Bonito on Cuenca Los Ojos.

Expanding use of roads provides vectors for non-native species to spread into the area. This includes both visitation to the refuge and Slaughter Ranch as well as traffic along the Roosevelt easement parallel to the international border. Refuge staff monitor these areas annually to observe and treat new arrivals of potentially invasive species, one example being the removal of occasional *Tamarix chinensis-T. ramosissima*-complex before it can harm the native riparian habitats.

Climate change predictions include milder winters with reduced precipitation, warmer summers with more intense fore-summer drought, and likely greater warm season precipitation in the summer monsoon and more frequent late summer-fall tropical storms and hurricanes. The southern distribution limits of winter rainfall species such as *Bassia scoparia, B. rubens. B. tectorum, Centaurea melitensis,* and *Rhaponticum repens* are likely to move north away from San Bernardino. The distributions of summer-active non-native perennial grasses, including *Bothriochloa ischaemum, Cenchrus ciliaris, Eragrostis echinocloidea*, *E. lehmanniana*, and *E. superba,* are likely to continue expanding southward in Sonora.

Noteworthy Species

Lilaeopsis schaffneri var. *recurva* (Huachuca waterumbel) is a federally listed Endangered Species in the United States. It is a delicate aquatic plant found in ciénegas and marshy areas along streams (Figure 8) in a small area from Tucson to Nogales and Douglas, Arizona, a few scattered areas in northern Sonora, and a single locality in Chihuahua. It is highly vulnerable because its habitat is so limited and severely impacted by cattle (Malcom & Radke 2008). It was reported to occur around Slaughter Ranch and several impoundments on SBNWR in the 1980s and 1990s, but these naturally occurring populations were not found in surveys in the 2000s (U.S. Fish and Wildlife 2017a). Since the 2000s, refuge staff have propagated and planted water umbel in suitable sites along Black Draw and Hay Hollow with mixed success (Malcom et al. 2017, Barron, pers. data). Several patches persisted and spread along the riparian corridor naturally for awhile through spring 2024 (U.S. Fish and Wildlife 2025b), but late season surveys in SBNWR and Leslie canyon did not find any patches. In 2008, James R. Rorabaugh found it in Río San

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Figure 9. San Bernardino National Wildlife Refuge plants. A, B. *Oenothera havardii*. C. *Glandularia pumila*. Photos by Chris Roll.

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Bernardino just below its confluence with Cajón Bonito (67 km by air SSE of MEX 2). It potentially occurs on RSB.

A thistle collected by Charles Wright in the San Bernardino Ciénega in 1851 was described in his honor as *Cirsium wrightii* (Wright's marsh thistle) by Asa Gray, the famous Harvard University botanist, in 1853 (Savinski & Tonne 2011). This single specimen is currently the only evidence of the plant occurring in Arizona, with a dozen present localities in New Mexico in the SEINet database. It is known in Mexico from three localities. In 1890, Carl V. Hartman collected it in Fronteras, Sonora, on the Carl Lumholtz Expedition to Mexico. This is the site of the Spanish Presidio, 58 km south-southwest of the refuge locality, on the Río Cabullona, a north-flowing tributary of the Río Bavispe. In 1982, Frank W. Reichenbacher and Van Devender collected it at Ojo de los Reyes in the Río Santa María Valley near Galeana, Chihuahua. At the time, they were working for The Nature Conservancy's Arizona Natural Heritage Program when Rancho San Bernardino was transferred to the U.S. Fish & Wildlife Service to found the refuge. The specimen was determined by Billie Lee Turner, guru of Mexican Asteraceae, at the University of Texas Herbarium. Since then, Ojo de los Reyes has been pumped dry by Mennonite farmers (Jesús Sánchez-E., pers. comm, 2022). In 2022, Valenzuela-Chacón collected it at Ojo Vareleño near Casa Grandes, Chihuahua, 53 km north-northwest of Ojo los Reyes. *C. wrightii* is a wetland-obligate species with pale lavender or white flowers strongly associated with ciénegas that is an Endangered species in New Mexico. It is thought to be extirpated from the San Bernardino wetlands due to intense grazing and agricultural practices despite several surveys on both sides of the border (U.S. Fish and Wildlife Service 2017).

Oenothera havardii (Havard's evening primrose) is a tufted perennial with a large flower (Figure 9A, B) that is only known from a few SEINet records in a curiously scattered distribution in Texas, Chihuahua, and the Agua Prieta-Douglas and San Bernardino areas in Arizona and Sonora. It is likely more common in disturbed habitats because, unless in flower, it is easily overlooked.

Glandularia pumila (dwarf vervain) is a common annual (Figure 9C) in central Texas and tropical southern and central Sonora. The SBNWR specimens are the first records from Arizona. It is locally abundant in wet years but absent in dry years.

Cleomella multicaulis (slender spider-flower) is an annual sporadically found in ciénegas from Wyoming to near Mexico City (Savinski and Tonne 2011). Toolin's collection in 1980 and its recent re-discovery on RSB are the only records for Sonora. It likely occurred in the ciénega on SBNWR in the past.

Ibervillea tenuisecta (slimlobe globeberry) occurs in the Chihuahuan Desert from San Luis Potosí north to western Texas and west to southeastern Arizona. In Sonora, it is known from near Agua Prieta and San Bernardino. In the warm season, dissected leaves emerge from a large subterranean tuber and then bear yellow flowers and orange fruit (Figure 10A). It is related to *I. sonorae* (*güerequi*) in tropical southern Sonora which has an aboveground tuber that is used medicinally.

Peniocereus greggii (night-blooming cereus) was first collected at San Bernardino by Thurber in 1851. It is found in northeastern Mexico through the Chihuahuan Desert in Texas west to western Arizona and northwestern Sonora. Usually, multiple stems grow from a very large tuber underneath taller mesquites or other desert shrubs. Its large white flowers open at night. The Chihuahuan variety *P. g.* var. *greggii* is in the San Bernardino area (Figure 10B, C). A large population at Mesa Las Víboras (14 km SSE of RSB) is unusual because the cactus stems, flowers, and fruit are higher than dwarf velvet mesquites growing in clay soil!

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Figure 10. A. *Ibervillea tenuisecta* on San Bernardino National Wildlife Refuge. *Photo by Chris Roll.* B, C. *Peniocereus greggii* flowers and tuber on Mesa la Víboras. *Photos by Erik F. Enderson.*

Trans-border Flora and History of San Bernardino *continued*

History

History of Mexico. After the 1521 conquest of the Aztec Empire, Hernán Cortés founded Mexico City as the capital of New Spain and immediately began the exploration of the vast new territory along the coasts, and establishing mines and missions inland. Acapulco (now in the state of Guerrero) was established in 1523 as the New World Pacific coast terminus for the Spanish *galleon* trade with the Philippines. In 1531, Nuño Beltrán de Guzmán established an outpost at San Miguel de Culiacán (now Sinaloa) to control the indigenous populations. In 1533-1535, Cortés sent ships from Culiacán to the Cape Region of the Baja California Peninsula and established the short-lived colony at Santa Cruz (= La Paz; Moriarty 1965).

The inland exploration of New Spain was fueled by the quest for minerals. Rich silver mines were opened in Zacatecas (central Mexico) in 1546. The Chamuscado and Rodríguez Expedition trekked through El Paso in Nuevo México in 1581–1582. El Paso del Norte (now Ciudad Juárez, Chihuahua) was founded in 1659. Santa Fe, Nuevo México, founded in 1610, is the oldest state capital in the United States and the earliest European settlement west of the Mississippi River.

Napoleon's invasion of Spain in 1808 led to a political crisis among American-born Spaniards in New Spain, resulting in the Mexican War of Independence in 1810–1821. The territory of the new country of Mexico was enormous — from the Yucatán Peninsula north to Texas and Colorado, and west to California. The state of Sonora, along the Pacific coast from Jalisco north to the Gila River included today's Sinaloa and southern Arizona. The state of California extended from the Baja California Peninsula north to Canada and east to Nuevo México. The area from Guatamala south to Panamá was added to Mexico in 1822–1823.

European History of Sonora. Ships commanded by Francisco de Ulloa discovered the port of Guaymas in 1539 (Figure 11). Resistance to European intrusion on their lands by the Yaqui Indians kept the Spanish out of southern Sonora until the 1600s. Álamos in southern Sonora was founded in 1630 when Jesuit missionaries built a church (French 1962). Resistance to European intrusion on their lands by the Yaqui Indians kept the Spanish out of southern Sonora until the 1600s. Álamos in southern Sonora was founded in 1630 when Jesuit missionaries built a church. With the discovery of rich silver deposits at La Aduana in 1683, Álamos grew into a wealthy colonial town. Small missions were established near Guaymas in the 1610s and 1620s when the Jesuits worked with the Yaqui Indians, but were soon abandoned. In the early 1700s, Jesuits Juan Maria Salvatierra and Eusebio Francisco Kino established several missions near Guaymas but they were abandoned by 1759 because of Seri Indian attacks. Although a military force defeated the Seris and Pimas and built a fort in 1769, colonists did not settle in the area until the early 1800s. New Spain authorized Guaymas for commercial maritime traffic for the port in 1811 and established a Mexican customs house in 1823.

Jesuit missions were founded in Ures in 1644, Fronteras in 1845, and Arizpe in 1646. The New Spain province of Sonora, Ostimuri y Sinaloa formed in 1691 but was divided into the states of Sinaloa and Sonora in 1823. Ures, with about 1,300 settlers, was the capital of Sonora. The states were reunited in

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Figure 11. View of Guaymas Bay. Columnar cactus is *Pachycereus pringlei* (cardón). *Photo by Tom Van Devender.*

1824 and re-separated in 1831 with the Sonoran capital in Hermosillo, Arizpe, and by 1838, Ures again.

In 1701, a Spanish presidio (military post) named Santa Rosa de Corodéguachi was established in Fronteras in northern Sonora to protect the scattered settlers and missions from Apache depredations. The second commander of the Fronteras Presidio in 1726 was Juan Bautista de Anza, whose son of the same name took 240 colonists from Tubac (now Arizona) to settle Monterrey in Upper California in 1775–1776 and then discovered San Francisco Bay. To provide a base for a general offensive campaign against the Apaches, the presidio was temporarily relocated from Fronteras to the San Bernardino springs in 1775–1780 and extensive fortress-like buildings were constructed.

History of San Bernardino. Sedimentary analyses of a core documented a wetland at San Bernardino for the last 7,000 years (Minckley & Brunnelle 2007). Because of the well-known perennial springs, San Bernardino was an important stop for travelers. The first European to have passed through San Bernardino was likely Álvar Núñez Cabeza de Vaca, a survivor of the ill-fated Panfilo de Narvaez Expedition in 1530. In 1539 and 1540, the Fray Marcos de Niza and Francisco Vázquez de Coronado expeditions passed through San Bernardino in search of the fabled seven cities of Cíbola.

Prior to the Mexican-American War (1846–1848), there were no towns and few Europeans between El Paso (now Texas) and Tucson (now Arizona) in the modern borderlands. The most-traveled route was from El Paso to the Santa Rita del Cobre mine (near Silver City, now New Mexico) south through Guadalupe Pass, along Arroyo Guadalupe to San Bernardino and Fronteras. In ca.1800, rich copper deposits were discovered in Santa Rita (in Chihuahua). From 1828 to 1838, Mina Santa Rita del Cobre produced vast amounts of copper. In 1838 Apaches massacred the people and burned the town, temporarily halting production. In 1862, New Mexico was the second most important mining district in the U.S. after Michigan, mostly because of the Santa Rita Mine.

In the 1620–1640s, Jesuit missionaries introduced cattle at the missions they established in Sonora. In 1694, when Padre Eusebio Kino visited San Bernardino, it was estimated that there were 10,000 cattle in northern Sonora (Wagoner 1975). But like the mines, ranches were periodically abandoned because of Apache raids. In the early 1700s, there were lots of cattle on San Bernardino but it was abandoned in the late 1700s. With the Mexican San Bernardino Land Grant to Lieutenant Ignacio Pérez in 1822, ranching revived but was abandoned by 1830 as the trading rapport between the Apaches and Spanish deteriorated after Mexican Independence in 1821.

The history of San Bernardino was directly impacted by faraway events. Texas won its independence from Mexico in 1836. It's application for U.S. statehood in 1845 sparked a heated debate because Texas was a slave state. When statehood was approved by Congress, Antonio López de Santa Anna, president of Mexico eleven times when he was not in exile, moved into Texas. He intended to reclaim the land between the Rios Bravo (Grande) and Nueces, reneging on the Texas-Mexico treaty. U.S. troops met the Mexican force in Texas, beginning the Mexican-American War. The only military confrontation in Sonora in the war was siege and capture of the port of Guaymas (Figure 11) by U.S. warships in 1847, which crippled the economy of the state.

In 1846, the Mormon Battalion went through the ruins of Rancho San Bernardino south of today's border. They were U.S. Army volunteers led by Lt. Colonel Philip St. George Cooke to develop a wagon road from New Mexico to San Diego (Cooke 1848). Robert Whitworth wrote in his diary "2 ft tall grass was as far as you could see in a beautiful valley. Mesquite was the only 'tree'." Feral cattle were common. 'An immense red bull rushed by', startling Cooke. Antelope were 'plenty'.

One of the routes to California during the 1849 Gold Rush was through San Bernardino. Benjamin Harris saw extensive grassland with 5,000–15,000 feral cattle near modern Agua Prieta. H.D.J. Powell saw locally common mesquite. After the Mexican-American War, the U.S. Mexico Boundary Survey

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Trans-border Flora and History of San Bernardino *continued*

Figure 12. A. Former Texas ranger John Slaughter ready for action. B. Valer Austin in Silver Creek on Rancho San Bernardino regaling visitors with her conservation actions. *Photo by Ana Lilia Reina-G.*

Expedition camped at San Bernardino in 1851 where Boundary Commissioner John Russell Bartlett saw "luxuriant meadows of grass and lots of water". Feral bulls bellowed and wolves howled at night (Davis 1982). In 1853, surveyor William H. Emory also noted "numerous springs, rushy ponds, and thick grasses" in the area (Emory 1857).

When the war ended, Sonora lost 339,370 hectares of its territory to the U.S. through the Treaty of Guadalupe Hidalgo. An additional 76,800 km^2 in present-day southern Arizona and southwestern New Mexico were added to the U.S. in the Gadsden Purchase in 1854. The United States-Mexico boundary passed through the San Bernardino Valley, leaving most of San Bernardino Land Grant in Mexico with only 970 ha (2,400 acres) in the United States (Wagoner 1975). It also divided wetlands with long-term impacts. Rancho Los Nogales was a camp for the U.S. Boundary Survey Expedition that grew into the town of Nogales.

Biologists on the Second U.S.-Mexico (1892–1894) boundary survey, led by U.S. Army Captain Edgar A. Mearns, inventoried the Sierra San Luis and Cajón Bonito. The area between Monument 73 at Arroyo Guadalupe (now Rancho Puerta Blanca) and Naco, Arizona/Sonora was visited in August 1893 (Mearns 1907). Lieutenant David Dubose Gaillard wrote the general vegetation descriptions for sites visited, including "The San Bernardino River is wooded with willow, cottonwood, boxelder, ash and mesquite; a few red junipers grow on adjacent hills; and creosote bush, mesquite, acacia and ocotillo occupy the stony mesas and arroyos which constitute the major portion of that region. The broad meadows below the San Bernardino Springs are now covered by grazing herds; but at the time of Emory's survey they were occupied by a dense growth of cane which has since entirely disappeared." He described the Arizona-Sonora borderlands as "bare, jagged mountains rising out of the plains like islands from the sea" — one of the first times that the powerful "sky island in a desert sea" image was used. Later he was the lead engineer on the construction of the Panama Canal.

Conservation of the San Bernardino Wetlands

As outlined above, the San Bernardino Ciénega and Río San Bernardino in the headwaters of the Río Yaqui were once extensive but today only exist in remnant sections. Many of the historical springs have either stopped flowing or only flow for part of the year (Hendrickson & Minckley 1985). Many areas of former Ciénega have been invaded by mesquite and other shrubs.

Slaughter Ranch. John Horton Slaughter (1841–1922) was a Texas ranger and Confederate soldier before moving to Arizona in late 1870s (Figure 12A). The Apache campaign of Crooke and Bourke in 1883 removed the Apache influence from southern Arizona and opened the San Bernardino Valley for permanent settlement (Bourke 1886). In 1884, Slaughter bought the San Bernardino Land Grant on both sides of the border from the descendants of Ignacio Pérez plus adjacent lands to establish a successful cattle ranch. In 1886–1890, he was the Sheriff of Cochise County. The ranch house became the San Bernardino Ranch National Historical Monument in 1964. In 1980, The Nature Conservancy bought the ranch as a holding project until Congress approved funds to transfer it to the U.S. Fish & Wildlife Service. The 2,369-acre San Bernardino National Wildlife Refuge was established in 1982 to protect what remained of the ciénega and wildlife, especially endangered Río Yaqui fishes (Hendrickson & Minckley 1985). In addition to monitoring and management of federally listed species, the refuge is presently working to restore former ciénega habitat through restoration of the water table.

Rancho San Bernardino. Valer Clark moved to a cattle ranch in the Chiricahua Mountains in southeastern Arizona (Figure 12B). She was taken by the rawness of the desert landscape but dismayed by how overgrazing had taken its toll on the grasslands. In the next four decades, she acquired more than 120,000 acres on nine ranches in Sonora south of the Arizona border that became the private Cuenca Los Ojos Foundation. It

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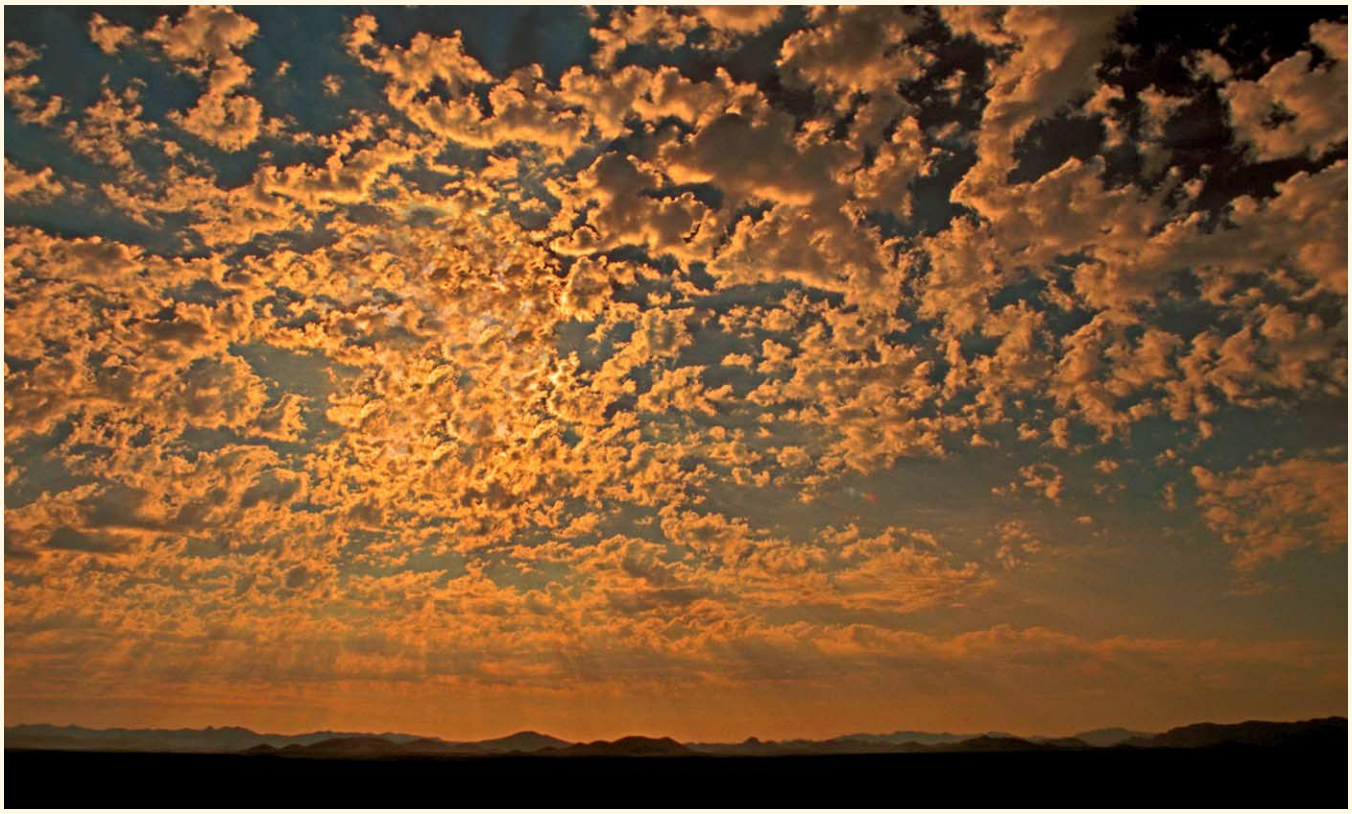

Figure 13. Sunrise in the San Bernardino Valley. *Photo by William R. Radke.*

Trans-border Flora and History of San Bernardino *continued*

not only protected the San Bernardino wetlands but adjacent Chihuahuan desertscrub and desert grassland; Plains grassland in the southern extension of the Cloverdale-Animas Valley; and oak woodland and pine-oak forest in the Sierra San Luis. The recovery of cottonwood gallery forests along Cajón Bonito (Figure 4) and grasses in many areas in the absence of cattle grazing has been amazing. *Muhlenbergia porteri* (bush muhly) is a palatable grass that is widespread in desertscrub and desert grassland in the southwestern United States and Sonora that is often uncommon or rare with cattle grazing. Its abundance on RSB reflects a strong recovery without grazing. In 2018, Clark formally created non-profit organizations in the U.S. (501[c])3) and Mexico (A.C. [Civil Association]) named Cuenca los Ojos (Figure 13).

San Bernardino and the Border Wall. In recent years, the construction of a wall along the U.S.-Mexico border has been controversial. Concerns have been expressed about biotic impacts, especially that the wall interrupts animal dispersals. The genetic integrity of animal populations and dispersal of individuals between them are not legally protected in the U.S. or Mexico. Animals are continuously killed along Mexican Federal Highway 2 immediately south of the border, including American black bear (*Ursus americanus*) and mountain lion (*Puma concolor*). In contrast, animals are not dying along the wall. Concerns have also been raised about the effects of the wall on water. Modifications in the wall allow water to pass in riparian areas like San Bernardino. Upland vegetation receives the same amount of rainfall on both sides of the border. Differences in vegetation north and south of the wall reflect different land use history, not interference in water flow.

Acknowledgments

Valer Clark's vision and the creation of Cuenca Los Ojos are shining examples of conservation in Sonora. Olyvia A. Childress and Valerie Gordon facilitated recent visits to SBNWR and RSB. Taxonomic advice from Susan D. Carnahan, Mark Fishbein, Elizabeth Makings, Guy L. Nesom, and Michael Bauer helped with the ever-changing plant names. Reviews by Ries Lindley and Minckley greatly improved the manuscript. Erik F. Enderson and William R. Radke allowed the use of their photos. Other images are by Reina-G., Roll, and Van Devender. Since 2015, Greater Good Charities has sponsored Madrean Discovery Expeditions to document biodiversity in Sonoran Sky Island mountain ranges. Marina Maskaykina at Greater Good Charities drafted the maps.

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CHECKLIST: San Bernardino, Arizona and Sonora *page 1 of 7*

NWR = San Bernardino National Wildlife Refuge

RSB = Rancho San Bernardino

An asterisk (*) denotes non-native status.

Pteridophytes

MARSILEACEAE

Marsilea vestita Hook. & Grev. NWR

Gymnosperms

CUPRESSACEAE

Juniperus arizonica (R.P. Adams) R.P. Adams NWR

EPHEDRACEAE

Ephedra trifurca Torr. ex S. Watson NWR, RSB

Eudicots

ACANTHACEAE

Anisacanthus thurberi (Torr.) A. Gray NWR, RSB

Carlowrightia arizonica A. Gray NWR

Dicliptera resupinata (Vahl) Juss. RSB

Ruellia ciliatiflora Hook. NWR, RSB

Tetramerium nervosum Nees NWR, RSB

AIZOACEAE

Trianthema portulacastrum L. NWR, RSB

AMARANTHACEAE

Alternanthera caracasana Kunth RSB

Amaranthus palmeri S. Watson NWR, RSB

Amaranthus torreyi (A. Gray) Benth. ex S. Watson NWR

Atriplex canescens (Pursh) Nutt. NWR, RSB

Atriplex elegans (Moq.) D. Dietr. NWR, RSB

Atriplex semibaccata R. Br. RSB

Atriplex wrightii S. Watson NWR **Bassia scoparia* (L.) A.J. Scott RSB

Blitum nuttallianum Schult. NWR

**Chenopodium album* L. var. *lanceolatum* (Muhl. ex Willd.) Coss. & Germ. NWR

Chenopodium arizonicum Standl. NWR

Chenopodium fremontii S. Watson NWR

Chenopodium incanum (S. Watson) A. Heller var. *elatum* Crawford NWR

Chenopodium leptophyllum (Moq.) Nutt. ex S. Watson NWR

Chenopodium neomexicanum Standl. NWR, RSB

**Salsola tragus* L. NWR, RSB

Suaeda torreyana S. Watson NWR, RSB

Tidestromia lanuginosa (Nutt.) Standl. NWR, RSB

ANACARDIACEAE

Rhus microphylla Engelm. NWR, RSB

**Schinus molle* L. RSB

APIACEAE

**Berula erecta* (Huds.) Coville NWR, RSB

Bowlesia incana Ruiz & Pav. NWR

Daucus pusillus Michx. NWR, RSB

Lilaeopsis schaffneriana (Schltdl.) J.M. Coult. & Rose var. *recurva* (A.W. Hill) Affolter NWR

Spermolepis lateriflora G.L. Nesom NWR

Vesper multinervatus (J.M. Coult. & Rose) R.L. Hartm. & G.L. Nesom NWR

Yabea microcarpa (Hook. & Arn.) K.-Pol. RSB

APOCYNACEAE

Asclepias brachystephana Engelm. ex Torr. NWR

Asclepias nyctaginifolia A. Gray NWR

Asclepias subverticillata (A. Gray) Vail NWR, RSB

Chthamalia producta (Torr.) L.O. Alvarado & E.B. Cortez NWR, RSB

Funastrum crispum (Benth.) Schltr. NWR

Funastrum cynanchoides (Decne.) Schltr. NWR, RSB

Funastrum heterophyllum (Engelm. ex Torr.) Standl. NWR, RSB

Mandevilla brachysiphon (Torr.) Pichon RSB

Matelea parvifolia (Torr.) Woods. RSB

ARISTOLOCHIACEAE

Aristolochia watsonii Wooton. & Standl.

ASTERACEAE

Acourtia nana (A. Gray) Reveal & R.M. King NWR, RSB

Acourtia wrightii (A. Gray) Reveal & R.M. King NWR, RSB

**Acroptilon repens* (L.) DC. RSB

Almutaster pauciflorus (Nutt.) A. Löve & D. Löve NWR

Ambrosia confertiflora DC. NWR, RSB

Ambrosia monogyra (Torr. & A. Gray) Strother & B.G. Baldwin NWR, RSB

Ambrosia psilostachya DC. NWR

Arida parviflora (A. Gray) D.R. Morgan & R.L. Hartm. RSB

Artemisia ludoviciana Nutt. NWR

Baccharis pteronioides DC. RSB

Baccharis salicifolia (Ruiz & Pav.) Pers. NWR, RSB

Baccharis sarothroides A. Gray NWR, RSB

Baileya multiradiata Harv. & A. Gray NWR, RSB

Barkleyanthus salicifolius (Kunth) H.E. Robins. & Brett. RSB

Bebbia juncea (Benth.) Greene NWR, RSB

Bidens laevis (L.) Britton, Sterns & Poggenb. NWR

Bidens leptocephala Sherff NWR

Calycoseris wrightii A. Gray NWR, RSB

**Centaurea melitensis* L. NWR, RSB

Chaenactis stevioides Hook. & Arn. NWR, RSB

Chaetopappa ericoides (Torr.) G.L. Nesom NWR, RSB

Chloracantha spinosa (Benth.) G.L. Nesom NWR

Cirsium neomexicanum A. Gray RSB

Cirsium ochrocentrum A. Gray NWR, RSB*Cirsium wrightii* A. Gray NWR (extirpated)

Conoclinium dissectum A.Gray NWR

Conyza canadensis (L.) Cronquist var. *glabrata* (A. Gray) Cronquist NWR, RSB

Diaperia verna (Raf.) Morefield NWR

Encelia farinosa A. Gray ex Torr. RSB

Erigeron divergens Torr. & A. Gray NWR, RSB

CHECKLIST: San Bernardino, Arizona and Sonora *page 2 of 7*

Erigeron flagellaris A. Gray RSB

Flourensia cernua DC. NWR, RSB

Gaillardia pulchella Foug. RSB

Gamochaeta stagnalis (I.M. Johnst.) Anderb. NWR

Gutierrezia microcephala (DC.) A. Gray NWR, RSB

Gutierrezia sarothrae (Pursh) Britton & Rusby RSB

Hedosyne ambrosiifolia (A. Gray) Strother NWR

Helenium thurberi A. Gray NWR, RSB

Helianthus annuus L. NWR, RSB

Helianthus ciliaris DC. NWR

Heliomeris hispida (A. Gray) Cockerell NWR

Heliomeris longifolia (Robins. & Greenm.) Cockerell RSB

Heterotheca subaxillaris (Lam.) Britton & Rusby NWR

Hymenothrix wislizeni A. Gray NWR

Hymenoxys odorata DC. NWR, RSB

Isocoma acradenia (Greene) Greene NWR, RSB

Isocoma tenuisecta Greene NWR, RSB

**Lactuca saligna* L. RSB

**Lactuca serriola* L. NWR, RSB

Laennecia coulteri (A. Gray) G.L. Nesom NWR, RSB

Machaeranthera tagetina Greene NWR, RSB

Malacothrix fendleri A. Gray NWR, RSB

Malacothrix glabrata (A. Gray ex D.C. Eaton) A. Gray NWR, RSB

Parthenium incanum Kunth NWR, RSB

Pectis cylindrica (Fern.) Rydb. NWR, RSB

Pectis filipes Harvey & A. Gray var. *subnuda* Fern. NWR

Picradeniopsis absinthifolia (Benth.) B.G. Baldwin NWR, RSB

Pluchea sericea (Nutt.) Coville NWR

Porophyllum gracile Benth. NWR

Prenanthella exigua (A. Gray) Rydb. RSB

**Pseudognaphalim luteoalbum* (L.) Hilliard & B.L. Burtt NWR

Pseudognaphalium stramineum (Kunth) W.A. Weber NWR

Psilostrophe cooperi (A. Gray) Greene RSB

Rafinesquia neomexicana A. Gray NWR

Sanvitalia abertii A. Gray NWR

Senecio flaccidus Less. var. *flaccidus* NWR, RSB

Senecio flaccidus Less. var. *monoensis* (Greene) B.L. Turner & T.M. Barkl. NWR, RSB

Solidago velutina DC. NWR

Solidago wrightii A. Gray var. *adenophora* Blake NWR

**Sonchus asper* (L.) Hill NWR, RSB

**Sonchus oleraceus* L. NWR, RSB

Stephanomeria pauciflora (Torr.) A. Nels. NWR, RSB

Symphyotrichum subulatum (Michx.) G.L. Nesom var. *parviflorum* (Nees) S.D. Sundberg NWR

Thymophylla acerosa (DC.) Strother NWR, RSB

Thymophylla pentachaeta (DC.) Small NWR, RSB

Uropappus lindleyi (DC.) Nutt. NWR, RSB

Verbesina encelioides (Cav.) Benth. & Hook. f. ex A. Gray subsp. *exauriculata* (B.L. Rob. & Greenm.) J.R. Coleman NWR, RSB

Verbesina rothrockii B.L. Rob. & Greenm. NWR

Viguiera dentata (Cav.) Spreng. NWR

Xanthisma gracile (Nutt.) D.R. Morgan & R.L. Hartm. NWR, RSB

Xanthisma spinulosum (Pursh) D.R. Morgan & R.L. Hartman var. *chihuahuanum* (B.L. Turner & R.L. Hartman) D.R. Morgan & R.L. Hartman NWR, RSB

Xanthium orientale L. NWR

Zinnia acerosa (DC.) A. Gray NWR, RSB

Zinnia grandiflora Nutt. RSB

BIGNONIACEAE

Chilopsis linearis (Cav.) Sweet RSB

BORAGINACEAE

Cryptantha barbigera (A. Gray) Greene NWR, RSB

Cryptantha crassisepala (Torr. & A. Gray) Greene NWR, RSB

Cryptantha muricata (Hook. & Arn.) A. Nelson & J.F. Macbr. RSB

Cryptantha pterocarya (Torr.) Greene NWR

Eucrypta micrantha (Torr.) Heller NWR, RSB

Lappula occidentalis (S. Watson) Greene NWR, RSB

Pectocarya platycarpa (Munz & I.M. Johnst.) Munz & I.M. Johnst. NWR

Pectocarya recurvata I.M. Johnst. RSB

Phacelia affinis A. Gray NWR, RSB

Phacelia arizonica A. Gray NWR, RSB

Phacelia bombycina Wooton & Standl. NWR

Phacelia caerulea Greene NWR, RSB

Phacelia crenulata Torr. ex S. Watson NWR, RSB

Phacelia neomexicana Thurb. ex Torr. RSB

Plagiobothrys arizonicus (A. Gray) Greene ex A. Gray NWR

Tiquilia canescens (A. DC.) A.T. Richardson NWR, RSB

BRASSICACEAE

**Brassica nigra* (L.) W.D.J. Koch RSB

**Brassica tournefortii* Gouan RSB

**Chorispora tenella* (Pall.) DC. RSB

Descurainia obtusa (Greene) O.E. Schulz subsp. *adenophora* (Wooton & Standl.) Detling RSB

Descurainia pinnata (Walter) Britton NWR, RSB

**Descurainia sophia* (L.) Webb ex Prantl NWR, RSB

Erysimum capitatum (Douglas ex Hook.) Greene RSB

**Eruca vescaria* (L.) Cav. subsp. *sativa* (P. Mill.) Thellung RSB

Lepidium oblongum Small NWR

Lepidium thurberi Wooton NWR, RSB

**Nasturtium officinale* W.T. Aiton NWR

Physaria gordonii (A. Gray) O'Kane & Al-Shehbaz NWR, RSB

Physaria purpurea (A. Gray) O'Kane & Al-Shehbaz NWR, RSB

**Raphanus raphanistrum* L. RSB

**Sisymbrium irio* L. NWR, RSB

Streptanthus carinatus C. Wright ex A. Gray subsp. *arizonicus* (S. Watson) Kruckeb., Rodman & Worth. NWR, RSB

CHECKLIST: San Bernardino, Arizona and Sonora *page 3 of 7*

CACTACEAE

Cylindropuntia fulgida (Engelm.) Knuth NWR

Cylindropuntia imbricata (Haw.) F.M. Knuth subsp. *spinosior* (Engelm.) M.A .Baker, Cloud-H. & Majure NWR, RSB

Cylindropuntia imbricata (Haw.) F.M. Knuth x *C. leptocaulis* (DC.) Knuth NWR

Cylindropuntia leptocaulis (DC.) Knuth NWR, RSB

Echinocereus fendleri (Engelm.) Sencke ex J.N. Haage subsp. *rectispinus* (Peebles) N.P. Taylor NWR, RSB

Ferocactus wislizeni (Engelm.) Britton & Rose NWR, RSB

Opuntia chlorotica Engelm. & Bigelow NWR

Opuntia engelmannii Salm-Dyck NWR, RSB

Opuntia macrocentra Engelm. NWR, RSB

Opuntia macrorhiza Engelm. subsp. *pottsii* (Salm-Dyck) U. Guzmán & Mandujano RSB

Opuntia phaeacantha Engelm. NWR, RSB

Opuntia santa-rita (Griffiths & Hare) Rose NWR, RSB

Peniocereus greggii (Engelm.) Britt. & Rose

CAMPANULACEACE

Nemacladus glanduliferus Jeps. RSB

CANNABACEAE

Celtis pallida Torr. NWR, RSB

Celtis reticulata Torr. NWR, RSB

CARYOPHYLLACEAE

Silene antirrhina L. RSB

CELASTRACEAE

Mortonia scabrella A. Gray RSB

CERATOPHYLLACEAE

Ceratophyllum demersum L. NWR

CLEOMACEAE

Cleomella multicaulis (DC.) J.C. Hall & Roalson RSB

COCHLOSPERMACEAE

Amoreuxia palmatifida DC. NWR, RSB

CONVOLVULACEAE

**Convolvulus arvensis* L. NWR, RSB

Convolvulus equitans Benth. NWR, RSB

Cuscuta umbellata Kunth NWR

Evolvulus alsinoides (L.) L. NWR

Ipomoea barbatisepala A. Gray NWR

Ipomoea costellata Torr. NWR, RSB

Ipomoea cristulata Hallier f. NWR, RSB

Ipomoea hederacea Jacq. NWR

Ipomoea leptotoma Torr. var. *ternifolia* (Torr.) J.A. McDonald NWR

Ipomoea purpurea (L.) Roth NWR, RSB

CUCURBITACEAE

Apodanthera undulata A. Gray NWR

Cucurbita digitata A. Gray NWR, RSB

Cucurbita foetidissima Kunth NWR, RSB

Echinopepon wrightii (A. Gray) S. Watson NWR, RSB

Ibervillea tenuisecta (A. Gray) Small NWR, RSB

Sicyos laciniatus L. NWR

EUPHORBIACEAE

Acalypha neomexicana Muell.-Arg. NWR

Acalypha ostryifolia Riddell ex J.M. Coult. NWR, RSB

Argythamnia serrata (Torr.) Müll.-Arg. NWR, RSB

Cnidoscolus angustidens Torr. RSB

Croton pottsii (Klotzsch) Müll.-Arg. NWR, RSB

Euphorbia abramsiana L.C. Wheeler NWR, RSB

Euphorbia albomarginata Torr. & A. Gray NWR, RSB

Euphorbia capitellata Engelm. NWR, RSB

Euphorbia florida Engelm. NWR, RSB

Euphorbia glyptosperma Engelm. NWR

Euphorbia gracillima S.Watson RSB

Euphorbia heterophylla L. NWR, RSB

Euphorbia hyssopifolia L. NWR, RSB

Euphorbia indivisa (Engelm.) Tidestrom NWR, RSB

Euphorbia micromera Boiss. NWR, RSB

Euphorbia prostrata Aiton NWR, RSB

Euphorbia serrula Engelm. NWR, RSB

Euphorbia setiloba Engelm. ex Torr. NWR

Euphorbia spathulata Lam. NWR

Euphorbia stictospora Engelm. NWR, RSB

Jatropha macrorhiza Benth. NWR, RSB

Manihot angustiloba (Torr.) Muell.-Arg. NWR

FABACEAE

Acmispon brachycarpus (Benth.) D.D. Sokoloff NWR, RSB

Astragalus allochrous A. Gray var. *playanus* (M.E. Jones) Isely NWR, RSB

Astragalus nuttallianus DC. var. *austrinus* (Small) Barneby NWR, RSB

Astragalus thurberi A. Gray NWR, RSB

Astragalus wootonii Sheldon RSB

**Caesalpinia gilliesii* (Hook.) Wallich ex D. Dietr. NWR

Chamaecrista nictitans (L.) Moench NWR

Dalea formosa Torr. NWR, RSB

Dalea mollissima (Rydb.) Munz RSB

Dalea pogonathera A. Gray NWR, RSB

Dalea pulchra Gentry RSB

Hoffmannseggia glauca (Ortega) Eifert NWR, RSB

Lupinus brevicaulis S. Watson NWR, RSB

Lupinus concinnus J.G. Agardh RSB

Lupinus sparsiflorus Benth. RSB

**Melilotus albus* Medik. NWR, RSB

**Melilotus indicus* (L.) All. NWR, RSB

Mimosa biuncifera Benth. NWR, RSB

Neltuma odorata (Torr. & Frém.) C.E. Hughes & G.P. Lewis NWR

Neltuma velutina (Wooton) Britton & Rose NWR, RSB

Parkinsonia aculeata L. RSB

Phaseolus acutifolius A. Gray var. *latifolius* Freeman NWR

Rhynchosia senna Gillies ex Hook. NWR

Senna bauhinioides (A. Gray) Irwin & Barneby NWR, RSB

Senna hirsuta (L.) H.S. Irwin & Barneby *var. glaberrima* (M.E. Jones) H.S. Irwin & Barneby NWR, RSB

Senna wislizeni (A. Gray) Irwin & Barneby RSB

CHECKLIST: San Bernardino, Arizona and Sonora *page 4 of 7*

Vachellia constricta (Benth. ex A. Gray) Seigler & Ebinger NWR, RSB

Vachellia vernicosa (Britton & Rose) Seigler & Ebinger NWR, RSB

Vicia ludoviciana Nutt. NWR

FOUQUIERIACEAE

Fouquieria splendens Engelm. NWR, RSB

GENTIANACEAE

Zeltnera arizonica (A. Gray) G. Mans. RSB

GERANIACEAE

**Erodium cicutarium* (L.) L'Hér. NWR, RSB

Erodium texanum A. Gray NWR

HYDRANGEACEAE

Fendlera rupicola A. Gray RSB

JUGLANDACEAE

**Carya illinoinensis* (Wangenh.) K. Koch NWR

KRAMERIACEAE

Krameria erecta Willd. ex J.A. Schultes RSB

Krameria lanceolata Torr. RSB

LAMIACEAE

Agastache wrightii (Greenm.) Wooton & Standl. NWR

Clerodendrum coulteri (A. Gray) Govaerts NWR, RSB

Hedeoma nana (Torr.) Briq. NWR

**Lamium amplexicaule* L. RSB

**Marrubium vulgare* L. NWR, RSB

**Mentha spicata* L. NWR

LINACEAE

Linum lewisii Pursh var. *pratense* Norton NWR

Linum puberulum (Engelm.) Heller NWR

LOASACEAE

Mentzelia albicaulis (Dougl.) Dougl. ex Torr. & A. Gray NWR, RSB

Mentzelia aspera L. NWR

Mentzelia isolata Gentry NWR

Mentzelia longiloba J. Darl. NWR, RSB

LYTHRACEAE

Ammannia coccinea Rottb. NWR

Lythrum californicum Torr. & A. Gray RSB

MALPIGHIACEAE

Cottsia gracilis (A. Gray) W.R. Anderson NWR, RSB

MALVACEAE

Abutilon incanum (Link) Sweet NWR

Abutilon mollicomum (Willd.) Sweet NWR

Abutilon parvulum A. Gray NWR, RSB

Anoda cristata (L.) Schltdl. NWR

Anoda pentaschista A. Gray NWR, RSB

Corchorus hirtus L. NWR

Hibiscus denudatus Benth. NWR, RSB

Malvella lepidota (A. Gray) Fryxell NWR

Rhynchosida physocalyx (A. Gray) Fryxell NWR, RSB

Sida abutilifolia Mill. NWR, RSB

Sidalcea neomexicana A. Gray RSB

Sphaeralcea angustifolia (Cav.) G. Don NWR, RSB

Sphaeralcea emoryi Torr. ex A. Gray RSB

Sphaeralcea incana Torr. ex A. Gray RSB

Sphaeralcea laxa Wooton & Standl. NWR, RSB

Sphaeralcea polychroma La Duke RSB

MARTYNIACEAE

Proboscidea altheifolia (Benth.) Decne. NWR

Proboscidea parviflora (Wooton) Wooton & Standl. NWR, RSB

MOLLUGINACEAE

Glinus radiatus (Ruiz & Pav.) Rohrb. RSB

Mollugo verticillata L. NWR, RSB

MONTIACEAE

Calandrinia ciliata (Ruiz & Pav.) DC. NWR

MORACEAE

Morus microphylla Buckley NWR

NAMACEAE

Nama hispida A. Gray NWR, RSB

NYCTAGINACEAE

Allionia incarnata L. NWR, RSB

Boerhavia coccinea P. Mill. NWR, RSB

Boerhavia coulteri (Hook. f.) S. Watson var. *palmeri* (S. Watson) Spellenb. NWR, RSB

Boerhavia erecta L. NWR

Boerhavia spicata Choisy NWR, RSB

Boerhavia triquetra S. Watson var. *intermedia* (M.E. Jones) Spellenb. NWR, RSB

Boerhavia wrightii A. Gray NWR, RSB

Commicarpus scandens (L.) Standl. NWR, RSB

**Mirabilis jalapa* L. RSB

OLEACEAE

Fraxinus velutina Torr. NWR

Menodora scabra A. Gray NWR, RSB

ONAGRACEAE

Chylismia claviformis (Torr. & Frém.) A. Heller RSB

Epilobium ciliatum Raf. NWR

Eremothera chamaenerioides (A. Gray) W.L. Wagner & Hoch NWR, RSB

Oenothera curtiflora W. L. Wagner & Hoch NWR, RSB

Oenothera havardii S. Watson NWR, RSB

Oenothera kunthiana (Spach) Munz RSB

Oenothera primiveris A. Gray NWR, RSB

Oenothera rosea L'Hér. ex Aiton RSB

Oenothera triloba Nutt. NWR

OROBANCHACEAE

Orobanche cooperi (A. Gray) A. Heller NWR, RSB

PAPAVERACEAE

Argemone pleiacantha Greene NWR

Corydalis aurea Willd. subsp. *occidentalis* (Engelm. ex Gray) G.B. Ownbey NWR, RSB

Eschscholzia californica Cham. subsp. *mexicana* (Greene) C. Clark NWR, RSB

**Fumaria officinalis* L. RSB

PHRYMACEAE

Erythranthe guttata (Fisch. ex DC.) G.L. Nesom NWR, RSB

CHECKLIST: San Bernardino, Arizona and Sonora *page 5 of 7*

PHYTOLACCACEAE

Rivina humilis L. NWR, RSB

PETIVERIACEAE

Rivina humilis L.

PLANTAGINACEAE

Mecardonia procumbens (P. Mill.) Small NWR

Nuttallanthus texanus (Scheele) D.A. Sutton NWR, RSB

Penstemon parryi (A. Gray) A. Gray RSB

Penstemon superbus A. Nels. RSB

Plantago patagonica Jacq. NWR, RSB

Plantago rhodosperma Decne. NWR, RSB

Plantago virginica L. RSB

Schistophragma intermedium (A .Gray) Pennell NWR, RSB

Veronica americana Schwein. ex Benth. RSB

Veronica anagallis-aquatica L. NWR, RSB

Veronica peregrina L. subsp. *xalapensis* (Kunth) Pennell NWR, RSB

PLATANACEAE

Platanus wrightii S. Watson RSB

POLEMONIACEAE

Eriastrum diffusum (A. Gray) Mason NWR, RSB

Gilia flavocincta A. Nels. NWR

Gilia mexicana A.& V. Grant NWR

Gilia sinuata Douglas ex Benth. NWR, RSB

Ipomopsis longiflora (Torr.) V. Grant subsp. *australis* Fletcher & W.L. Wagner NWR, RSB

Linanthus bigelovii (A. Gray) Greene NWR, RSB

POLYGALACEAE

Hebecarpa obscura (Benth.) J.R. Abbott NWR

Rhinotropis lindheimeri (A. Gray) J.R. Abbott var. *parvifolia* (Wheelock) J.R. Abbott NWR, RSB

Senega scoparioides (Chodat) J.F.B. Pastore & J.R. Abbott RSB

POLYGONACEAE

Eriogonum abertianum Torr. NWR, RSB

Eriogonum polycladon Benth. NWR

Eriogonum wrightii Torr. ex Benth. NWR, RSB

Persicaria lapathifolia (L.) Delarbre NWR, RSB

**Polygonum argyrocoleon* Steud. ex Kunze NWR, RSB

**Rumex crispus* L. NWR, RSB

Rumex hymenosepalus Torr. NWR, RSB

PORTULACACEAE

**Portulaca oleracea* L. NWR

Portulaca retusa Engelm. RSB

Portulaca suffrutescens Engelm. NWR

Portulaca umbraticola Kunth NWR

PRIMULACEAE

Androsace occidentalis Pursh NWR

RANUNCULACEAE

Clematis drummondii Torr. & A. Gray NWR, RSB

Clematis ligusticifolia Nutt. NWR, RSB

Delphinium wootonii Rydb. RSB

Myosurus minimus L. NWR

Ranunculus sceleratus L. NWR

RHAMNACEAE

Condalia correllii M.C. Johnston NWR

Condaliopsis obusifolia (Hook. ex A. Gray) Seuss. NWR, RSB

**Ziziphus jujuba* Mill. RSB

ROSACEAE

Fallugia paradoxa (D. Don) Endl. RSB

RUBIACEAE

Galium proliferum A. Gray NWR

SALICACEAE

Populus fremontii S. Watson NWR, RSB

Salix gooddingii C.R. Ball NWR, RSB

Salix taxifolia Kunth RSB

SANTALACEAE

Phoradendron californicum Nutt. NWR, RSB

SAPINDACEAE

Sapindus drummondii Hook. & Arn. NWR, RSB

SAPOTACEAE

Sideroxylon lanuginosum Michx. subsp. *rigidum* (A. Gray) T.D. Pennington NWR, RSB

SAURURACEAE

Anemopsis californica (Nutt.) Hook. & Arn. NWR, RSB

SCROPHULARIACEAE

**Verbascum virgatum* Stokes RSB

SOLANACEAE

Chamaesaracha arida Henrickson NWR, RSB

Chamaesaracha sordida (Dunal) A. Gray NWR, RSB

Datura innoxia Mill. NWR, RSB

Datura quercifolia Kunth NWR, RSB

Lycium andersonii A. Gray NWR, RSB

Lycium berlandieri Dunal RSB

Lycium pallidum Miers RSB

Margaranthus solanaceous Schltdl. NWR

**Nicotiana glauca* Graham NWR

Nicotiana obtusifolia M. Martens & Galeotti NWR

Physalis acutifolia (Miers) Sandw. NWR, RSB

Physalis angulata L. NWR

Physalis pubescens L. NWR

Solanum elaeagnifolium Cav. NWR, RSB

Solanum nigrum L. NWR

Solanum setigeroides (Whalen) S. Stern NWR, RSB

TALINACEAE

Talinum aurantiacum Engelm. NWR, RSB

Talinum sonorae D.J. Ferguson NWR

TAMARICACEAE

**Tamarix chinensis* Lour.-*T. ramosissima* Ledeb. NWR, RSB

URTICACEAE

Parietaria pensylvanica Muhl. ex Willd. var. *hespera* (B.D. Hinton) S.L. Welsh NWR

CHECKLIST: San Bernardino, Arizona and Sonora *page 6 of 7*

VERBENACEAE

Aloysia gratissima (Gillies & Hook.) Troncoso NWR

Aloysia wrightii Heller ex Abrams NWR

Glandularia gooddingii (Briq.) Solbrig RSB

Glandularia latilobata (L.M. Perry) G.L. Nesom NWR, RSB

Glandularia pumila (Rydb.) Umber NWR

Glandularia wrightii (A. Gray) Umber NWR

Verbena bracteata Cav. ex Lag. & Rodr. RSB

Verbena carolina L. RSB

Verbena menthifolia Benth. NWR

Verbena neomexicana (A. Gray) Small RSB

Verbena plicata Greene NWR, RSB

Verbena scabra Vahl NWR

VIBURNACEAE

Sambucus nigra L. subsp. *cerulea* (Raf.) Bolli NWR, RSB

VIOLACEAE

Hybanthus verticillatus (Ortega) Baill. NWR, RSB

ZYGOPHYLLACEAE

Kallstroemia californica (S. Watson) Vail RSB

Kallstroemia grandiflora Torr. ex A. Gray NWR, RSB

Kallstroemia hirsutissima Vail ex Small NWR

Kallstroemia parviflora J.B.S. Norton NWR

Larrea divaricata Cav. subsp. *tridentata* (Sessé & Moc. ex DC.) Felger & C.H. Lowe NWR, RSB

**Tribulus terrestris* L. NWR, RSB

Monocots

ALISMATACEAE

Sagittaria longiloba Engelm. ex J.G. Sm. RSB

AMARYLLIDACEAE

Allium macropetalum Rydb. NWR, RSB

Nothoscordum bivalve (L.) Britton NWR

Zephyranthes longifolia Hemsl. NWR, RSB

ARACEAE

Lemna gibba L. NWR

Lemna minor L. NWR

Lemna minuta Kunth NWR

ASPARAGACEAE

Agave palmeri Engelm. NWR, RSB

**Asparagus officinalis* L. NWR

Dichelostemma capitatum (Benth.) Alph. Wood subsp. *pauciflorum* (Torr.) G. Keator NWR, RSB

Nolina texana S. Watson RSB

Yucca baccata Torr. NWR, RSB

Yucca elata (Engelm.) Engelm. NWR, RSB

COMMELINACEAE

Commelina erecta L. NWR, RSB

CYPERACEAE

Bolboschoenus maritimus (L.) Palla NWR

Carex agrostoides Mackenzie NWR, RSB

Carex praegracilis W. Boott NWR

Cyperus esculentus L. NWR

Cyperus niger Ruiz & Pav. NWR

Cyperus odoratus L. NWR, RSB

Cyperus squarrosus L. NWR

Eleocharis macrostachya Britton NWR

Eleocharis palustris (L.) Roem. & Schult. NWR

Eleocharis parishii Britton NWR, RSB

Eleocharis rostellata (Torr.) Torr. NWR, RSB

Schoenoplectus acutus (Muhl. ex Bigelow) Á. Löve & D. Löve var. *occidentalis* (S. Watson) S.G. Smith NWR

Schoenoplectus americanus (Pers.) Volk. ex Schinz & R. Keller *RSB*

HYDROCHARITACEAE

Najas guadalupensis (Spreng.) Magnus NWR

Najas marina L. NWR

IRIDACEAE

Sisyrinchium angustifolium Mill. RSB

Sisyrinchium scabrum Cham. & Schltdl. RSB

JUNCACEAE

Juncus balticus Willd. subsp. *ater* (Rydb.) Snogerup NWR, RSB

Juncus balticus Willd. subsp. *mexicanus* (Willd. ex Schult. & Schult. f.) Snogerup NWR

Juncus bufonius L. RSB

Juncus torreyi Coville NWR, RSB

POACEAE

Aristida adscensionis L. NWR

Aristida purpurea Nutt. var. *longiseta* (Steud.) Vasey NWR

Aristida purpurea Nutt. var. *nealleyi* (Vasey) Allred NWR, RSB

Aristida purpurea Nutt. var. *purpurea* NWR

Aristida ternipes Cav. var. *gentilis* (Henr.) Allred NWR

Aristida ternipes Cav. var. *ternipes* NWR, RSB

**Arundo donax* L. NWR

Bothriochloa barbinodis (Lag.) Herter NWR

**Bothriochloa ischaemum* (L.) Keng NWR, RSB

Bothriochloa laguroides (DC.) Herter subsp. *torreyana* (Steud.) Allred & Gould NWR

Bouteloua barbata Lag. var. *barbata* NWR, RSB

Bouteloua chondrosioides (Kunth) Benth. ex S. Watson NWR

Bouteloua curtipendula (Michx.) Torr. NWR, RSB

Bouteloua dactyloides (Nutt.) Columbus RSB

Bouteloua eriopoda (Torr.) Torr. NWR

Bouteloua gracilis (Kunth) Lag. ex Griffiths RSB

Bouteloua repens (Kunth) Scribn. & Merr. NWR

**Bromus catharticus* Vahl NWR, RSB

**Bromus rubens* L. NWR

**Bromus tectorum* L. NWR

**Cenchrus americanus* (L.) Morrone NWR

**Cenchrus ciliaris* L NWR, RSB

CHECKLIST: San Bernardino, Arizona and Sonora *page 7 of 7*

Chloris virgata Sw. NWR, RSB

Cottea pappophoroides Kunth NWR

**Cynodon dactylon* (L.) Pers. NWR, RSB

Dasyochloa pulchella (Kunth) Willd. ex Rydb. NWR, RSB

Digitaria californica (Benth.) Henr. NWR, RSB

Dinebra panicea (Retz.) P.M. Peterson & N. Snow subsp. *brachiata* (Steud.) P.M. Peterson & N. Snow NWR

Dinebra viscida (Scribn.) P.M. Peterson & N. Snow NWR

Disakisperma dubium (Kunth) P.M. Peterson & N. Snow NWR, RSB

Distichlis spicata (L.) Greene NWR, RSB

**Echinochloa colona* (L.) Link NWR

**Echinochloa crus-galli* (L.) P. Beauv. NWR

Elymus elymoides (Raf.) Swezey NWR

Enneapogon desvauxii Desv. ex Beauv. NWR

**Eragrostis barrelieri* Daveau NWR

**Eragrostis cilianensis* (All.) Vignolo ex Janch. NWR, RSB

**Eragrostis echinochloidea* Stapf NWR

**Eragrostis lehmanniana* Nees NWR, RSB

Eragrostis lugens Rupr. RSB

Eragrostis pectinacea (Michx.) Nees ex Steud. NWR

**Eragrostis superba* Peyr. NWR

Eriochloa acuminata (J. Presl) Kunth var. *acuminata* NWR, RSB

Erioneuron avenaceum (Kunth) Tateoka var. *longiaristatum* (Kurtz) Beetle NWR

Heteropogon contortus (L.) Beauv. ex Roemer & J.A. Schultes NWR

Hilaria belangeri (Steud.) Nash NWR

Hilaria mutica (Buckley) Benth. NWR, RSB

Hopia obtusa (Kunth) Zuloaga & Morrone NWR, RSB

**Hordeum jubatum* L. RSB

**Hordeum murinum* L. subsp. *glaucum* (Steud.) Tzvelev NWR

**Hordeum murinum* L. subsp. *leporinum* (Link) Arcang. NWR

Hordeum pusillum Nutt. NWR**Hordeum vulgare* L. var. *trisulcatum* (Schltdl.) Alef. RSB

Leptochloa crinita (Lag.) P.M. Peterson & N. Snow NWR

Lolium multiflorum Lam. NWR

Muhlenbergia alopecuroides (Griseb.) P.M. Peterson & Columbus NWR

Muhlenbergia asperifolia (Nees & Meyen ex Trin.) Parodi NWR, RSB

Muhlenbergia porteri Scribn. ex Beal NWR, RSB

**Panicum antidotale* Retz. NWR

**Panicum coloratum* L. NWR, RSB

Panicum hirticaule J. Presl var. *hirticaule* NWR, RSB

Panicum hirticaule J. Presl var. *stramineum* (A.S. Hitchc. & Chase) Beetle NWR

**Paspalum dilatatum* Poir. NWR

Paspalum distichum L. NWR, RSB

Phalaris caroliniana Walter NWR

**Phalaris minor* Retz. RSB

**Poa annua* L. NWR

Poa bigelovii Vasey & Scribn. NWR

**Polypogon monspeliensis* (L.) Desf. NWR, RSB

**Polypogon viridis* (Gouan) Breistr. NWR

Schedonorus arundinaceus (Schreb.) Dumort. NWR

Schedonorus pratense Huds. NWR

**Schismus arabicus* Nees RSB

**Schismus barbatus* (Loefl. ex L.) Thellung NWR

Scleropogon brevifolius Phil. NWR

**Setaria adhaerens* (Forsk.) Chiov. NWR, RSB

Setaria grisebachii Fourn. NWR, RSB

Setaria macrostachya Kunth NWR, RSB

**Sorghum bicolor* (L.) Moench NWR

**Sorghum halepense* (L.) Pers. NWR, RSB

Sporobolus airoides (Torr.) Torr. NWR, RSB

Sporobolus contractus A.S. Hitchc. NWR

Sporobolus cryptandrus (Torr.) A. Gray NWR

Sporobolus pyramidatus (Lam,) Hitchc. NWR

Sporobolus wrightii Munro ex Scribn. NWR, RSB

Tridentopsis mutica (Torr.) P.M. Peterson NWR

Urochloa arizonica (Scribn. & Merr.) O. Morrone & F. Zuloaga NWR

Urochloa fusca (Sw.) B.F. Hansen & Wunderlin NWR, RSB

PONTEDERIACEAE

Heteranthera limosa (Sw.) Willd. NWR, RSB

POTAMOGETONACEAE

Potamogeton foliosus Raf. NWR

Potamogeton gramineus L. NWR

Potamogeton nodosus Poir. NWR

Stuckenia pectinata (L.) Börner NWR

Zannichellia palustris L. NWR

TYPHACEAE

Typha domingensis Pers. NWR, RSB

THE ARIZONA NATIVE PLANT SOCIETY
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