Scabrethia scabra,
Badland Mule's Ears

Cora Estelle Mosher

Plant Press Arizona

THE ARIZONA NATIVE PLANT SOCIETY

Volume 48, Number 2 **Winter 2025**

The Agave Issue

Plus

With Regular Features

Shindagger or Schott Agave (*Agave schottii*) habitat, Cochise County, AZ, *credit: Douglas Ripley.*

The Agave Issue

by J. Douglas Ripley, President Arizona Native Plant Society

This issue of the *Plant Press Arizona* is devoted to two main subjects. The first consists of a review of the iconic Southwestern Agave genus, including descriptions of the major Agave species occurring in Arizona, its taxonomic history, and the human uses for these remarkable plants dating from the present to pre-Columbian peoples. The second major subject is a flora and history of the Tónichi Area on the Río Yaqui, Municipality of Soyopa, Sonora, Mexico.

Above: Fall Quaking Aspens, White Mountains, *credit: Arlene Ripley.*

President's Note

by Douglas Ripley jdougripley@gmail.com

I extend year-end greetings to all Arizona Native Plant Society members and supporters. Unfortunately for native plant admirers, 2025 proved to be yet another extremely dry year with a highly diminished monsoon season. Consequently, opportunities to enjoy our wonderful native flora in flower were practically nonexistent in most regions of the state. As in the past few years, I explored opportunities to observe our native plants in areas that were not negatively impacted by the drought. One such place was the White Mountains where my wife and I enjoyed seeing spectacular quaking aspen colors in October. Let's hold good thoughts that 2026 will see the return of at least normal precipitation, especially during the monsoon season.

The Arizona Native Plant Society enjoyed a good year with continued activities sponsored by its eleven chapters and committees, including efforts taken recently to revitalize and upgrade the contributions of the Cochise and Phoenix Chapters. The Education Committee, in cooperation with the University of Arizona Herbarium, offered the ever-popular grass identification class. That effort will continue and possibly expand in the new year. The Conservation Committee also undertook several very valuable restoration efforts and continued its sponsorship of invasive species eradication projects in several parts of the state.

The Education Committee sponsored the highly successful Botany 2025 Conference attended by 150 participants at the Desert Botanical Garden in March 2025. The Committee is now making plans for the Botany 2026 Conference which is tentatively scheduled for June 13–14 in Flagstaff. We decided to hold the 2026 meeting in cooperation with the American Penstemon Society. The meeting presentations will occur in the beautiful facilities of the Lowell Observatory with a variety of guided field trips offered before and after the main meeting on June 13. Specific details about the meeting will be forthcoming early in the new year.

This issue of *Plant Press Arizona* represents the second and final issue for 2025. It continues an effort started several years ago to highlight a specific group of especially charismatic and important Arizona native plants, in this case the agaves. We also continue in this issue the especially important contributions by Tom Van Devender, Ana L. Reina-Guerrero, and George M. Ferguson in documenting the flora and history of important regions in northern Sonora, Mexico. We hope that the *Plant Press Arizona* provides our members with interesting and useful information on our native flora. We certainly welcome comments on the journal and enthusiastically solicit suggestions for future articles.

I wish to thank the officers and members of the Arizona Native Plant Society for their excellent support during the past year and extend all best wishes for the new year.

Jimador harvesting Blue Agave (*Agave tequilana*) in Mexico for tequila production (Figure 1) and Blue Agave cultivation in Jalisco, Mexico (Figure 2), *credits: Wikipedia.*

The Agaves

by Douglas Ripley, Jack Dash, and Ries Lindley, Arizona Native Plant Society

Arizona's flora consists of approximately 3,900 taxa of vascular plants. Within that huge body of plants there are obviously certain groups that occupy a very special place in the grand scheme of Arizona botany owing to their spectacular beauty, charismatic nature, and diversity of human uses. In previous issues of *Plant Press Arizona*, we have featured some of those groups, such as the grass family, the orchid family, the non-vascular plants, and the gymnosperms. The goal of those articles was to provide a simple introduction to the major members of those groups which would hopefully increase one's appreciation of them and facilitate the identification of individual species. In this issue we provide a summary of the agaves, a genus in the asparagus family that contains quintessential representatives of the plants of the American southwest and Mexico. Agaves are much admired for their striking beauty and distinctive growth forms. Approximately 16 agave taxa are found in Arizona along with several species of other related genera such as *Dasylirion* (desert spoon), *Nolina* (beargrass), and false agaves and yuccas.

The Agaves

The genus Agave was described and named by Linnaeus based on the Greek meaning of the word for "noble" or "admirable." Agaves are most common in Mexico, with a range extending into northern South America and the Caribbean. But approximately 28 species, subspecies, varieties, and hybrids occur in the American southwest. Approximately 16 species and many subspecific taxa occur in Arizona. Agaves in Arizona occur mainly in the upland deserts, grasslands, and pinyon-juniper woodlands. They possess special adaptations to accommodate the very dry conditions of those habitats, including a form of photosynthesis (CAM) that allows for the absorption of carbon dioxide through their leaf stomata at night when temperatures are cooler than in the day, thus reducing water loss. Another curious feature of the Agaves is their mode of so-called, monocarpic reproduction, through which an individual plant will flower only once after it has grown for some time (in some cases for many years) and accumulated enough stored food to produce a single flower stalk followed by the death of the entire plant.

For millennia, agaves have been of great value to Native Americans who have used them for food, fiber, soap (saponin), fuel, and a modern, very popular use in the form of alcohol. The agave is used in the brewing of the alcoholic beverage pulque from a fermented mash made from the plant. Mescal, made from the cooked heart of agave plants, and tequila, made from agave's combined stem and root (caudex), are other more popular alcoholic beverages. The Blue Agave (*Agave tequilana*), presumed to be a native of Jalisco, is cultivated in at least four other Mexican states and is the principal source for tequila (Figures 1 and 2).

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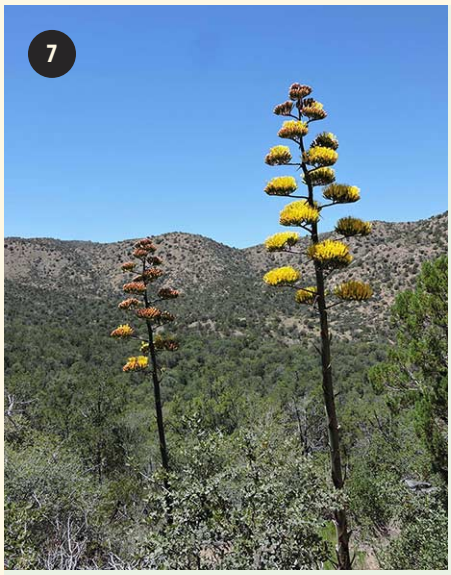
American Agave (*Agave americana*), Cochise County
Starting to flower (Figure 3) and in full flower (Figures 4–6), *credits: Douglas Ripley.*



Golden-flowered Agave (*Agave chrysantha*), Pinal Mountains
In flower (Figures 7–9) and mature rosette (Figure 10), *credits: Douglas Ripley*; and mature fruit (Figure 11), *credit: Ries Lindley.*

The Agaves *continued*

Taxonomically, the agaves are extremely difficult to classify owing to their ability to hybridize and also because Native Americans developed and propagated numerous cultivars, including many that may be the results of hybridization or mutation events resulting in fully or partially sterile clones. Notwithstanding the agaves sometimes complicated taxonomy, many of the Arizona species can be easily recognized and appreciated on many levels. The discussion of the individual Arizona agaves that follows does not cover in detail the varieties and subspecies of each species but rather provides a brief introduction to each of the major ones. To learn the many complex details of agave classification and distribution in Arizona one should consult the outstanding guidebook by Jon L. Hawker (2016, *book review on page 16*). The definitive treatment of the genus *Agave* was published by the eminent botanist Howard Scott Gentry (1982). Wendy Hodgson of the Desert Botanical Garden also prepared an outstanding treatment of the agaves in Arizona (1999).

Arizona Agaves

1. American Century Plant (*Agave americana*)

This gigantic species is hard to miss in many parts of Arizona, having been planted as an ornamental and then escaping and becoming naturalized. Its flower stalks can reach as high as forty feet. It can be found in many locations in southern Arizona, particularly in gardens and as an escaped plant in nearby areas. It is the progenitor to numerous varieties, subspecies, and other agave forms.

2. Golden-flowered Agave (*Agave chrysantha*)

This plant provides a stunning visual treat during its flowering season from May to July in central Arizona where it graces the pinyon-juniper woodlands to grasslands at elevations from 2,300 to 6,900 feet.

3. Simple Desert Agave (*Agave simplex*)

This relatively uncommon but hardy plant survives in the brutally hot and dry deserts of southwestern Arizona and southeastern California at elevations ranging from 1,000 to 4,000 feet. It is known to hybridize with the shindagger agave (*A. schottii*) and the McKelvey agave (*Agave mckelveyana*).

4. McKelvey Agave (*Agave mckelveyana*)

This species occurs mainly in sandy to gravelly or rocky places within the desert scrub, chaparral, and pinyon-juniper woodlands of northwestern Arizona at elevations of 2,600 to 6,000 feet. It produces fairly small pale-yellow flowers on flowering stalks up to 16 feet in height. It is related to *Agave simplex* and possibly also *Agave chrysantha.*

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Simple Desert Agave (*Agave simplex*)
Mature rosette (Figure 12), dead flowering stalk (Figure 13), and mature rosette (Figure 14), *credits: Andrew Salywon.*

McKelvey Agave (*Agave mckelveyana*)
Mature flowering stalk (Figure 15, *credit: iNaturalist*), and mature rosette (Figure 16, *credit: Jan Emming*).

Palmer Agave (*Agave palmeri*) Starting to flower (Figure 17) and mature flowering stalk (Figure 18), Cochise County, *credits: Douglas Ripley*; leaf detail (Figure 19, *credit: Tom Van Devender*); ripening fruits (Figure 20, *credit: Ries Lindley*); and woodpecker nest cavity (Figure 21, *credit: Douglas Ripley*).

Parry Agave (*Agave parryi*) Inflorescence (Figure 22, *credit: Anthony Mendosa*), mature flowering stalk (Figure 23, *credit: Max Licher*), and rosettes (Figure 24, *credit: Ana L. Reina-Guerrero*).

The Agaves *continued*

5. Palmer Agave (*Agave palmeri*)

The Palmer agave is a very conspicuous and handsome component of the southeastern Arizona flora, extending from central Pima County east to Santa Cruz and Cochise Counties and as far north as the I-10 corridor. It occupies grassy plains and oak woodlands at elevations of 3,300 to 6,400 feet and is easily observed in the foothills of the many Sky Islands of the region. Flowering occurs between June and October. This species was an important food and fiber resource for Native Americans, and is still widely used in Sonora to produce mescal.

6. Parry Agave (*Agave parryi*)

The habitat for the Parry Agave ranges from open grasslands to pinyon-juniper woodlands and pine forests. Its range extends from northern Mexico and New Mexico, continuing through southeastern Arizona in a gently northwestern direction to the Mogollon Rim in north-central Arizona. It occurs sympatrically with the Palmer Agave in the southeastern part of its range at elevations extending from 3,700 to 6,400 feet. The flower stalks and flowers are very similar to the Palmer Agave but a brighter yellow color with a more compact branching.

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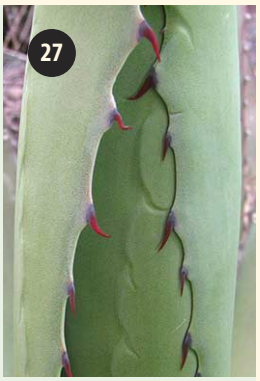

Huachuca Agave (*Agave parryi* var. *huachucensis*)
Habitat (Figure 25, *credit: Teague Embrey*), rosettes (Figure 26, *credit: Janet Fox*), and leaf detail (Figure 27, *credit: Ana L. Reina-Guerrero*).

The Agaves *continued*

7. Huachuca Agave (*Agave parryi* var. *huachucensis*)

This robust agave is recognized as a variety of *Agave parryi* and is thought to have been cultivated for food by pre-Columbian peoples owing to its huge rosettes. It has been appreciated as a very popular landscaping plant and can therefore be seen in many gardens in southern Arizona. It occurs naturally only in the Canelo Hills, Huachuca Mountains, and east to the Animas Mountains in southwestern New Mexico, in Cochise and Santa Cruz Counties, and in adjacent Mexico ranging from the grasslands to coniferous forests.

8. Small-flowered Agave (*Agave parviflora*)

As its scientific specific name *parviflora* attests ("parv" from the Latin for "small"), this rare agave has several very interesting characteristics, not the least of which is that it is the smallest agave to occur in the United States. Not surprisingly, the plant exhibits very small sizes for all its plant parts (flowers, leaves, etc.). Its flower morphology also presents a curious adaptation which consists of a constriction at the top of the ovary which contains the nectar glands. Pollinators must squeeze through the constriction to reach the nectar and in so doing effect a more complete pollination through their movements inside the flower. The plant is found on open slopes of desert grasslands and oak woodlands at elevations from 3,600 to 4,600 feet in Pima and Santa Cruz Counties. Flowering occurs from May to August.

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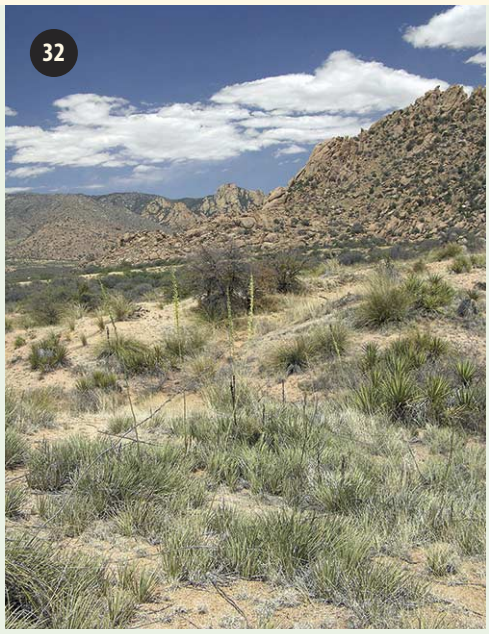
Small-flowered Agave
(*Agave parviflora*)
Rosettes (Figure 28, *credit: Sue Carnahan*); mature flower (fFgure 29) and interior of flower showing constriction at the top of the ovary which contains the nectar glands (Figure 30), *credits: Ries Lindley*.



Shindagger or Schott Agave (*Agave schottii*)
Flowering stalks (Figure 31), habitat, Cochise County, AZ (Figure 32), and inflorescence (Figure 33), *credits: Douglas Ripley*

The Agaves *continued*

9. Shindagger or Schott Agave (*Agave schottii)*

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

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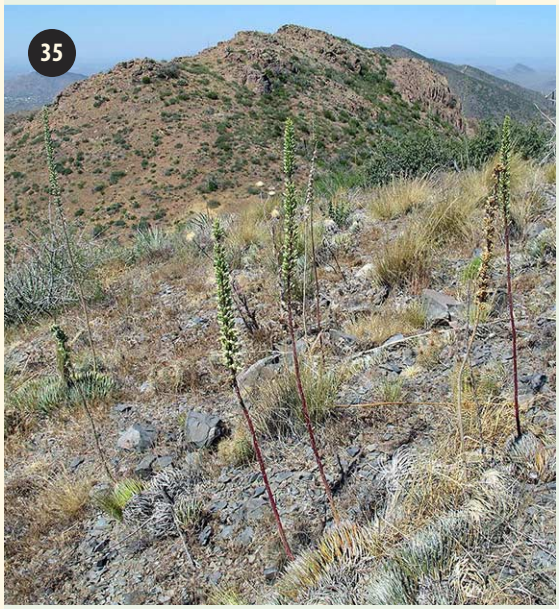

Toumey Agave (*Agave toumeyana*)
Rosettes (Figure 34, *credit: Ries Lindley*); habitat (Figure 35), and rosettes (Figure 36), *credits: Paul Santori*; inflorescence (Figure 37) *credit: Les Landrum*.

Utah Agave (*Agave utahensis*)
Flowering stalks (Figures 38–39) and mature fruits (Figure 40), *credits: Gregory Gust;* rosettes (Figure 41), *credit: Teague Embrey*.

The Agaves *continued*

shindagger produces striking flower stalks, ranging in length up to five feet, and bearing beautiful fragrant yellow flowers.

10. Toumey Agave (*Agave toumeyana*)

The Toumey agave occurs in sparse desert grasslands and mixed scrub on thin rocky soils in a circular area of approximately 100 miles in diameter in the geographical center of the state. Elevations range from 2,000 to 5,000 feet. It is related to the Shindagger agave (*Agave schottii*) and Small-flowered agave (*Agave parviflora*) but does not occur near populations of either of those species.

11. Utah Agave (*Agave utahensis*)

This species, which resembles the shindagger agave in several respects, occurs on open rocky slopes of Mojave and Great Basin desertscrub and grasslands in Coconino and Mojave Counties, southeast Nevada, and southwest Utah. The species is represented by four varieties which are not presented here.

12. Pre-Columbian Cultivated Agaves

A curious and special group of Arizona agaves are remaining populations of cultivated agaves domesticated in the area or brought to the southwest by pre-Columbian peoples who cultivated them for various purposes. Today these agaves persist usually in very small, typically sterile populations that can primarily reproduce only vegetatively. Six such agaves are briefly described here but ongoing research, particularly by Wendy Hodgson and Andrew Salywon, at the Desert Botanical Garden, will most likely result in the description of additional agaves in this group.

a. Tonto Basin Agave (*Agave delamateri*)

This extremely rare agave is found only in the upper Verde Valley and Salt River at elevations ranging from 700 to 1,600 feet. The plant is believed to be a cultivar developed by pre-Columbian people and is represented by less than 100 known clones. Flowering occurs in June and July but as the plant is sterile it produces no fruit or seeds. Reproduction therefore occurs only via cloning.

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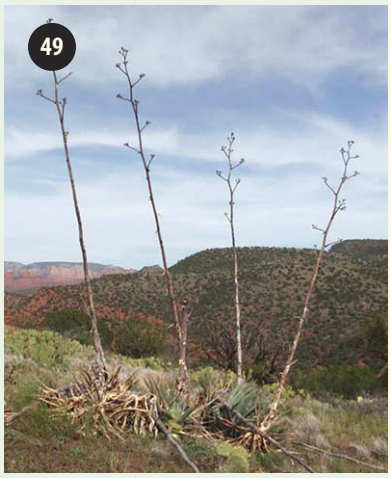
Tonto Basin Agave (*Agave delamateri*)
Habitat (Figure 42, *credit: Wendy Hodgson)*, flower stalk (Figure 43) and flower (Figure 44), *credits: Max Licher*, rosette (Figure 45, *credit: Mark Taylor*).

Hohokam or Murphey's Agave (*Agave murpheyi*)
Habitat (Figure 46, *credit: Mark Taylor*).

Grand Canyon Agave
(*Agave phillipsiana*)
Rosettes (Figure 47–48), habitat (Figure 49), *credits: Max Licher.*



The Agaves *continued*

b. Hohokam or Murphey's Agave (*Agave murpheyi*)

Owing to its cold sensitivity, this species is restricted to low desert habitats in the Phoenix and Tonto Basin. Evidence suggests that it originated in Mexico and was brought north by pre-Columbian peoples where it was cultivated for food. Flowering occurs on stalks from March through August but the plant is completely sterile.

c. Grand Canyon Agave (*Agave phillipsiana*)

This agave was described and named by Wendy Hodgson from four sites on terraces along waterways in Grand Canyon National Park. It is named in honor of Arthur Phillips III, a Grand Canyon botanist who first pointed it out to Wendy. It has subsequently been found in additional locations outside the park.

d. Sacred Mountain Agave (*Agave verdensis*)

The species grows on rocky substrates in the upper Verde Valley and Coconino and Yavapai counties in Arizona at altitudes between 2,900 and 4,900 feet. It was described in 2013 by Wendy Hodgson and Andrew Salywon.

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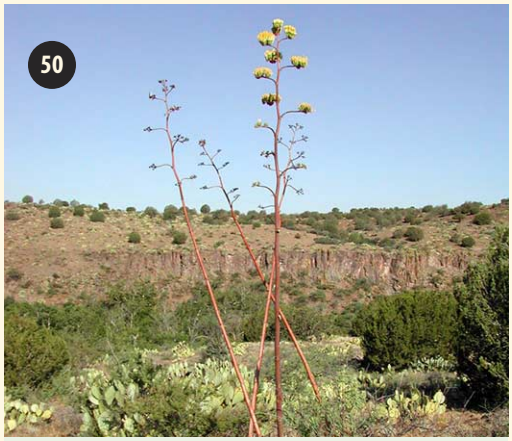


Sacred Mountain Agave (*Agave verdensis*)
Habitat (Figure 50, *credit: Max Licher*), rosette (Figure 51, *credit: Desert Botanical Garden*).

Page Springs Agave (*Agave yavapaiensis*)
Habitat (Figure 52), rosettes (Figure 53–54), *credit: CJ Grinar.*

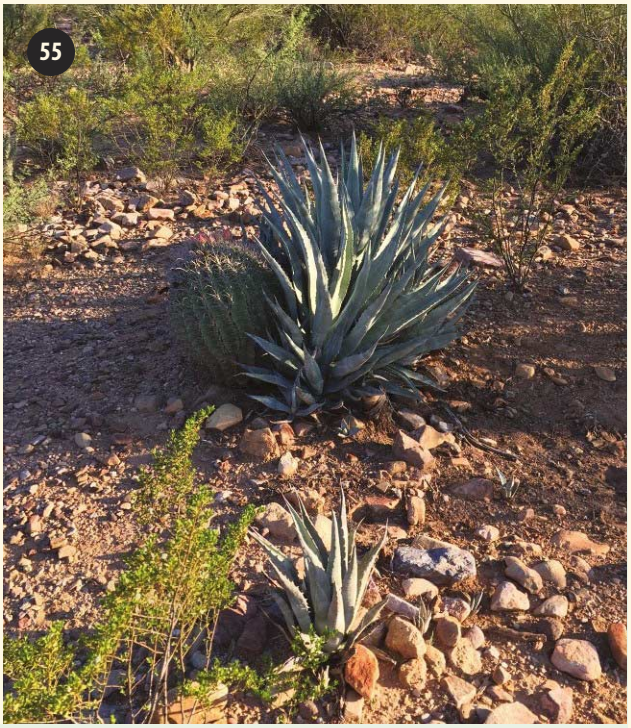
The Agaves *continued*

e. Page Springs Agave (*Agave yavapaiensis*)

This species is known only from the Verde Valley at elevations from 3,300 to 5,600 feet. Although it is largely sterile and reproduces mainly by vegetative offsets, it does flower from June to July and may produce limited fruits with viable seeds.

f. San Pedro Agave (*Agave sanpedroensis*)

Found in 2012 by archaeologists working along the San Pedro River in southeastern Arizona, these agaves represented a previously undescribed, new species which was subsequently described and named *Agave sanpedroensis* by Wendy Hodgson and Andrew Salywon. The few clones occur along the San Pedro River and in the foothills of the Tortolita Mountains at elevations ranging from 3,017 to 3,686 feet. Flowering occurs from late August to September.



San Pedro Agave
(*Agave sanpedroensis*)
Rosettes (Figure 55–56), inflorescence (Figure 57), *credits: Wendy Hodgson and Andrew Salywon.*

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From left Figure 1. Mexican long-nosed bat. *Credit: Mike Timmons.* Figure 2. Lesser long-nosed bat. *Credit: Pima County, AZ.*

Agave Conservation and Restoration in the Southwestern US to Benefit Bats and People *by Rachel Burke*[1]

Bat Conservation International's (BCI's) Agave Restoration Initiative began in 2018 as a large undertaking to restore and protect a nectar corridor for migratory nectar-feeding bats while benefiting the people living in, and working on, these landscapes. Our program is built around the idea that healthy agave landscapes simultaneously support healthy bat populations and local livelihoods, and that working with local partners enables more effective conservation of landscapes and more sustainable conservation outcomes. Our work spans from central Mexico to the southwestern United States, with emphasis on locally tailored solutions to curtail habitat loss.

Each year, the Mexican long-nosed bat (Figure 1), Lesser long-nosed bat (Figure 2), and Mexican long-tongued bat (Figure 3) migrate from south-central Mexico to the southwestern United States following a "nectar corridor" of blooming columnar cacti and paniculate (branched) agaves. All three species occur in Arizona and New Mexico, with this region playing an outsized role in the health and survival of these bats. These states represent the northernmost range of these bats and the farthest documented extent of late summer foraging. Recent detections of the endangered Mexican long-nosed bat in new areas highlight both the vulnerability and resilience of this region. As changing climate conditions drive shifts in bat movement and agave phenology, the northern edge of the bats' nectar corridor becomes a testing ground for how well conservation strategies can support both bats and agaves. Thus, this region is a major focal area for BCI's Agave Restoration Initiative.

As the bats move from key maternity and post-maternity roosts in Arizona to their late summer habitat in the southeastern part of the state and into New Mexico, they rely solely on nectar from Palmer's agave (*Agave palmeri*), an iconic Sky Island species that serves as an ecological keystone. This agave species plays an especially important role during the late summer months as bats are accumulating energy stores prior to undertaking their long migration back to Mexico. Though often seen as a hearty desert plant, agaves are not exempt from the impacts of extreme drought, warming temperatures, and shifting plant communities. Like many Sky Island species, *Agave palmeri* is likely undergoing climate-driven range contractions.

In the southwestern US, BCI works with local partners to restore agave landscapes. Through partnerships with native

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Inset Figure 3. Mexican long-tongued bat. *Credit: Steve Buchmann, USDA Forest Service.*

[1]Agave Restoration Coordinator, Bat Conservation International, PO Box 140434, Austin, TX 78714-0434.

Agave Conservation and Restoration in the Southwestern US *continued*

plant nurseries such as Borderlands Restoration Network and Gila Watershed Partnership in Arizona, we can grow regionally appropriate plants to further the supply chain of native agaves. Other key nursery partners include High Desert Native Plants and Sul Ross State University in Texas, and the Santa Ana Pueblo Native Plant Nursery in New Mexico. Our nursery partners have produced thousands of seed-grown agaves for restoration. All our nursery partners make it possible to respond to habitat loss and climate stress at the scale needed to make an effective impact for nectar-feeding bat recovery.

After three years of cultivation in the nursery, the agave seedlings are ready to be transplanted into the wild. BCI uses local ecological knowledge, soil maps, and habitat models to identify suitable sites for the plants, working with key stakeholders to determine where restoration efforts are warranted. Local knowledge is essential to this process because agave restoration is not just about putting plants in the ground; in many areas, drought, historic land use, grazing pressure, and the loss of native vegetation have reduced agave recruitment and created large stretches of bare, exposed soil where young plants struggle to survive. To enable better seedling survival, we must identify microhabitats with better soil structure, shade, and moisture retention. This is often facilitated by the presence of native perennial grasses in agave habitat. To promote better cover of native grasses in agave habitat, BCI is working with local partners to integrate erosion control and water-capturing features to help young plants survive extreme drought.

BCI's work in New Mexico and Arizona sits at the northern edge of a conservation effort that spans the full migratory range of nectar-feeding bats. Because the Agave Restoration Initiative works across Mexico and the southwestern United States, restoration in any single region directly influences the corridor as a whole. What happens in Arizona and New Mexico reverberates all the way back to the wintering and maternity grounds in Mexico. BCI's efforts to restore this nectar corridor fuels bat migration and promotes resilient landscapes for bats and people for generations to come.

From top left Figures 4–7. Agave restoration site, SW New Mexico. *Credit: Rachel Burke.*

Gentry's Agaves

by George M. Ferguson, University of Arizona Herbarium, Arizona Native Plant Society

Dr. Howard Scott Gentry's unique career spanned decades of botanical investigation, culminating in a focus on the genus *Agave*. It initiated during his own idea of a self-supported exploration of a blank spot on the map before he turned 30 in the middle of the Depression Era. In the Foreword to Gentry's 1942 *Rio Mayo Plants*, Forrest Shreve wrote: "This paper constitutes the first publication of a comprehensive botanical study of any area in the Pacific drainage of Mexico…Mr. Gentry collected 3,200 numbers, representing 1,276 species and varieties, of which 90 have already been detected as new."

In his Rio Mayo study, Gentry described five species of *Agave* new for Sonora, and designated a type specimen of each from his own collections: *Agave bovicornuta, A. colorata, A. shrevei, A.wocomahui* and *A. mayoensis*, the latter which he subsumed later into an older synonym *A. vilmoriniana*. Besides Agaves, for the 1942 publication, he only described six other new plant species from his collections, so Agaves were already an interest at the time. Indeed, he sent the bulk of his botanical survey to Paul C. Standley at Chicago's Field Museum for identification, and to other specialists. By 1942, Standley described at least 50 new species in 26 families, all from Gentry's collections (most of which are still considered valid and not synonyms), and other authors described at least another 10 new plant species from Gentry's collections during that time (ARIZ database, SEINet).

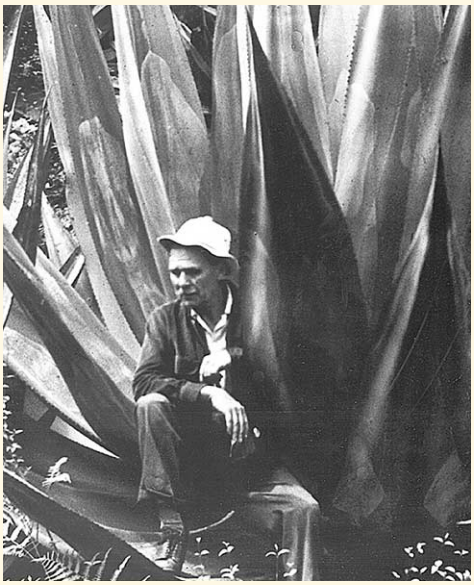

Figure 1. Howard Scott Gentry (1903–1993).
Credit: Desert Botanical Garden.

Gentry became interested in what he called "Rio Mayo country" as he completed his undergraduate degree in Zoology at UC Berkeley in 1931. Inspired by his anthropology professor, Dr. Kroeber, he wanted to enter a graduate program to study the Guarijío Indians in Sonora, their language had been classified by Kroeber, but instead Gentry was sent to see Carl Sauer in the Geography department. Dr. Sauer, who had visited San Bernardo, Sonora and the Guarijío, encouraged Gentry to carry onward with the idea, and explore the country on his own, and to report anything he could learn about the Guarijío people (Gentry et al. 1995).

Gentry began planning a biological survey, with the right connections at the right time, having taken courses with Dr. Joseph Grinnell who taught him how to stuff mammal specimens, and with Dr. Herbert Mason learning to press plant specimens. He also worked part-time at the California Academy of Sciences identifying wasps. He and his brother headed south in a Model A Ford after earning summer money packing fruit. Gentry went by Stanford University on his way to try to get a plant press from the Dudley Herbarium (Dr. Abrams encouraged him, but did not loan one); he had already acquired insect and mammal collecting gear (Gentry et al. 1995). His trip to Sonora in fall 1933 was to collect mammals, fossils, insects, and a few plants as they "set out quite blindly" into Sierra Obscura east of Cajeme (Cd. Obregon). The initial set of plants from his first adventure he sent to Stanford University and University of Michigan (Gentry 1942).

Gentry turned his attention entirely to plants for the next four years, spending a total of 27 months from fall 1934 to spring 1937 collecting throughout the Rio Mayo country with an assistant (often his wife Marie) and Guarijío guides. While working out of San Bernardo, accessible by only one road, the only botanist to visit him there was Dr. Francis Pennell in August 1935, who gave him good quality plant presses and instructions on techniques in collecting. Gentry usually made as many as 10 duplicates of each collection, drying the presses over coals. Forrest Shreve at the Carnegie Institution's Desert Laboratory (on Tumamoc Hill in Tucson) bought a subscription in 1935 as did other institutions to obtain sets of specimens, and Shreve provided workspace as a base of operations for Gentry (Gentry et al. 1995, Gentry 1942).

With the Rio Mayo book completed, in 1941 Gentry began a graduate program at University of Michigan under Dr. Bartlett studying the grassland habitats in Durango, Mexico. During his second year at Michigan, he went to work for the war effort in the USDA's Emergency Rubber Project, but he returned to complete his doctorate in 1947 (Gentry et al. 1995). The USDA work had stationed him in Sinaloa, Mexico to farm guayule (*Parthenium argentatum*, Asteraceae) and rubber vine

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Gentry's Agaves *continued*

(*Cryptostegia grandiflora,* Apocynaceae) as rubber substitutes. From 1950 to 1971 he had a remarkable economic botany career with the USDA that took him to 24 countries searching for wild plants worthy of cultivation.

Working for the USDA, he continued collecting plants, mainly in Mexico including *Agave.* In 1963, from his 1930s notes, he published his ethnographic survey of the Guarijío people. In the years following the 1942 Rio Mayo book, there have been at least another 75 new species and varieties described by other authors with types designated from Gentry's original collections in Sinaloa, Sonora, and elsewhere (with only about 10 later being synonyms of an older name). From 1946 to 1972 Gentry himself described 23 new species of various plants in 12 families, other than the *Agave* (ARIZ database, SEINet) plus one *Agave costaricana* (syn. *A. angustifolia*).

Encouraged by his superior in Washington to write up his notes on plants he collected in the Agave family, between 1960 and 1970 Gentry published four Agave names in journals—*Agave x arizonia, A. colimana* (syn. *A. ortgiesiana*), *A. guiengola* (from Mexico), and *A. mckelveyana* (from Arizona). He produced a government publication in 1972 Agriculture Handbook No. 399, titled "The Agave Family in Sonora," in which he named 11 new species or subspecies in the genus *Agave,* all with types designated from his own collections made between 1948 and 1966: *Agave aktites, A. felgeri, A. fortiflora, A. jaiboli, A. multifilifera, A. parviflora* subsp. *flexiflora, A. pelona, A. polianthiflora, A. ocahui, A. shrevei* subsp. *matapensis, A. zebra,* plus a new combination *Agave americana* var. *expansa.*

After retirement from USDA as principal plant collector, Gentry returned to Arizona and the family farm in southern California to continue his study cultivating Agaves. The Desert Botanical Garden was headquarters for his "agave project" supported by the National Science Foundation (Gentry 1982). Recognizing that he had been able to see more agaves than any other student of botany, Gentry said he knew "I had to make that information available to others— That is a scientist's duty" (Cunningham 1993). The first product was "The Agaves of Baja California" published in 1978, Occasional Papers of the California Academy of Sciences No. 130, with illustrations by Wendy Hodgson and others. Seven were new species or subspecies described by Gentry with types designated from his own collections in 1947–1973: *Agave capensis* (syn. *A. aurea* var. *capensis*), *A. cerulata* subsp. *subcerulata, A. deserti* subsp. *simplex* (type from Arizona, syn. *A. simplex*), *A gigantensis, A. moranii, A. sobria* subsp. *frailensis, A. vizcainoensis,* and one new combination *Agave shawii* var. *goldmaniana.*

Figure 2. *Agave gentryi,* one-meter-tall, waiting to bloom, growing 28 years in Tucson, AZ. *Credit: George Ferguson.*

What followed was Gentry's monumental 670-page volume *Agaves of Continental North America,* published by University of Arizona Press in 1982. In there he named over a dozen new species of *Agave,* with types assigned from his own collections except for one, and another 10 new subspecies. In addition, for *Agave* species previously described by others long ago, he designated 10 new neotypes from his own collections. As humbly stated in the Preface, he said "I leave the next agave taxonomists a good opportunity for improvement." Altogether, some 37 *Agave* species and 15 subspecies have been described by Gentry, of which at least 32 are still valid names, plus many new combinations. In tribute to Gentry, in 1990, a researcher in Netherlands named the northeastern Mexico populations of *Agave macroculmis,* a well-known aguamiel and pulque producer in central Mexico, as *Agave gentryi* (Figure 2).

I met Howard Gentry in 1983 at the Boyce Thompson Arboretum when he was selling his new book, and I had him sign mine. Later, when I took a class with Dr. Paul Martin on Tumamoc Hill, Gentry was a guest lecturer one evening. I saw a sample of his instinct in spotting new varieties of plants (for which he was famous as an economic botanist); he promoted the small Sonoran sycamore tree that grows sparsely in the canyons above San Bernardo with an attractive single slender trunk, as something to be cultivated. Finally, on top of Tumamoc Hill one

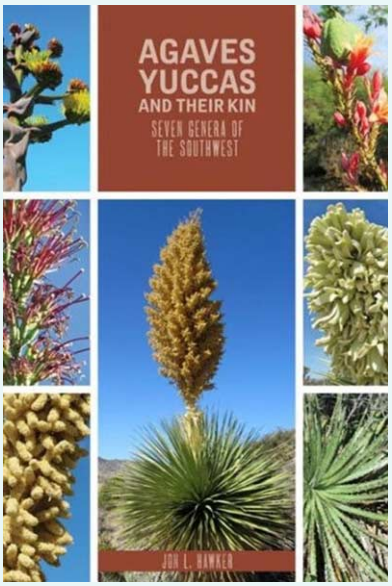
continued page 17

BOOK REVIEW *by Wendy C. Hodgson, Desert Botanical Garden, Phoenix, Arizona*

Agaves, Yuccas and their Kin, Seven Genera of the Southwest

by Jon Hawker. Texas Tech University Press, 2016. 30 pages and over 400 images. $35.23, paperback.

One fateful day a several years ago I received a phone call from a gentleman who said he was writing a book on agaves, yuccas and their kin. This of course piqued my interest, and I listened to him describe a bit of his project, the challenges, and ask if I would be amenable to talking with him further on the subject. There was something captivating about this guy—was it his obvious passion and dedication to the project, so readily apparent in our phone conversation? His slightly off-kilter, whimsical sense of humor that even today finds me caught off guard, scratching my head, and then laughing and rolling my eyes? Whatever it was, I found myself jumping in with both feet, agreeing to meet with him in the field, looking for special agaves. Thus began a most rewarding and, I must say, oddly fun odyssey and friendship that continues to this day.



When I was asked to review his book, I wondered, "how can I provide an unbiased review for a friend on a subject of which I am deeply involved? What if it isn't good? Will I be truthful? I agreed to write the review because, simply, I suspected it would be a great book. And, indeed, it is.

There are so many reasons this book is very good. The task of writing such a guidebook—on complex groups for which we still know relatively little but where opinions and theories are many —is no small task to say the least. Jon's purpose in writing this book is made clear at the start: "This is not really a scientific book... I am no expert in the field of plant taxonomy… I am instead in marketing, sort of an agave public relations man or a shill for yuccas, perhaps guilty of beargrass boosterism." Jon succeeded in his goal, marketing the fascinating and unique attributes of an amazing group of plants so that more people will care about them and be their advocate. What better contribution to the plant world can there be? Jon is also humble. Despite professing that he is not an expert in plant taxonomy, his writing reflects someone who not only has spent a lot of time with the plants he loves, but also someone with a deep insight and understanding of species and population dynamics and diversity, and the complex processes in plant speciation. This is crucial to understanding and writing about the systematics of any plant group, especially plants such as these, many of which are characterized by polyploidy, hybridization, and variability — characteristics/phenomena that challenge botanists' ideas of species concepts and delimitations today. Jon's master's degree in botany and background in natural history (he is a retired professor who taught such diverse courses as animal behavior, Missouri wildflowers, and swamp ecology) contribute to his broad knowledge of plants (as well as insects and other organisms), allowing him to discuss with authority broader topics such as CAM photosynthesis and stem and leaf growth and development. While Jon states this is "not really a scientific book," he successfully weaves science—including information from peer-reviewed botanical journals and conversations with experts—with his own experiences, ideas, and of course, humor. So much information is packed into this little book that it will likely appeal to a broad audience. For example, as someone who appreciates botanical history, Jon writes how William Trelease named *Yucca harrimaneae* for Mary W. Harriman. Harriman was the wife of Edward Harriman, a wealthy and powerful railroad magnate who financed one of the biggest scientific expeditions ever, an expedition that included Trelease, John Muir, Louis Agassiz Fuertes, John Burroughs, and C. Hart Merriam. On returning from Seattle, the group train was delayed near Helper, Utah, allowing Trelease to roam around the area, finding *Y. harrimaneae* in the field for the first time. He had only seen depauperate herbarium specimens prior to this. Upon his return to Missouri Botanical Garden, he described and named the species in Mary's honor. In 2014, Jon took me and Steve Blackwell to Helper to see the *Y. harrimaneae* population that Trelease

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Agaves, Yuccas and their Kin *continued*

observed and documented over a century ago. As Jon stated in his book, a fire that same year took out all of the surviving clones that had existed only a year prior. Sad, but fascinating. Historical and personal accounts such as these animate a book that will inform and entertain scientists and amateur botanists alike.

The setup of the book is straightforward, with each chapter focusing on a genus. Genera covered are *Agave, Dasylirion, Hechtia, Hesperaloe, Hesperoyucca, Nolina,* and *Yucca* of the southwestern United States. An overview of the genus is provided and includes a wealth of information on such topics as growth habits, photosynthesis pathways, morphology and development of plant parts, ecology (soils, geomorphology, pollination ecology), ethnobotany, plant-animal relationships, seed and seedling ecology, and taxonomic history. Following the introduction to each genus is a discussion of each taxon within the genus, its description, origin of name, distribution, and other interesting factoids. A map for each taxon clearly indicates general distribution as well as the extent of its territory relative to other species. Jon claims that his distribution range is "rough" and provides "approximations," but I find it adequate and informative. One can easily access SEINet for more accurate distribution data. Map data are based on several sources, including *Flora of North America*, SEINet, and various important research papers.

An especially strong feature of the book is the multitude of excellent photographs, with all but two taken by Jon. It is well known that dedicated plant aficionados/authors/botanists will go to great lengths to secure a needed photograph, herbarium specimen or live collection. Such is the case with Jon, who routinely traveled hundreds and even thousands of miles to obtain just a bit more information or photo, accompanied by his ever-present companion and model, Kelly, his loyal yellow lab. The photos often depict not only the requisite habit and leaf/flower/fruit close-ups, but also growth patterns, population variability, and species comparisons. And with characteristic humor, Jon describes his choice of measurements, the "Kelly Unit." You see, having photos with Kelly, his "measuring dog," as the indicator of plant size works quite well. One Kelly Unit "equals approximately 24 inches, more or less," except when "she sags a bit in the heat." Of course.

My only one very small criticism of the book regards the structure of the index which I feel would have been more helpful if Jon had kept the scientific and common names separated and not embedded together, thereby making it much easier to use.

I am proud to own this excellent guidebook and am pleased to give it a fine review. Unbridled passion and dedication backed with knowledge, an openness to learning from others, and an ability to weave together all of the complicated, diverse and fascinating ideas and facts of these iconic plant groups make this a unique, must-have book. And did I mention his sense of humor? Upon reading an insert at the very beginning, one gets the sense that this book is not going to be like any other guidebook: "Outside of a dog, a book is a man's best friend. Inside of a dog it's too dark to read. Groucho Marx." Thank you, Jon.

Gentry's Agaves *continued from page 15*

day, I was helping Ray Turner survey saguaros, when Paul Martin drove up in his pickup with Gentry (well in his 80s). I recall Gentry asking—"Paul have you been to Tepopa, yet?" From then on, we made an effort to get there, which we did on a trip with Paul to the Sierra Sahuaribo in spring, hiking down from the mesa edge. And, I returned the next spring with Steve Hale, David Yetman, Mark Fishbein, and others hiking up the old packtrain route from San Bernardo to the tropical evergreen arroyo and cliffs from where at least five species of Gentry's plants were named, and one of Paul's. Gentry's legacy sets the foundation for current and future students of botany and notably the Agave family.

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Figure 1. *Agave ovatifolia* seen here growing on limestone soil and among limestone boulders at the type locality in the Sierra Lampazos in Nuevo Leon in northeastern Mexico. Figure 2. *Agave azurea* with its sky-blue leaves after a good summer rainy season in the Picachos de Santa Clara in Baja California. Figure 3. *Agave cremnophila* grows on the nearly inaccessible mountain cliffs not far north of Santiago Lachiguiri on the Isthmus of Tehuantepec in southern Oaxaca, Mexico.

A Personal Journey with Amazing Agaves

by Greg Starr, College of Social and Behavioral Sciences, University of Arizona. Photos credit the author.

In the Beginning

My personal journey with these amazing plants began sometime in the fall of 1981 when I was working for a local landscape company in Tucson, Arizona. I was a member of the Arizona Native Plant Society and attended a talk on the genus given by Dr. Howard Scott Gentry. He was promoting his soon-to-be published monograph titled, *Agaves of Continental North America*. Dr. Gentry was an engaging speaker and regaled the audience with tales of his travels throughout Mexico and Central America. He was working for the U.S. Department of Agriculture (USDA) primarily researching beans, and became enamored with agaves, which often grow in the same habitat as beans in the genus Phaseolus. I grew tired of working a physically demanding job in the heat of summer in Tucson and returned to the University of Arizona to pursue an MS in botany to go along with my undergraduate degree in horticulture. I met PhD candidate Tony Burgess who was focusing on the physiology of agaves in Baja California, and Tony invited me on one of his research trips. My interest in agaves was rekindled, and in 1983 I traveled with PhD candidate Russ Buhrow who also happened to be studying plants in the genus Phaseolus. We traveled most of the length and breadth of Mexico in search of beans and encountered many Agave species much as Gentry must have done while conducting his research for the USDA.

Continuing Interest in Botany

After receiving my MS in botany in 1985, I started a small nursery and became acquainted with Mr. Ron Gass, then the owner of Mountain States Wholesale Nursery. Ron and I traveled to Mexico in search of potential low-water-use plants suitable for landscaping in the desert southwest and came across an undescribed Hesperaloe species. I managed to produce a small monograph on Hesperaloe in which I named and described two new species and one subspecies (since elevated to species). In 1999, George Hull from Mountain States Wholesale Nursery sent me a picture of an undescribed Agave. In 2000, Dr. José Angel Villarreal, the describing author of *Agave montana*, and I collaborated on a paper in which we named and described *Agave ovatifolia* (Figure 1) as a new species distinct from its nearest relatives, *A. havardiana* and *A. parrasana*.

I quickly became fascinated by this intriguing group of plants both botanically and horticulturally. Taxonomy is a source of fascination for me. Gentry followed earlier Agave

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A Personal Journey with Amazing Agaves *continued*

taxonomists, Salm-Dyck, Baker, and Berger, in dividing the species into two subgenera (some earlier authors had included a third subgenus to accommodate the genera Manfreda, Polianthes, and Procnyanthes) and then arranged the species into informal groups. This concept of informal groups was recently updated, the formal groups becoming Sections with a few name changes to Gentry's classification.

The fact that most species' rosettes will grow for 10 years or more before sending up their life-ending flower stalk is also a source of curiosity for me. For clarity, not all agaves die after flowering; there are species in sections Juncineae and Micranthae that produce new rosettes from the leaf axils of the mother rosette, which then continue living.

Working with Agaves Horticulturally

I took a 12-year hiatus from working with agaves botanically while concentrating on my nursery and learning more about how to grow them in the United States southwest deserts. It seems the longer I work with various Agave species, the more problems crop up. The most well-known insect pest is the Agave Snout Weevil (*Sycphophorus acupunctatus*). In habitat, the female beetle lays her eggs in flowering rosettes that are rich in sugars and an ideal nourishment for the young larvae. This process works well in nature because the plants take many years to bloom, minimizing the supply of material rich in sugars and keeping the weevil population in balance with available plants. When the larvae chew through the dying mass, that helps in the decomposition of the dying rosette. Because agaves have become so numerous in cultivation and their natural defenses are weakened by excessive moisture, the checks and balances have been thrown out the window and the Agave Snout Weevil has become more prevalent, and they have made themselves at home among cultivated plants.

Figure 4. A typically toothy specimen of *Agave oteroi* at the type locality near the Rio Hondo along the Puebla-Oaxaca border.

Another major pest is not an insect but a microscopic eriophyid mite in the genus Oziella. These creatures live deep within the leaf cone and scrape tender tissue leaving unsightly scars when the leaf finally unfurls from the cone months or even years later. Left untreated, the mites will ruin prized specimens and run rampant through a collection. These are sometimes called "grease mites" due to the greasy looking patches commonly seen on the leaves. The mites are difficult to control because they are usually deep in the leaf cone making contact miticides ineffective even those labeled for treating eriophyid mites. Predatory mites can be used to prevent infestations but are generally worthless in curing infestations.

Mealybugs can also be a problem for agaves in cultivation. These little buggers will sometimes nestle into the very tip of the leaf cone hiding out underneath a layer or two of the leaves. If caught early, the leaves can be pulled apart, and the mealybugs can be wiped off by hand or with an alcohol wipe using rubbing alcohol. Sometimes simply spraying with a strong stream of water will remove a small infestation. Mealybugs get oxygen through small pores in their body, so thoroughly spraying with insecticidal soap or soapy water to completely cover their bodies can deprive them of oxygen. Wait a few hours or even a day, then wash them off with a stream of water. There are several other natural solutions you could use, including citrus peel solution, baking soda mixture, or vinegar and essential oil mixture. If the infestation is very heavy, you might consider removing the leaf cone and hope for the plant to produce axillary offshoots or destroy the plant completely if it is not extremely rare.

Resurgence of Botanical Interest

In April 2013, Bob Webb took me to see a potentially undescribed agave in the Picachos de Santa Clara in the Vizcaino Desert of Baja California. It was geographically closest to *Agave vizcainoensis* but much more robust with larger leaves. Fortunately, the plants were in flower and we were able to collect material to measure and make herbarium vouchers. We measured plant height and width, flowers, and leaf dimensions, and when we returned to Tucson, and compared them to both *A. vizcainoensis* and *A. gigantensis*. Gentry had made collections from these mountains and identified the plants as both of those species which left us a

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Figure 5. *Agave calciphila* grows on the sharp limestone in the "Rock Gardens" of the Sierra Tolistoque near Nizanda, Oaxaca on the Isthmus of Tehuantepec. Figure 6. *Agave salomonii* is found in only one localized spot in all of the vast expanse of the Tehuacán-Cuicatlán Valley in northcentral Oaxaca. Figure 7. There is only one hillside with a mix of crumbly gypsum and limestone near San Bartolomé Yucuañe in western Oaxaca where *Agave yucuanensis* is found.

A Personal Journey with Amazing Agaves *continued*

puzzle to solve. We determined the plants were indeed undescribed and closest to *A. vizcainoensis*. We eventually described them, giving them the name *A. azurea* based on the sky-blue leaves seen on the plants after a wet summer rainy season (Figure 2).

I next worked on a plant that had been on my radar since about 2002 when a friend mentioned that I ought to look at an agave he spotted growing on vertical cliff faces near the town of Santiago Lachiguiri in southern Oaxaca. I made several trips to the locality looking for a way to access the plants and find them in flower. Finally in 2018, a friend had three plants that had been grown from seed from the locality produce flower stalks. I went to his garden that year to make all the proper measurements of the plants and make proper herbarium vouchers. I invited Julia Etter and Martin Kristen, agave researchers who run the website **agavaceae.com**, to work with me on the description and we named the new species *Agave cremnophila* (Figure 3), a name suggested by my friend Jeff Chemnick.

The next plant I worked on was from the Oaxaca-Puebla border area and was long known as Agave species FO-076 until someone got the idea the plants were the same as *Agave titanota*. After many trips to see both these and *Agave titanota*, I and my co-investigator, Tristan Davis, described the plant as a new species and gave it the name *A. oteroi* (Figure 4). The two are clearly related but occupy different soils and keep their own unique characteristics with no gradation between the extremes.

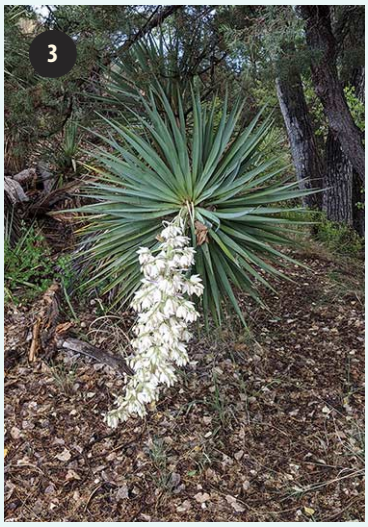
I continued working on agaves in Oaxaca and eastern Mexico with the goal of clearing up some misconceptions about a couple species names and subsequently described *Agave calciphila* (Figure 5) from the "Rock Gardens" near Nizanda on the Isthmus of Tehuantepec in Oaxaca, *A. cryptica*, with Tristan Davis, from Nuevo León and Tamaulipas in northeastern Mexico, *A. salomonii* (Figure 6) with Tristan and Oaxacan botanist Gonzalo Juárez from central Oaxaca, and finally, *A. yucuanensis* (Figure 7), with Gonzalo Juárez, from western Oaxaca.

I have my eye on three other agaves that are potentially undescribed and hope to continue working with the genus, both horticulturally and botanically trying to bring some of Gentry's work up to date. I hope you become as enthusiastic about these plants as I am, whether you want to grow them, or you find their taxonomic relationships interesting, or you like both aspects as I do. I look forward to seeing you at future cactus and succulent presentations and sales.

SPOTLIGHT ON A NATIVE PLANT *by Jack Dash*[1] *Photos credit the author.*

Mountain Yucca (*Yucca schottii*)

Mountain yucca has been the subject of much taxonomic debate in recent years since a paper, published in 2000 by Lee Lenz and Michael Hanson argued that previously collected specimens of this plant were either misidentified *Yucca madrensis*, or possible hybrids. The authors questioned the validity of the type specimen collected in the 1850s by Arthur Schott in southeastern Arizona while he was part of the US-Mexico boundary survey. However, more recent studies appear to show that *Yucca schottii* and *Yucca madrensis* are best treated as separate species and *Yucca schottii* is not of hybrid origin at all.



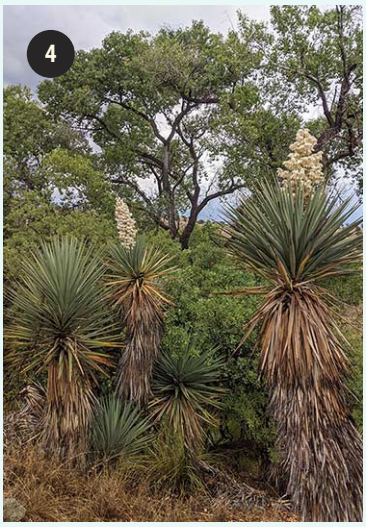


Figure 1. The cream-colored stamens, ovary, and tepals of *Yucca schottii.*

Figure 2 *Yucca schottii* in the Atascosa Highlands of southern Arizona.

Figure 3 A nodding inflorescence on a *Yucca schottii* growing in Madrean Evergreen Woodland.

Figure 4 A patch of mature *Yucca schottii* in the Canelo Hills. This site has many mature plants but seemingly no recruits.

Whatever the finer points of its taxonomy, this species is absolutely stunning in habitat or in cultivation. Found in Madrean Evergreen Woodland on rocky soil, this plant is often associated with oaks (*Quercus* spp.) and junipers (*Juniperus* spp.). Growing from a thick trunk several feet tall, this multi-headed yucca has sage-green, or gray-blue bayonet-like leaves that surround the trunk. New heads may sprout from near the top or the bottom of the main stem and older plants can have several rosettes of leaves. An easy way to tell the difference between this species and the Arizona banana yucca (*Yucca baccata*), often found nearby, is that the latter has white strings along the leaf margins, and this species has none. The inflorescence typically only comes up a few feet from the top of the foliage, where bell-shaped blossoms with cream-colored petals appear. Like all yuccas, this species is pollinated by a specialized Tageticula moth that lays its eggs inside the ovary of the yucca flower where they will be safe as the ovary develops into a thick, fleshy fruit. Eventually the eggs hatch and the larvae chew their way out, falling to the ground where they will overwinter.

With its stately appearance and stunning blossoms, this species makes a big statement in a landscape. Unlike most yuccas, this plant can tolerate shade and can be placed under a tree or on the northeast side of a house. This yucca is also quite cold tolerant, and appropriate for many high elevation landscapes. Sometimes available in the nursery trade, this is an excellent landscape plant for most Arizona landscapes except the very hottest and coldest. Just be sure to give the plant plenty of space to grow so you won't have to dodge the sharp leaf tips on your stroll around the garden..

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Flora and History of the Tónichi Area on the Río Yaqui, Municipality of Soyopa, Sonora, Mexico

by Thomas R. Van Devender[1], Ana Lilia Reina-Guerrero[1], and George M. Ferguson[1]

Abstract

We report 431 taxa in 269 genera and 69 families for the Tónichi area. The most diverse families are Fabaceae (61 taxa); Poaceae (40 taxa); Asteraceae (36 taxa); Euphorbiaceae (27 species); Malvaceae (22 species); Convolvulaceae (20 species); Solanaceae (18 species); Boraginaceae (15 species); Apocynaceae and Cactaceae (11 species each); and Acanthaceae and Nyctaginaceae (10 species each). The most speciose genera are *Euphorbia* (15 species); *Ipomoea* (11 species); *Boerhavia* and *Cyperus* (7 species each); *Cuscuta, Physalis,* and *Solanum* (6 species each); and *Bouteloua, Portulaca,* and *Senna* (5 taxa each). There are 25 non-native species (5.8%) in the Tónichi flora.

Tónichi was the northernmost Pima Bajo Indian village upstream of Ónavas, Movas, and Nuri. A branch railroad connected Estación Corral near Ciudad Obregón to Tónichi from 1908 to 1945. The smelter at Toledo processed regional ores until 1911 when it was shut down by raiding Yaquis. During the Mexican Revolution in 1911, federal troops defeated Francisco I. Madero's rebels in the Batalla de Tónichi at Loma Maderista near Toledo.

Resumen

Se reportan 431 taxones de plantas en 269 géneros y 69 familias para la zona de Tónichi. Las familias más diversas son Fabaceae (61 taxones); Poaceae (40 taxones); Asteraceae (36 taxones); Euphorbiaceae (27 especies); Malvaceae (22 especies); Convolvulaceae (20 especies); Solanaceae (18 especies); Boraginaceae (15 especies); Apocynaceae y Cactaceae (11 especies cada una); y Acanthaceae y Nyctaginaceae (10 especies cada una). Los géneros con más especies son *Euphorbia* (15); *Ipomoea* (11 especies); *Boerhavia* y *Cyperus* (7 especies cada uno); *Cuscuta, Physalis* y *Solanum* (6 especies cada uno); y *Bouteloua, Portulaca* y *Senna* (5 taxones cada uno). La flora de Tónichi incluye 25 especies introducidas (5.8%).

Tónichi fue el asentamiento más al norte de indígenas Pima Bajo, río arriba de Ónavas, Movas y Nuri. Un ramal de ferrocarril conectó Estación Corral cerca de Ciudad Obregón con Tónichi de 1908 a 1945. La fundición de Toledo procesó minerales regionales hasta 1911, cuando fue cerrada por los ataques de los yaquis. Durante la Revolución Mexicana en 1911, las tropas federales derrotaron a los Maderistas en la Batalla de Tónichi en la Loma Maderista, cerca de Toledo.

Introduction

The northern limit of the New World tropics is in Sonora, not as often stated the Tropic of Cancer (23.37°N) just north of Mazatlán, Sinaloa. The northernmost tropical deciduous forest is in the Sierra San Javier, 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

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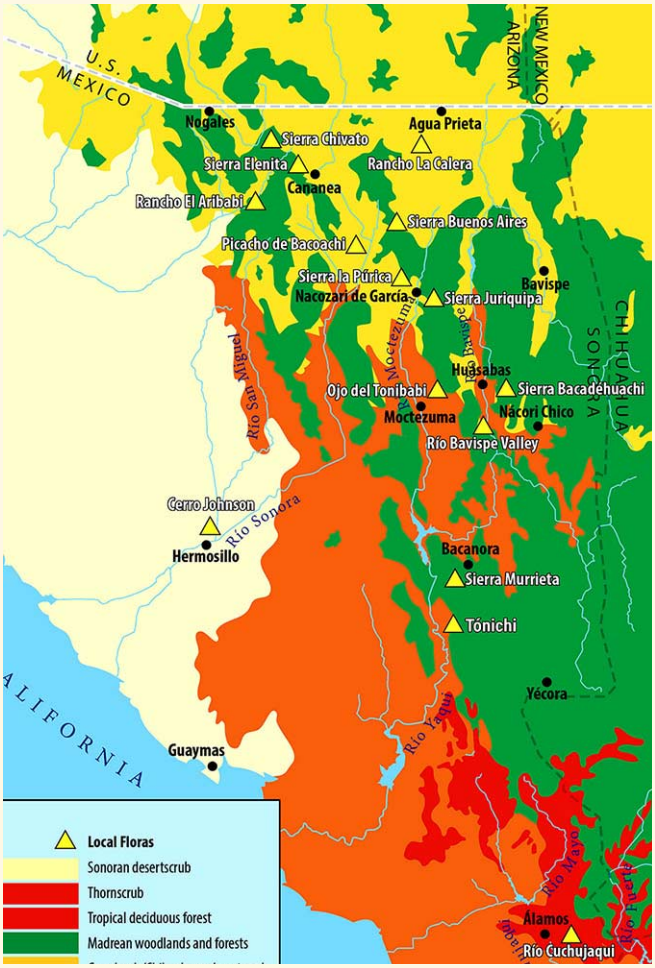

Figure 1. Map of local floras in Sonora, Mexico. Vegetation modified from Brown & Lowe (1982). *Drafted by Marina Maskaykina*

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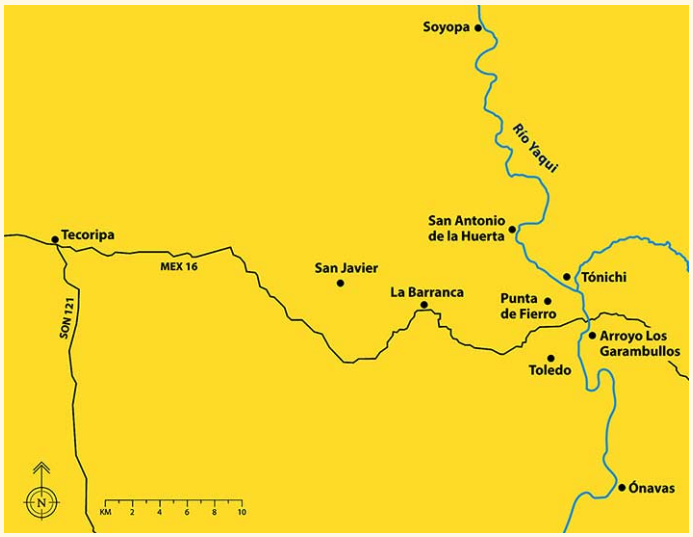
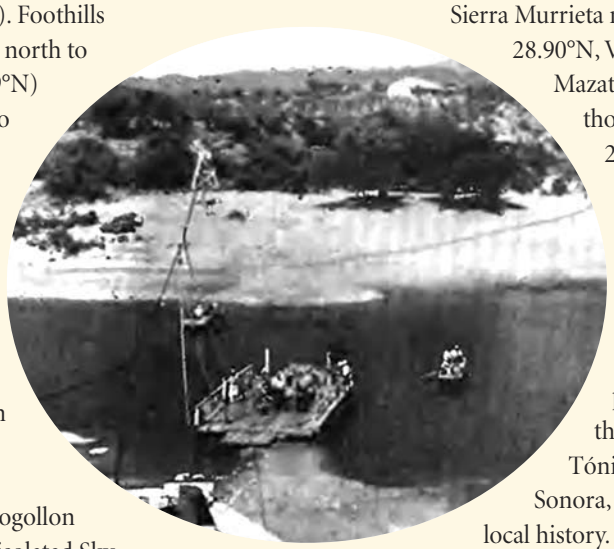


From left Figure 2. Río Yaqui at Tónichi. Figure 3. Map of the Tónichi area. *Drafted by Marina Maskaykina.*
Inset Figure 4. Hand-propelled ferry across the Río Yaqui. Note foothills thornscrub on slopes and houses in Tónichi in background.

Flora and History of the Tónichi Area on the Río Yaqui *continued*

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 (27.90°N). Foothills thornscrub is inland on rocky slopes north to Angostura on the Río Bavispe (30.49°N) and near Arizpe (30.40°N) on the Río Sonora (96 to 104 km south of the Arizona border; Van Devender & Reina-G. 2021), where it merges into 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). In the Madrean Archipelago (= Sky Island Region) 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, 32 of them in northeastern Sonora (Deyo et al. 2013, Van Devender et al. 2013). Sky Islands, crowned with oak woodland or pine-oak forest, emerge from lowland 'seas' of Chihuahuan and Sonoran desertscrub, desert grassland, foothills thornscrub, or tropical deciduous forest.

Local floras published in Sonora (Figure 1) include tropical areas in the Municipality of Huatabampo (coastal thornscrub, 26.64°N, Van Devender et al. 2024a), Río Cuchujaqui near Álamos (tropical deciduous forest, 27.00°N, Van Devender et al. 2000), the Municipality of Yécora (foothills thornscrub, tropical deciduous forest, 28.40°N, Van Devender & Reina-G. 2016), Sierra Murrieta near Bacanora (foothills thornscrub, 28.90°N, Van Devender et al. 2024b), Sierra Mazatán near Hermosillo (foothills thornscrub, 29.13°N, Sánchez-E. et al. 2017), lower Río Bavispe Valley (foothills thornscrub, 29.94°N, Van Devender et al. 2018), and Rancho Las Playitas near Bacoachi (foothills thornscrub-desert grassland transition, 30.57°N, Van Devender et al. 2023). Here, we present the local flora in foothills thornscrub along the Río Yaqui near Tónichi, Municipality of Soyopa, Sonora, Mexico (Figures 2, 3, 5) and the local history.

Study Area

Plants were collected in the Tónichi area along the Río Yaqui in the Municipality of Soyopa, Sonora (28.57 to 28.61°N, 109.54 to 109.58°N; 15.4 km^2; Figures 2, 6). Elevations along the Río Yaqui are 175 to 185 m. Most of the study area is at 190 to 220 m elevation, reaching 300 m on a hill east of the San Antonio de la Huerta road.

The most intensively surveyed areas were Arroyo Los Garambullos south of the MEX 16 bridge on the east side of the

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Flora and History of the Tónichi Area on the Río Yaqui *continued*

Río Yaqui, on Loma Maderista, around the ruins of the Fundición (smelter) de Toledo, and north along the road to San Antonio de la Huerta on the west side of the river. A ferry across the river connected Tónichi to the train station at Punta de Fierro before the bridge on MEX 16 over the Río Yaqui was finished in 1978 (Figure 4). The train arrived on Wednesday with merchandise and departed on Friday with processed silver, gold, local animals, corn, beans, and vegetables for Guaymas.

The Río Yaqui has one of the largest drainage basins in Sonora (Figure 2, 5, 6). 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, flows southeast to meet the Río San Bernardino at La Junta de dos Ríos, becomes the Río Batepito, and joins the Río Bavispe at Colonia Morelos. The Río Bavispe begins in the Sierra Madre Occidental in Chihuahua, flows west into Sonora, north around the Sierra El Tigre and south through Presa Angostura (Figure 16), Huásabas, and Granados. The Río Áros flows west from Chihuahua to meet the Bavispe north of Sahuaripa, forming the main Río Yaqui (Figure 5) which eventually enters the Gulf of California west of Ciudad Obregón. The river near Tónichi is wide and fast flowing. Before the dam above La Estrella (42 km north) was finished in 1964, creating Presa El Novillo (formally Plutarco Elías-Calles), it flooded annually. After that, water levels varied depending on releases from the dam. In 2013, an aqueduct was built to divert water from El Novillo to Hermosillo. In 2024, President López-Obrador increased the water allotment for large-scale agriculture on Yaqui lands on the coastal plain near Ciudad Obregón. Ongoing droughts have further reduced water levels in Sonoran reservoirs and rivers while tropical storms and hurricanes often bring heavy rains to Sonora. Today, water levels in the Río Yaqui near Tónichi vary from dry to flooded.

Vegetation

Habitats in the area are foothills thornscrub on rocky slopes (Figure 2, 6) and riparian areas along the river and in large arroyos. Along the Río Yaqui, deep slot canyons are incised into middle Miocene volcanic mudflow deposits of the Báucarit Formation (Cochemé & Demant 1991). Foothills thornscrub is a transitional vegetation type along a gradient from near tropical deciduous forest (closed canopy in rainy season, trees taller than columnar cacti, high rainfall) to near Sonoran desertscrub (open structure with columnar cacti if present not the tallest species, low rainfall). In the Tónichi area, foothills thornscrub is on the lower, drier end of the gradient. Dominants are the shrubs and trees *Coursetia glandulosa* (*sámota*), *Fouquieria macdougalii* (tree ocotillo, *pitillo, ocotillo macho*), *Haematoxylum brasiletto* (*brasil*), *Mimosa distachya* (*uña de gato*), and *Vachellia campeachiana* (boat-thorn acacia, *chirahui, güinolo*). *Bursera fagaroides* (*torote blanco*), *B. laxiflora* (*torote prieto*), and *V. farnesiana* (*vinorama*) are common. Other thornscrub species present are *Ambrosia cordifolia* (Sonoran bursage, *chicurilla*), *Croton flavescens* (*vara prieta*), *Jatropha cordata* (*torote papelío*), *Karwinskia humboldtiana* (*cacachila*), *Neltuma velutina* (velvet mesquite, *mezquite*), *Phaulothamnus spinescens* (*putía, tútuqui*), *Piscidia mollis* (*palo blanco*), *Pleuradenophora bilocularis* (*hierba de la flecha*), and *Randia thurberi* (*papache borracho*). Common succulents are *Agave angustifolia* (*bacanora, mescal*), *Cylindropuntia thurberi* (Thurber's cholla, *civiri*), *Opuntia gosseliniana* (*nopal duraznilla*), *O.* aff. *wilcoxii* (*nopal*), and *Stenocereus thurberi* (organ pipe cactus, *pitahaya*).

Many interesting tropical plants are mostly restricted to the narrow slot canyons, including the trees and shrubs *Cordia sonorae* (*palo de asta*), *Ficus petiolaris* (rock fig, *tescalama*), *Handroanthus impetiginosus* (*amapa*), *Hintonia latiflora* (*copalquín*), and *Plumeria rubra* (*cascalosuchil*); succulents *Agave vilmoriniana* (*amole*) and *Hechtia montana* (*magueyito*); and the woody vine *Rhynchosia precatoria* (rosary snoutbean, *ojo de chanate*). *Cochemiea grahamii* (Graham's pincushion cactus, *biznaguita, chorito, pitahayita*) is locally abundant.

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Figure 5. Río Yaqui in flood upstream from Tónichi. Note dense foothills thornscrub on slopes. *Credit: Thomas R. Van Devender.*

Flora and History of the Tónichi Area on the Río Yaqui *continued*

Foothills thornscrub becomes denser and taller on slopes above the river north of Tónichi between Soyopa and La Estrella. The closest tropical deciduous forest to Tónichi is near San Javier-La Barranca (28.57°N) in the Municipality of San Javier (ca.10 km west) and in the Municipalities of Ónavas and Yécora (13 km east; Van Devender & Reina-G. 2016, 2021).

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. Riparian species along the Río Yaqui in the Tónichi flora include the trees *Havardia mexicana* (*chino*), *Neltuma odorata* (honey mesquite, *mezquite*), *Parkinsonia aculeata (huacaporo), Pithecellobium dulce* (*guamuchil*), *Salix gooddingii* (Goodding's willow, *saúz*), *Sapindus saponaria* (*arbolío*), and *Vitex mollis* (*uvalama*); the shrubs *Ambrosia ambrosioides* (canyon ragweed, *chicura*), *A. monogyra* (*jécota*), and *Cephalanthus salicifolius* (*mimbro*); and the perennial herbs *Hydrocotyle umbellata, Ludwigia octovalvis, Persicaria maculosa, P. punctata, Rumex inconspicuus,* and *Xanthium orientale* (*guachapori*). More tropical species in Arroyo los Conejos on the road to San Antonio de la Huerta are the trees and shrubs *Brongniartia alamosana* (*palo piojo*), *Ceiba aesculifolia* (*pochote*), *Celtis iguanaea* (*vainoro garabato*), *Chloroleucon mangense* var. *leucospermum* (*palo fierro, palo pinto,* Figure 7), *Esenbeckia hartmanii* (*palo amarillo*), *Guazuma ulmifolia* (*guásima*), *Lycium berlandieri* (wolfberry, *huichurilla*), *Lysiloma divaricatum* (*mauto*), *Malpighia emarginata* (*granadilla*), *Mariosousa russelliana* (*guayabillo*), *Pachycereus pecten-aboriginum* (*etcho*), *Parthenium tomentosum* var. *stramonium (guasaraco,* Figure 8) *Senegalia occidentalis* (*teso*), *Sideroxylon occidentale* (*bebelama*), *Vachellia californica* (*vara prieta,* Figure 9), and *Zanthoxylum fagara* (*matalased*); and perennial vines *Antigonon leptopus* (*sanmiguelito*) and *Callaeum macropterum* (*batanene, matanene, gallinitas*).

Figure 6. Río Yaqui in the Tónichi study area. Note foothills thornscrub on slopes. *Stenocereus thurberi* and flowering *Fouquieria macdougalii* in foreground. *Credit: Thomas R. Van Devender.*

Methods

Howard S. Gentry's *Río Mayo Plants* was an elegant introduction to the flora, vegetation, and peoples of tropical southern Sonora (Gentry 1942). The boundary of his Río Mayo region was just east of Nuri on the Río Yaqui. The first plant collections from the Tónichi area were made in 1941 by Rosamund B. Spicer while her anthropologist husband Edward H. Spicer interviewed local residents for his *Cycles of Conquest* (Spicer 1962). Raymond M. Turner, J. Rodney Hastings, and Annetta M. Carter gathered records in the Soyopa-Tónichi area in 1971 for *An Atlas of Some Plant Distributions in the Sonoran Desert* (Hastings et al. 1972). Turner was an ecologist with the U.S. Geological Survey and Hastings a meteorologist at the University of Arizona, both in Tucson. Carter was Principal Botanist at the University of California Herbarium in Berkeley. In April 1979, Laurence J. Toolin collected a few specimens along the Río Yaqui below the MEX 16 bridge. In July 1983, Van Devender, Rebecca K. Wilson, and Cecil R. Schwalbe collected plants along the Río Yaqui on a canoe trip from La Estrella to Tónichi. In March 1984 and June 1986, Ferguson visited the Tónichi area. He and Paul S. Martin visited the ruins of the Toledo smelter in March 1988, 1989, and 1990. Ferguson, Mark Fishbein, and Richard S. Felger camped in the area in 1994. The specimens collected on these trips were included in *Gentry's Río Mayo Plants* (Martin et al. 1998). The Río Yaqui area below the MEX 16 bridge was a regular camping area on trips to document the flora of the Municipality of Yécora to the east (Van Devender & Reina-G. 2016). It was also a study area in an Arizona-Sonora Desert Museum project on hummingbird plants and potential nectar corridors for the Rufous Hummingbird (*Selasphorus rufus*) in Sonora, Mexico (Van Devender et al 2004). Ornithologists William A. Calder, Karen Krebbs, and Stephen M. and Ruth O. Russell visited the area. We collected plants in the Tónichi study area on 39 trips in May, August, and September 1995; May, August, September, and November 1996; February, July, September, and November 1997; March, May, August, and September 1998; March, May, September, and December 1999; March, August, and September 2000; January, March, May, and June 2001; August 2002, August 2003; March 2004; March, April, and May 2005; August, September, October, and December 2006; May 2008; and August

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Figure 7. *Chloroleucon mangense* var. *leucospermum*. A. Flowers and leaves in Álamos, Sonora. B. Bark in the Sierra La Laguna, Baja California Sur. *Credits: Susan D. Carnahan.*

Flora and History of the Tónichi Area on the Río Yaqui *continued*

2012. Most of the collections were by Van Devender and Reina-G. Other botanists on the trips were Kim Baker, Alberto Búrquez-Montijo, J. Travis Columbus, Thomas F. Daniel, Julie A. Emmett, George M. Ferguson, Mark Fishbein, Augustín Flores-M., Samuel L. Friedman, Socorro Guerrero-E., Mark Kaib, José L. León de la Luz, Cynthia Lindquist, José Juan Pérez-N., Donald J. Pinkava, J. Mark Porter, María A. Quintana, Jon P. Rebman, Andrew M. Salywon, Barbara J. Skye, Richard W. Spellenberg, Victor W. Steinmann, Thomas Todsen, William Trauba, Leonardo Varela, Patricia West, and David A. Yetman. Specimens were deposited primarily in herbaria at University of Arizona (ARIZ), Centro de Investigaciones del Noroeste (HCIB), New Mexico State University (NMC), San Diego Natural History Museum (SD), University of Texas (TEX), Universidad Autónoma de México (MEXU), and Universidad de Sonora (USON). Additional specimens were deposited into herbaria at Austin Peay State University (APSC), Northern Arizona University (ASC), Arizona-Sonora Desert Museum (ASDM), Fort Worth Botanic Garden-Philecology (BRIT), California State University, Los Angeles (CSLA), Stover-Ebinger Herbarium, Eastern Illinois University (EIU), Universidad de Guadalajara (IBUG), Centro Regional del Bajío, Instituto de Ecología (IEB), Universidad Autónoma de México, Iztacala (IZTA), Royal Botanic Garden, Kew (K), University of Lethingbridge (LEA), University of Michigan (MICH), New York Botanical Garden (NYBG), Portland State University (PSU), National Tropical Botanical Garden (PTBG), Universidad Autónoma de Querétero (QMEX), Rocky Mountain Herbarium, University of Wyoming (RM), Universidad Autónoma Metropolitana Iztapalpa (UAMIZ), University of California at Berkeley and Riverside (UC, UCR), University of New Mexico (UNM), Wilford Laurier University (WLU), and Washington State University (WS). The records documenting the Tónichi flora are publicly available in the Madrean Discovery Expeditions (**madreandiscovery.org**) in the SEINet herbarium network. iNaturalist was searched for Tónichi area observations.

Results

We report 431 species in 269 genera and 69 families for the Tónichi area (Checklist). The most diverse families are Fabaceae (61 taxa); Poaceae (40 taxa); Asteraceae (36 taxa); Euphorbiaceae (27 species); Malvaceae (22 species); Convolvulaceae (20 species); Solanaceae (18 species); Boraginaceae (15 species); Apocynaceae and Cactaceae (11 species each); Acanthaceae and Nyctaginaceae (10 species each); Cyperaceae (9 species); Amaranthaceae (8 species); Brassicaceae and Malpighiaceae (7 taxa each); and Verbenaceae (6 species). The most speciose genera are *Euphorbia* (15 species); *Ipomoea* (11 species); *Boerhavia* and *Cyperus* (7 species each); *Cuscuta, Physalis,* and *Solanum* (6 species each); *Bouteloua, Portulaca,* and *Senna* (5 species each); and *Abutilon, Cottsia, Parkinsonia,* and *Sida* (4 taxa each).

There are 25 non-native species (5.8%) in the Tónichi flora (Checklist). The families with the most exotic species are Poaceae (8 species), and Brassicaceae, Cucurbitaceae, and

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Figure 8. *Parthenium tomentosum* var. *stramonium*. A. Trees along highway near Bacanora. B. Flowers in Arroyo Las Lamas near San José de Pimas. *Credits: Thomas R. Van Devender and Stephen F. Hale.*

Flora and History of the Tónichi Area on the Río Yaqui *continued*

Solanaceae (2 species each). *Cenchrus ciliaris* (buffelgrass) is a subshrubby grass that rapidly resprouts from each stem node and from massive roots after fire well before the next rains. Native bunch grasses regrow from the root crown after the first summer rain. Buffelgrass forms a fire-climax African 'savanna' that replaces natural vegetation dominated by native species not adapted to fire. In 2006, Ibarra-F. et al. (2009) estimated that ca. 1 million hectares of *C. ciliaris* had been planted in Sonora. Morales-R. et al. (2025) concluded that buffelgrass stands were long-lived and stable in thornscrub pastures planted 10 and 50 years ago east of San José de Pimas. Although it is a serious invasive species elsewhere in Sonora, *C. ciliaris* was present in only a few pastures and scattered individuals in the Tónichi study area in 2005. It has likely increased since then.

Cryptostegia grandiflora (rubber vine, *laurel de España*) is a robust vine with showy pink flowers and copious latex native to southwestern Madagascar (Seier et al. 2023). It was taken by Portuguese traders to India in the late 1700s where Scottish botanist William Roxburgh (1751-1815) 'discovered' it and named it *Nerium grandiflorum* related to *N. oleander* (oleander). Then it was carried to England and grown in hothouses on private estates before being donated to the Royal Botanic Garden. In 1820, the RBG botanist Robert Brown (also Scottish, 1773-1858) renamed it *Cryptostegia grandiflora*. Lacking a holotype, he designated an illustration as the lectotype (Figure 10). Today, it is a serious invasive species throughout the tropical world, including Mexico and the southeastern United States. Gentry (1942) reported that it was an ornamental in Álamos in southern Sonora that was rapidly escaping out of town along the arroyo. From there, it spread widely in tropical deciduous forest and thornscrub in Sonora as far north as Jécori on the Río Moctezuma (29.94°N) near Cumpas and the Guaymas area in the Sonoran Desert. In 2006, Micaela Franco de Encinas told us that foreign miners brought *laurel de España* as an ornamental to La Barranca or San Javier and it followed the road to Tónichi.

Noteworthy Species

Holographis pallida (Acanthaceae) is a Sonoran endemic shrub with pale yellow flowers known from coastal and foothills thornscrub tropical localities from the Álamos area north to near Soyopa (28.759°N). It was in Arroyo Los Garambullos in the Tónichi study area.

Polystemma canisferum (milkweed vine, Apocynaceae) is a Sonoran endemic perennial vine with green flowers in tropical deciduous forest and coastal and foothills thornscrub from the Álamos area north to the Sierra Mazatán (McDonnell & Fishbein 2016). A paratype was from Loma Maderista near Tónichi.

Tetramerium yaquianum (*rama del toro,* Acanthaceae) is a Sonoran endemic herbaceous perennial with pale yellow flowers known in coastal and foothills thornscrub from the Mesa Masiaca near Navojoa north to El Chinalito between Hermosillo and Ures (29.28°N) along the Río Sonora. A paratype from near La Estrella in the Municipality of Soyopa on the Río Yaqui 42 km north of Tónichi was in its description (Daniel 1986). It was collected in the study area in Arroyo Las Tinajas below the Toledo smelter.

Tradescantia gentryi (Gentry's spiderwort, Commelinaceae) was described on a Howard Gentry specimen from north of Los Mochis, Sinaloa, in tropical deciduous forest (Hunt 2007). A paratype from Arroyo Los Garambullos near Tónichi, Sonora, is the northernmost locality for the species (Hunt 2007).

Hibiscus acicularis (Malvaceae) is a canary yellow flowered shrub best known in Coahuila, Nuevo Léon, and Tamaulipas in northeastern Mexico. It is common in foothills thornscrub in central Sonora (Figure 11).

Pediomelum rhombifolium (roundleaf scurfpea, Fabaceae) is a prostrate perennial herb with brick red or salmon-pink flowers that mostly occurs in Texas and adjacent Coahuila and Nuevo León in northeastern Mexico. Its distribution in Mexico of

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Clockwise from top left Figure 9. *Vachellia californica* at Bahía San Pedro, Sonora. A. Plant. B. Branch with leaves and thorns. C. Flowers. D. Pods. *Credits: Susan D. Carnahan.*

Flora and History of the Tónichi Area on the Río Yaqui *continued*

scattered records in Baja California, Baja California Sur, Guerrero, Jalisco, and Oaxaca states suggests that it is human dispersed. The Tónichi collection is the only Sonoran record for the species.

Cyperus erythrorhizos (redroot flatsedge, *coquillo,* Cyperaceae) is widespread and common from British Columbia and Ontario, Canada, and across the entire United States. In Mexico, it is only known from Baja California (Socorro González-Elizondo, pers. comm., 2025) and Sonora at Arroyo Las Tinajas near Toledo in our study area. Considering that heavy machinery was freighted in wagons to the smelter from the United States, it could have been introduced at that time.

Chloroleucon mangense (Fabaceae) is in tropical Mexico from Chiapas and Yucatán north along the Pacific coast to Sonora and in the Cape Region of Baja California Sur. It is a small tree with white flowers in the spring dry season (Figure 7A). The bark begins green but turns to mottled light and dark brown after peeling (Figure 7B). *Chloroleucon mangense* var. *leucocephalum* is common in tropical deciduous forest in the Álamos area (Martin et al. 1998, Van Devender et al 2000). The northernmost locality is in the Sierra Mazatán (Sánchez-E. et al. 2017).

Ctenodon petraceus (northern jointvetch, Fabaceae) is a yellow flowered shrub in tropical western Mexico from Guerrero north to Sonora (Martin et al. 1998). The northernmost locality is Arroyo Los Garambullos near Tónichi.

There are six species of *Ficus* (Moraceae) in tropical deciduous forest in southern Sonora (Martin et al. 1998). *Ficus petiolaris* is widespread in tropical Mexico north to central Sonora and the Cape Region in Baja California Sur. *Ficus. p.* subsp. *palmeri* is in Baja California and the Guaymas area in Sonora while *F. p.* subsp. *petiolaris* occurs in rocky habitats in numerous scattered areas in southern and east central Sonora. The northernmost Sonoran locality is in the Sierra El Tigre (30.63°N). Its growth form ranges from trees with elegant white roots strangling cliff faces in tropical deciduous forest (Figure 12) to dwarf shrubs in crevices on rocky canyon walls.

Loeselia amplectens (Polemoniaceae) is a subshrub with whitish flowers with magenta spots found in tropical western Mexico from Guerrero north to Sonora. The northernmost locality near Tónichi is the only record for Sonora.

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Flora and History of the Tónichi Area on the Río Yaqui *continued*

Pisonia capitata (*vainoro garabato,* Nyctaginaeae) is a densely spiny shrub in tropical habitats on the west coast of Mexico from Jalisco north to Tepache, Sonora (29.55°N). It is common in tropical deciduous forest along the Río Cuchujaqui near Álamos in southern Sonora (Van Devender et al. 2000).

Pithecellobium dulce (Fabaceae) is a riparian tree native to the Pacific coast and adjacent highlands of Mexico (Figure 13). It is introduced and often invasive in Florida, the Caribbean, Hawaii, India, Cambodia, Thailand, southern Asia, and elsewhere. It was carried from Mexico to the Philippines in the Manila galleons, but the Spanish were more interested in ornamental and useful plants than taxonomy. It was 'discovered' and described as *Mimosa dulcis* by Scottish botanist William Roxburgh in his flora of the coast of Coromandel, India (Roxburgh 1798). He thought it was introduced from the Philippines and native to East Indies. In the Philippines and India, it is called Manila tamarind and Madras thorn. In Sonora, it is called *guamuchil.* Because of its edible fruit and medicinal uses, its native distribution in Sonora is difficult to know, even when it occurs away from human developments. The stomach of a catfish *(Ictalurus pricei* x *I. punctatus*) caught in the Río Yaqui near Tónichi was full of *P. dulce* fruit.

History of Tónichi

In 1622, Jesuit missionary Diego de Vandersipe built the Nuestra Señora del Pópulo de Toninizi church in Tónichi (Nentvig 1971, Figure 14). The Pima people were reported to be peaceful, devoted farmers who readily accepted Christianity. Nentvig (1971) said that the populations of Tónichi were mixed Eudeve and Pima in 1750–1767. Tónichi was a major indigenous settlement.

The indigenous languages spoken in southern Arizona and northeastern Sonora were part of the widespread Uto-Aztecan language family. The Pima language was similar to O'odham in Arizona and Sonora and Tepehuan in Chihuahua, Durango, and Sinaloa. Jean B. Johnson's 1939–1940 study of the Yaqui language (Johnson 1962) reported that the people in Tónichi spoke Eudeve, a variation of the Ópata language. This reflected the Ópata expansion from the northeast into large areas north and west of Tónichi (Spicer 1962). The name Tónichi came from the Eudeve words *toni* (hot) and *tzi* (boiling)

Tónichi was the northernmost Pima Bajo Indian village on the east side of the Río Yaqui in southeastern Sonora upstream of Ónavas, Movas, and Nuri (Spicer 1962). Farther east, Pimas lived in the Sierra Madre Occidental at Maicoba and Yécora, Sonora, and Yepachic, Chihuahua. West of the Río Yaqui, Pimas were at

From left Figure 10. Lectotype of *Cryptostegia grandiflora. Drawing by J. Ridgway in 1820.*

Figure 11. *Hibiscus acicularis* on Rancho as Playitas, Sonora. *Credit: Guillermo Molina-P.*

Cumuripa, San José de Pimas, San Marcial, Suaqui Grande, and Tecoripa. Campbell W. Pennington studied the surviving material culture of the Pima Bajo in Ónavas (Pennington 1979).

In the 1870s, wagon roads to haul merchandise and ores from mines went from Estación Torres near Hermosillo south to Ortiz and north along the Río Yaqui to Cumuripa, La Dura, and Tónichi (Nelson 1910). Wagon roads were expensive to build and maintain and often raided by the Yaquis. In 1880–1882, Ferrocarril de Sonora between Guaymas and Nogales was built by an American company. This established Hermosillo as permanent capital of Sonora and moved ore from mines at La Dura, Suaqui Grande, and Minas Prietas and coal from mines at La Barranca and San Marcial (**https://es.m.wikipedia.org/wiki/Ferrocarril_de_Sonora**). In 1897, William C. Greene was awarded a concession from Southern Pacific to build railroads south of Cananea. His company was Ferrocarril Cananea, Río Yaqui y Pacific. Greene was the wealthy, influential American owner of the rich copper mine in Cananea. He died in 1904 but the railroad from Estación Corral near Ciudad Obregón through La Dura (Figure 15) to Punta Fierro across the river from Tónichi was constructed in 1907 to 1910 (Wilson & Rocha 1949). The railroad branch was finally closed in 1945. The 2020 census reported 280 people living in Tónichi.

In 1910, mining in Sonora was set to have a revival in the Districts of Ures, Hermosillo, and Sahuaripa (Wilson 1910). The Mix-Rayall mining concession was prevented from prospecting from Tecoripa and Cumuripa to San Antonio de la Huerta and Tónichi by Yaqui attacks. Development of the ill-fated Toledo smelter near Tónichi was stalled due to lack of funds and scarcity of ores but was revamping and restarting in 1910 (Nelson 1910). In August 2006, Tónichi resident Micaela Franco de Encinas told us that the smelter was a big operation with heavy machines transported from the U.S. in carts. Ore was processed from

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Flora and History of the Tónichi Area on the Río Yaqui *continued*

mines at La Colorada, San Javier, San Antonio de la Huerta, and others. She saw bars of silver and gold stamped with Toledo and the date. About 20 worker families were living in adobe houses near the smelter. In 1911, raiding Yaquis from Bacatete killed the American manager Barney and many workers, including her grandfather, and permanently closed the smelter. The tower of fire-hardened bricks was still standing in 2006. During the Mexican Revolution in 1911, federal troops defeated those of Francisco I. Madero near Toledo in the Batalla de Tónichi (Camín 1984). Today, local residents call the site Loma Maderista.

Discussion

Detailed local floras are crucial to understanding regional plant distributions, ecology, and biogeography. The Tónichi flora is a mixture of different biogeographic affinities. Species typical of tropical deciduous forest in the flora include the trees *Ceiba aesculifolia, Brongniartia alamosana, B. nudiflora, Diphysa occidentalis* (*güiloche*), *Handroanthus impetigenosus, Lonchocarpus hermannii, Lysiloma divaricatum, L. watsonii,* and *Parthenium tomentosum* var. *stramonium* (Figure 8); the shrubs *Croton flavescens, Euphorbia cymosa* (*candelilla, jumete*) *Heliotropium hartwegianum* (*hierba prieta*), *Malpighia emarginata,* and *Plumeria rubra*; perennial herbs *Abutilon mucronatum* (*malva*) and *Bastardiastrum cinctum* (*malva blanca*); and the succulents *Opuntia pubescens* (*siviri chucha*) and *Pachycereus pecten-aboriginum.*

Figure 12. *Ficus petiolaris* on Río Guajaray north of Álamos, Sonora in 1994. Note massive white roots on cliff. Human scale is Mark Fishbein. *Credit: Mark A. Dimmitt.*

Tónichi species that are widespread in tropical deciduous forest, thornscrub, and Sonoran desertscrub include the trees and shrubs *Bursera fagaroides, B. laxiflora, Fouquieria macdougalii, Guaiacum coulteri* (*guayacán*), *Haematoxylum brasiletto,* and *Parkinsonia praecox* (*palo brea*)*;* the perennial herbs *Abutilon abutiloides* (*pintapán*) and *Turnera diffusa* (*damiana*); and the succulents *Agave angustifolia, Cylindropuntia thurberi,* and *Stenocereus thurberi.*

Tónichi species more common in Sonoran desertscrub are the shrubs *Coursetia glandulosa, Encelia farinosa* (*hierba del vaso*), *Fouquieria splendens, Jatropha cordata, Mimosa distachya, Phaulothamnus spinescens,* and *Pleuradenophora bilocularis* while the tree *Olneya tesota* (desert ironwood, *palo fierro*); the shrub *Jatropha cardiophylla* (limberbush, *sangrengado*); and the succulents *Cochemiea mainae* and *Cylindropuntia fulgida* (*choya*) are typical Sonoran desertscrub species.

Shared Species. The percentages of species in the Tónichi thornscrub flora shared with other tropical floras in Sonora is insightful: *e.g.,* Municipality of Yécora (70.9%), Río Cuchujaqui (62.1%), Sierra Mazatán (60.5%), lower Río Bavispe Valley (49.1%), Municipality of Huatabampo (45.3%), Rancho Las Playitas (35.5%), and the Sierra Murrieta (32.8%). The flora of the Municipality of Yécora in eastern Sonora has the entire gradient from lowland foothills thornscrub and tropical deciduous forest to upland oak woodland and pine-oak forest (Van Devender & Reina-G. 2016). The Río Cuchujaqui flora in the Municipality of Álamos in southern Sonora (Van Devender et al. 2000) is representative of tropical deciduous forest. Foothills thornscrub is below oak woodland with Sonoran desertscrub on the west side of the Sierra Mazatán in central Sonora (Sánchez-E. et al. 2017). The flora of the lower Río Bavispe Valley east of Huásabas is foothills thornscrub and riparian vegetation along the river (Van Devender et al. 2018). The flora of the Municipality of Huatabampo in southern

continued next page

Flora and History of the Tónichi Area on the Río Yaqui

continued

Sonora is coastal thornscrub (Van Devender et al. 2024a). The vegetation of Rancho Las Playitas flora near Bacoachi in the Municipalities of Arizpe and Bacoachi is transitional between foothills thornscrub and desert grassland (Van Devender et al. 2023). Rich foothills thornscrub is below oak woodland in the Sierra Murrieta in Municipality of Bacanora (Van Devender et al 2024b).

These percentages are influenced by several factors. Tropical deciduous forest is well-developed in the Municipality of Yécora and along the Río Cuchujaqui. Also, these areas and the Sierra Mazatán have been exceptionally well collected. The lower Río Bavispe Valley and the Municipality of Huatabampo are direct thornscrub comparisons but reflect floristic differences and variability in this widespread vegetation type (Van Devender & Reina-G. 2021). The Rancho Las Playitas flora is in the transition between the New World tropics and the northern temperate zone and reflects declining tropical affinities northward as winter temperatures decrease. The fewer shared species with the Sierra Murrieta flora is interesting and probably reflects inadequate inventory in the rich thornscrub zone at the base of the mountain.

The richest tropical floras in Sonora are in tropical deciduous forest. Gentry (1942) and Martin et al. (1998) are the primary floristic references for tropical deciduous forest in the Río Mayo region in southern Sonora. The only local flora restricted to this vegetation type is the Río Cuchujaqui (Van Devender et al. 2000). The total of 736 taxa in 46 km^2 along 42 kilometers of river is diverse, but there are many more species in the uplands away from the river, especially in the Sierra de Álamos. Considering that thornscrub is a xeric version of tropical deciduous forest, most thornscrub species are present in more tropical vegetation. Two previous local thornscrub floras in Sonora are in the Municipality of Huatabampo (529 taxa, Van Devender et al. 2024a) and the lower Río Bavispe Valley (401 taxa, Van Devender et al. 2018). The total taxa (431) in the Tónichi thornscrub flora is similar but from a much smaller, intensely collected area (15.4 km^2) with diverse microhabitats.

Many tropical deciduous forest dominants near Álamos (Van Devender et al. 2000) are in shady slot canyons or mesic arroyos in the Tónichi study area, including *Brongniartia alamosana, Ceiba aesculifolia, Chloroleucon mangense* var. *leucocephalum, Handroanthus impetiginosus, Lysiloma divaricatum,* and *Pachycereus pecten-aboriginum.* Other tropical deciduous forest trees close to the Tónchi study area elsewhere in the Municipality of Soyopa or in the adjacent Municipalities of

Figure 13. *Pithecellobim dulce* fruit near Álamos, Sonora. *Credit: Stephanie A. Meyer.*

Ónavas or San Javier include *Coulteria platyloba* (S. Watson) N. Zamora (*palo colorado*), *Heliocarpus attenuatus* S. Watson (*samo baboso*), *Ipomoea arborescens* (Humb. & Bonpl.) G. Don (tree morning glory, *palo blanco*), and *Senna atomaria* (Humb. & Bonpl.) H. S. Irwin & Barneby (*palo zorillo*). Several noteworthy species in the study area, including *Chloroleucon mangense, Ctenodon petraeus, Ficus petiolaris, Guaiacum coulteri, Handroanthus impetiginosus, Lonchocarpus hermannii, Loeselia amplectens, Pisonia capitata,* and *Pithecellobium dulce,* are at the northern end of their distributions along the tropical Pacific coast of Mexico. *Holographis pallida, Polystemma canisferum,* and *Tetramerium yaquianum* are endemic to Sonora and *Pholisma culiacana* (*hongo*) and *Tradescantia gentryi* are endemic to Sonora and adjacent northern Sinaloa. *Cyperus erythrorhizos, Loeselia amplectens,* and *Pediomelum rhombifolium* are the first records for the species in Sonora. The biotic affinities of *Hibiscus acicularis* and *Pediomelum rhombifolium* are with Texas and northeastern Mexico. *Cyperus erythrorhizos* is a southern record of a northern temperate species. This flora strongly supports thornscrub as a tropical vegetation type derived from tropical deciduous forest (Figure 16).

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Profesor Rogelio Amaya-Coronado, Manuel Cazares, Armida Encinas-Franco, José Isedo-Esparza, Micaela Franco de Encinas, Cronista Blanca Rosa López-Martínez, Esther Martínez, Maria Teresa Tecolote-Armenta, and Altagracia Valenzuela provided common names of plants and information about the history of Tónichi. Specimens were identified by Daniel F. Austin (*Ipomoea*), Rupert C. Barneby (Fabaceae), J. Brasher

continued next page

Figure 14. Church and gazebo in the plaza in Tónichi in 2005. *Credit: Thomas R. Van Devender.*

Figure 15. Train from La Dura to Tónichi. Note foothills thornscrub on slopes.

Flora and History of the Tónichi Area on the Río Yaqui *continued*

(*Cryptantha*), Lincoln Constance (*Phacelia*), Mihai Costea (*Cuscuta*), Alfonso Delgado-S. (Fabaceae), Mark Fishbein (Apocynaceae), Richard S. Felger (general), G. Flores-F. (*Senna*), Paul A. Fryxell (Malvaceae), Rosaura Grether (*Mimosa*), M. Socorro González-E. (Cyperaceae), Ronald L. Hartman (Caryophyllaceae), James R. Henrickson (*Portulaca*), Philip D. Jenkins (general), Matthew B. Johnson (Fabaceae), David H. Lorence (Rubiaceae), Mahinda Martínez (*Physalis*), Guy Nesom (Asteraceae), Donald J. Pinkava (Cactaceae), J. Mark Porter (Polemoniaceae), John and Charlotte Reeder (Poaceae), Eric H. Roalson (Cyperaceae), Aarón Rodríguez-Contreras (Solanaceae), Richard M. Spellenberg (Nyctaginaceae), Leticia Torres-Colín (Fabaceae), Gordon C. Tucker (Cyperaceae), Billie L. Turner (Asteraceae), Victor W. Steinmann (Euphorbiaceae), Oscar Tellez (*Sphinctospermum*), Rebecca K. Wilson (general), and George Yatskievych (Lennoaceae, Pteridaceae). A review by Susan D. Carnahan greatly improved the manuscript. Susan D. Carnahan, Mark A. Dimmitt, Stephen F. Hale, Stephanie A. Meyer, Guillermo Molina-Padilla, and Caroline Treadway allowed the use of their photos. The Arizona-Sonora Desert Museum supported the field trips to Tónichi and Yécora. Greater Good Charities supports the understanding of the biogeography of Sonora with its Madrean Discovery Expeditions database. Marina Maskaykina at Greater Good Charities drafted the maps.

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continued next page

Flora and History of the Tónichi Area on the Río Yaqui

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Figure 16. Sunset view of Presa Angostura on the Río Bavispe (upper Río Yaqui tributary) from the Sierra El Tigre. *Credit: Caroline Treadway.*

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CHECKLIST: Tónichi Area, Municipality of Soyopa, Sonora *page 1 of 6*

An asterisk (*) denotes non-native status.

Pteridophytes

PTERIDACEAE

Astrolepis sinuata (Lag. ex Sw.) D.M. Benham & Windham subsp. *sinuata*

Astrolepis windhamii D.M. Benham

Hemionitis lozanoi (Maxon) Christenh.

Hemionitis lemmoni (D.C. Eaton) Cristenh.

Myriopteris pringlei (Davenp.) Grusz & Windham var. *pringlei*

SELAGINELLACEAE

Selaginella sartorii Hieron.

Selaginella wrightii Hieron.

Dicots

ACANTHACEAE

Carlowrightia arizonica A. Gray

Carlowrightia pectinata Brandegee

Dicliptera resupinata (Vahl) Juss.

Elytraria imbricata (Vahl) Pers.

Holographis pallida Leonard & Gentry

Justicia candicans (Nees) L.D. Benson

Ruellia intermedia Leonard

Tetramerium nervosum Nees

Tetramerium tenuissimum Rose

Tetramerium yaquianum T.F. Daniel

ACHATOCARPACEAE

Phaulothamnus spinescens A. Gray

AIZOACEAE

Trianthema portulacastrum L.

AMARANTHACEAE

Alternanthera stellata Uline & Bray.

Amaranthus palmeri S. Watson

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

Chenopodium neomexicanum Standl.

Dysphania ambrosioides (L.) Mosyakin & Clements

Gomphrena serrata Pav. ex Moq.

Gomphrena sonorae Torr.

Tidestromia lanuginosa (Nutt.) Standl.

APIACEAE

Daucus pusillus Michx.

Hydrocotyle umbellata L.

Eryngium nasturtiifolium Juss. ex F. Delaroche

Spermolepis lateriflora G.L. Nesom

APOCYNACEAE

**Cryptostegia grandiflora* (Roxb.) R. Br.

Cynanchum ligulatum (Benth.) Woodson

Funastrum clausum (Jacq.) Schltr.

Funastrum heterophyllum (Engelm. ex Torr.) Standl.

Gonolobus arizonicus (A. Gray) Woodson

Metastelma arizonicum A. Gray

Polystemma canisferum McDonnell & Fishbein

Polystemma tristiflora (Standl.) L.O. Alvarado & S. Islas

Plumeria rubra L. var. *acutifolia* (Poir.) Woodson

Ruehssia edulis (S. Watson) L.O Alvarado

Vallesia glabra Link

ARISTOLOCHIACEAE

Aristolochia watsonii Wooton & Standl.

ASTERACEAE

Ambrosia ambrosioides (Cav.) W.W. Payne

Ambrosia confertiflora DC.

Ambrosia cordifolia (A. Gray) W.W. Payne

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

Baccharis salicifolia (Ruiz & Pav.) Pers.

Bebbia juncea (Benth.) Greene

Brickellia brandegeei B.L. Rob.

Brickellia coulteri A. Gray

Coreocarpus sonoranus Sherff var. *sonoranus*

Diaperia verna (Raf.) Morefield

Eclipta prostrata (L.) L.

Encelia farinosa A. Gray ex Torr.

Erigeron velutipes Hook. & Arn.

Flaveria sonorensis A.M. Powell

Galinsogeopsis spilanthoides Sch. Bip. var. *saxosa* (Brandegee) Lichter-Marck

Galinsogeopsis spilanthoides Sch. Bip. var. *spilanthoides*

Gamochaeta americana (Mill.) Wedd.

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

Helenium thurberi A. Gray

Laennecia coulteri (A. Gray) G.L. Nesom

Logfia filaginoides (Hook. & Arn.) Morefield

Melampodium appendiculatum B.L. Rob.

Melampodium sericeum Lag.

Parthenium hysterophorus L.

Parthenium tomentosum DC. var. *stramonium* (Greene) Rollins

Pectis filipes Harv. & A. Gray

Pectis papposa Harv. & A. Gray

Pectis prostrata Cav.

Perityle californica Benth.

Porophyllum gracile Benth.

Porophyllum ruderale (Jacq.) Cass. subsp. *macrocephalum* (DC.) R.R. Johnson

**Sonchus oleraceus* L.

Symphyotrichum expansum (Poepp. ex Spreng.) G.L. Nesom

Thymophylla concinna (A. Gray) Strother

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

Xanthium orientale L.

CHECKLIST: Tónichi Area, Municipality of Soyopa, Sonora *page 2 of 6*

BIGNONIACEAE

Handroanthus impetiginosus (Mart. ex DC.) Mattos

Tecoma stans (L.) Juss. ex Knuth var. *angustata* Rehder

BIXACEAE

Cochlospermum gonzalezii (Sprague & L. Riley) Byng & Christenh.

BORAGINACEAE

Cordia sonorae Rose

Cryptantha barbigera (A. Gray) Greene

Eucrypta chrysanthemifolia (Benth.) Greene var. *bipinnatifida* (Torr.) Constance

Eucrypta micrantha (Torr.) A. Heller

Heliotropium angiospermum Murray

Heliotropium hartwegianum (Steud.) Halse & Feuillet

Heliotropium macrostachyum (DC.) Hemsl.

Johnstonella angustifolia (Torr.) Hasenstab & M.G. Simpson

Johnstonella grayi (Vasey & Rose) Hasenstab & M.G. Simpson var. *cryptochaeta* (J.F. Macbr.) Hasenstab & M.G. Simpson

Myriopus volubilis (L.) Small

Nama coulteri A. Gray

Nama hispida A. Gray

Nama jamaicensis L.

Nama stenocarpa A. Gray

Phacelia gentryi Constance

BRASSICACEAE

Descurainia pinnata (Walter) Britton

Dryopetalon runcinatum A. Gray

Lepidium lasiocarpum Nutt.

Lepidium oblongum Small

**Nasturtium officinale* W.T. Aiton

**Sisymbrium irio* L.

Tomostima cuneifolia (Nutt. ex Torr. & A. Gray) Al-Shehbaz, M. Koch & Jordan-Thaden

BURSERACEAE

Bursera fagaroides (Kunth) Engl. var. *elongata* McVaugh & Rzed.

Bursera laxiflora S. Watson

CACTACEAE

Cochemiea grahamii (Engelm.) Doweld

Cochemiea mainiae (K. Brandegee) P.B. Breslin & Majure

Cylindropuntia fulgida (Engelm.) F.M. Knuth

Cylindropuntia leptocaulis (DC.) F.M. Knuth x *C. thurberi* (Engelm.) F.M. Knuth

Cylindropuntia thurberi (Engelm.) F.M. Knuth

Mammillaria standleyi Orcutt

Opuntia aff. *wilcoxii* Britton & Rose

Opuntia gosseliniana F.A.C. Weber

Opuntia pubescens H.L. Wendl. ex Pfeiff.

Pachycereus pecten-aboriginum Britton & Rose

Stenocereus thurberi (Engelm.) Buxbaum

CAMPANULACEACE

Diastatea ternera (A. Gray) McVaugh

Nemacladus orientalis (McVaugh) Morin

CANNABACEAE

Celtis iguanaea (Jacq.) Sarg.

Celtis pallida Torr.

CARYOPHYLLACEAE

Cerastium texanum Britton

Drymaria glandulosa C. Presl var. *glandulosa*

Loeflingia squarrosa Nutt.

Silene antirrhina L.

CLEOMACEAE

Cleome melanocarpa S. Watson

Cleome tenuis S. Watson

**Cleome viscosa* L.

CONVOLVULACEAE

Cuscuta americana Thunb. ex Engelm.

Cuscuta corymbosa Ruiz & Pav. var. *grandiflora* Engelm.

Cuscuta desmouliniana Yunck.

Cuscuta legitima Costea & Stefanovic

Cuscuta tuberculata Brandegee

Cuscuta umbellata Kunth

Distimake palmeri (S. Watson) A.R. Simões & Stables

Evolulus alsinoides (L.) L.

Ipomoea aristolochiifolia G. Don

Ipomoea bracteata Cav.

Ipomoea costellata Torr.

Ipomoea dimorphophylla Greenm.

Ipomoea hederacea Jacq.

Ipomoea muricata (L.) Jacq.

Ipomoea nil (L.) Roth

Ipomoea purpurea (L.) Roth.

Ipomoea scopulorum Brandegee

Ipomoea ternifolia Cav. subsp. *leptotoma* (Torr.) J.R.I. Wood & Scotland

Ipomoea triloba L.

Jacquemontia pringlei A. Gray

CRASSULACEAE

Graptopetalum rusbyi (Greene) Rose

CUCURBITACEAE

**Citrullus lanatus* (Thunb.) Matsum. & Nakai

**Cucumis melo* L. var. *cantalupo* Ser.

Cucumis melo L. var. *dudaim* (L.) Naudin

Cucurbita argyrosperma C. Huber subsp. *sororia* (L.H. Bailey) Merrick & D.M. Bates

EUPHORBIACEAE

Acalypha aliena Brandegee

Acalypha havanensis Müll. Arg.

Acalypha ostryifolia Riddell

CHECKLIST: Tónichi Area, Municipality of Soyopa, Sonora *page 3 of 6*

Argythamnia serrata (Torr.) Müll. Arg.

Croton flavescens Greenm. var. *brandegeeanus* Croizat

Croton texensis (Klotzsch) Müll. Arg.

Euphorbia albomarginata Torr. & A. Gray

Euphorbia capitellata Engelm.

Euphorbia cymosa Poir.

Euphorbia dioscoreoides Boiss.

Euphorbia florida Engelm.

Euphorbia gracillima S. Watson

Euphorbia graminea Jacq.

Euphorbia heterophylla L

Euphorbia hirta L.

Euphorbia hyssopifolia L.

Euphorbia pediculifera Engelm.

Euphorbia petrina S. Watson

Euphorbia polycarpa Benth.

Euphorbia setiloba Engelm. ex Torr.

Euphorbia thymifolia L.

Jatropha cardiophylla (Torr.) Müll. Arg.

Jatropha cordata Müll. Arg.

Manihot angustiloba (Torr.) Müll. Arg.

Pleradenophora bilocularis (S. Watson) Esser & A.L. Melo

**Ricinus communis* L.

Tragia nepetifolia Cav

FABACEAE

Astragalus nuttallianus DC. var. *austrinus* (Small) Barneby

Brongniartia alamosana Rydb.

Brongniartia nudiflora S. Watson

Caesalpinia pulcherrima (L.) Sw.

Calliandra eriophylla Benth.

Calliandra humilis Benth. var. *humilis*

Chamaecrista nictitans (L.) Moench subsp.. *nictitans*

Chloroleucon mangense (Jacq.) Britton & Rose var. *leucospermum* (Brandegee) Barneby & Grimes

Coursetia caribaea (Jacq.) Lavin var. *caribaea* (Jacq.) Lavin

Coursetia glandulosa A. Gray

Crotalaria pumila Ortega

Ctenodon fascicularis (Schltdl. & Cham.) A. Delgado

Ctenodon petraeus (B.L. Rob.) A. Delgado

Dalea elata Hook. & Arn.

Dalea pringlei A. Gray var. *multijuga* Barneby

Desmanthus covillei (Britton & Rose) Wiggins

Desmodium procumbens (Mill.) C.L. Hitchc. var. *exiguum* (A. Gray) Schub.

Desmodium rosei B.G. Schub.

Desmodium scopulorum S. Watson

Desmodium tortuosum (Sw.) DC.

Diphysa occidentalis Rose

Erythrina flabelliformis Kearney

Galactia wrightii A. Gray

Haematoxylum brasiletto H. Karst.

Havardia mexicana (Rose) Britton & Rose

Hoffmannseggia glauca (Ortega) Eifort

Indigofera jamaicensis Spreng.

Indigofera suffruticosa Mill.

**Leucaena leucocephala* (Lam.) de Wit

Lonchocarpus hermannii M. Sousa

Lysiloma divaricatum (Jacq.) J.F. Macbr.

Lysiloma watsonii Rose

Marina alamosana (Rose) Barneby

Marina palmeri (Rose) Barneby

Mariosousa russelliana (Britton & Rose) Seigler & Ebinger

Mimosa distachya Cav. var. *distachya*

Mimosa distachya Cav. var. *laxiflora* (Benth.) Barneby

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

Neltuma velutina (Wooton) Britton & Rose

Olneya tesota A. Gray

Parkinsonia aculeata L.

Parkinsonia florida (Benth. ex A. Gray) S. Watson

Parkinsonia praecox (Ruiz & Pav.) Hawkins

Parkinsonia x *sonorae* (Rose & I.M. Johnst. ex I.M. Johnst.) Hawkins & Felger

Pediomelum rhombifolium (Torr. & A. Gray) Rydb.

Phaseolus acutifolius A. Gray var. *latifolius* Freeman

Piscidia mollis Rose

Pithecellobium dulce (Roxb.) Benth.

Rhynchosia minima (L.) DC.

Rhynchosia precatoria (Humb. & Bonpland. ex Willd.) DC.

Senegalia occidentalis (Rose) Britton & Rose

Senna covesii (A. Gray) H.S. Irwin & Barneby

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

Senna obtusifolia (L.) H.S. Irwin & Barneby

Senna occidentalis (L.) Link

Senna pallida (Vahl) H.S. Irwin & Barneby var. *shreveana* H.S. Irwin & Barneby

Sesbania herbacea (Mill.) McVaugh

Sphinctospermum constrictum (S. Watson) Rose

Vachellia californica (Brandegee) Siegler & Ebinger

Vachellia campeachiana (Mill.) Siegler & Ebinger

*Vachellia farnesiana (*L.) Wight & Arn.

FOUQUIERIACEAE

Fouquieria macdougalii Nash

Fouquieria splendens Engelm.

KRAMERIACEAE

Krameria erecta Willd. ex J.A. Schultes

CHECKLIST: Tónichi Area, Municipality of Soyopa, Sonora *page 4 of 6*

LAMIACEAE

Cantinoa mutabilis (A. Richard) Harley & J.F.B. Pastore

Condea albida (Kunth) Harley & J.F.B. Pastore

Hedeoma nana (Torr.) Briq.

Salvia lasiocephala Hook. & Arn.

Salvia misella Kunth

Vitex mollis Kunth

LENNOACEAE

Pholisma culiacana (Dressler & Kuijt) Yatsk.

LOASACEAE

Gronovia scandens L.

Mentzelia aspera L

MALPIGHIACEAE

Callaeum macropterum (Moc. & Sessé ex DC.) D.M. Johnson

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

Cottsia californica (Benth.) W.R. Anderson & C. Davis x *C. gracilis* (A. Gray) W.R. Anderson & C. Davis

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

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

Echinopterys eglandulosa (A. Juss.) Small

Malpighia emarginata DC.

MALVACEAE

Abutilon abutiloides (Jacq.) Garcke ex Hochr.

Abutilon incanum (Link) Sweet

Abutilon mucronatum J. Fryxell

Abutilon reventum S. Watson

Anoda pentaschista A. Gray

Anoda reticulata S. Watson

Ayenia filiformis S. Watson

Bastardiastrum cinctum (Brandegee) D.M. Bates

Ceiba aesculifolia (Kunth) Britton & Baker f.

**Gossypium hirsutum* L.

Guazuma ulmifolia Lam.

Herissantia crispa (L.) Briz.

Hibiscus acicularis Standl.

Hibiscus biseptus S. Watson

Malvastrum coromandelianum (L.) Garcke

Melochia tomentosa L.

Sida abutilifolia Mill.

Sida alamosana S. Watson ex Rose

Sida ciliaris L.

Sida rhombifolia L.

Sphaeralcea coulteri (S. Watson) A. Gray

Waltheria indica L.

MARTYNIACEAE

Proboscidea altheifolia (Benth.) Decne.

Proboscidea parviflora (Wooton) Wooton & Standl.

MENISPERMACEAE

Nephroia diversifolia (DC.) L. Lian & Wei Wang

MOLLUGINACEAE

Mollugo verticillata L.

MORACEAE

Ficus petiolaris Kunth

NYCTAGINACEAE

Allionia incarnata L.

Boerhavia coccinea Mill.

Boerhavia coulteri (Hook. f.) S. Watson

Boerhavia erecta L.

Boerhavia purpurascens A. Gray

Boerhavia spicata Choisy

Boerhavia triquetra S. Watson

Boerhavia xantii S. Watson

Commicarpus scandens (L.) Standl.

Pisonia capitata (S. Watson) Standl.

ONAGRACEAE

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

Eulobus californicus Nutt. ex Torr. & A. Gray

Ludwigia octovalvis (Jacq.) P.H. Raven

Oenothera kunthiana (Spach) Munz

Oenothera primiveris A. Gray

OXALIDACEAE

Oxalis latifolia Kunth

PAPAVERACEAE

Argemone ochroleuca Sweet

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

PASSIFLORACEAE

Passiflora foetida L.

Turnera diffusa Willd. ex Schult.

PHRYMACEAE

Erythranthe floribunda (Lindl.) G.L. Nesom

Erythranthe unimaculata (Pennell) G.L. Nesom

PLANTAGINACEAE

Nuttallanthus texanus (Scheele) D.A. Sutton

Sairocarpus costatus (Wiggins) D.A. Sutton

Schistophragma intermedium (A. Gray) Pennell

Stemodia durantifolia (L.) Sw.

Stemodia palmeri A. Gray

Veronica peregrina L. subsp. *xalapensis* (Kunth) Pennell

POLEMONIACEAE

Dayia sonorae (Rose) J.M. Porter

Linanthus jonesii (A. Gray) Greene

Loeselia amplectens (Hook. & Arn.) Benth. ex DC.

CHECKLIST: Tónichi Area, Municipality of Soyopa, Sonora *page 5 of 6*

POLYGONACEAE

Antigonon leptopus Hook. & Arn.

Persicaria maculosa A. Gray

Persicaria punctata (Elliott) Small

Rumex inconspicuus Rech. f.

PORTULACACEAE

Portulaca halimoides L.

Portulaca oleracea L.

Portulaca pilosa L.

Portulaca suffrutescens Engelm.

Portulaca umbraticola Kunth

RANUNCULACEAE

Clematis drummondii Torr. & A. Gray

RESEDACEAE

Oligomeris linifolia (Vahl) J.F. Macbr.

RHAMNACEAE

Karwinskia humboldtiana (Willd. ex Schult.) Zucc.

RUBIACEAE

Cephalanthus salicifolius Bonpl.

Galium proliferum A. Gray

Houstonia prostrata Brandegee

Houstonia wrightii A. Gray

Hintonia latiflora (DC.) Bullock

Randia thurberi S. Watson

RUTACEAE

Esenbeckia hartmanii B.L. Rob. & Fernald

Zanthoxylum fagara (L.) Sarg.

SALICACEAE

Salix gooddingii C.R. Ball

SAPINDACEAE

Cardiospermum corindum L.

Sapindus saponaria L.

SAPOTACEAE

Sideroxylon occidentale (Hemsl.) T.D. Penn.

SCROPHULARIACEAE

Buddleja sessiliflora Kunth

SOLANACEAE

Calibrachoa parviflora (Juss.) D'Arcy

Capsicum annuum L. var. *glabriusculum* (Dunal) Heiser & Pickersgill

Datura discolor Bernh.

Lycium berlandieri Dunal

**Nicotiana glauca* Graham

Nicotiana obtusifolia M. Martens & Galeotti

Physalis acutifolia (Miers) Sandw.

Physalis crassifolia Benth.

Physalis grisea (Waterf.) M. Martínez

Physalis hederifolia A. Gray

Physalis leptophylla B.L. Rob. & Greenm.

Physalis pubescens L.

Solanum deflexum Greenm.

Solanum erianthum D. Don

Solanum grayi Rose

Solanum houstonii Martyn

Solanum lumholtzianum Bartlett

**Solanum lycopersicum* L.

TALINACEAE

Talinum sonorae D.J. Ferguson

TAMARICACEAE

**Tamarix chinensis* Lour.

URTICACEAE

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

VERBENACEAE

Glandularia gooddingii (Briq.) Solbrig

Glandularia pumila (Rydb.) Umber

Lantana camara L.

Phyla nodiflora (L.) Greene

Priva lappulacea (L.) Pers.

VIOLACEAE

Pombalia attenuata (Humb. & Bonpl. ex Willd.) Schulze-Menz

VITACEAE

Cissus cf. *trifoliata* (L.) L.

ZYGOPHYLLACEAE

Guaiacum coulteri A. Gray

Kallstroemia californica (S. Watson) Vail

Kallstroemia grandiflora Torr. ex A. Gray

Kallstroemia parviflora Norton

Monocots

AMARYLLIDACEAE

Hymenocallis sonorensis Standl.

ASPARAGACEAE

Agave angustifolia Haw.

Agave vilmoriniana A. Berger

BROMELIACEAE

Hechtia montana Brandegee

COMMELINACEAE

**Commelina diffusa* Burm. f.

Commelina erecta L.

Tradescantia gentryi D.R. Hunt

CYPERACEAE

Cyperus erythrorhizos Muhl.

**Cyperus iria* L.

Cyperus ochraceus Vahl

**Cyperus rotundus* L.

Cyperus squarrosus L.

Cyperus subsquarrosus (Muhl.) Bauters

Cyperus surinamensis Rottb.

Eleocharis montevidensis Kunth

Fimbristylis annua (All.) Roem. & Schult.

CHECKLIST: Tónichi Area, Municipality of Soyopa, Sonora *page 6 of 6*

POACEAE

Aristida adscensionis L.

Aristida ternipes Cav. var. *ternipes*

Bouteloua aristidoides (Kunth) Griseb.

Bouteloua barbata Lag. var. *barbata*

Bouteloua barbata Lag. var. *sonorae* (Griffiths) Gould

Bouteloua diversispicula Columbus

Bouteloua repens (Kunth) Scribn. & Merr.

**Cenchrus ciliaris* L.

Chloris virgata Sw.

**Cynodon dactylon* (L.) Pers.

**Dactyloctenium aegyptium* (L.) Willd.

**Digitaria bicornis* (Lam.) Roem. & Schult.

Digitaria horizontalis Willd.

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

Dinebra panicoides (J. Presl) P.M. Peterson & N. Snow

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

Diplachne fusca (L.) P. Beauv. ex Roem & Schult. subsp. *fascicularis* (Lam.) P.M. Peterson & N. Snow

**Echinochloa colona* (L.) Link

Eriochloa aristata Vasey

Enneapogon desvauxii P. Beauv.

**Eragrostis cilianensis* (All.) Vignolo ex Janch.

Eragrostis pectinacea (Michx.) Nees var. *pectinacea*

Festuca octoflora Walter var. *hirtella* (Piper) Hitchc.

Festuca octoflora Walter var. *octoflora*

Heteropogon contortus (L.) P. Beauv. ex Roem. & Schult.

**Melinis repens* (Willd.) Zizka

Muhlenbergia arizonica Scribn.

Muhlenbergia microsperma (DC.) Kunth.

Muhlenbergia minutissima (Steud.) Swallen

Panicum alatum Zuloaga & Morrone var. *minus* (Andersson) Zuloaga & Morrone

Panicum hirticaule J. Presl var. *hirticaule*

Paspalum paniculatum L.

Paspalum squamulatum E. Fourn. ex Hemsl.

**Phalaris minor* Retz.

Setaria grisebachii E. Fourn.

Setaria liebmannii E. Fourn.

Setariopsis auriculata (E. Fourn.) Scribn.

Setariopsis latiglumia Scribn.

Urochloa arizonica (Scribn. & Merr.) Morrone & Zuloaga

Urochloa fusca (Sw.) B.F. Hansen & Wunderlin

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