



Left Sierra Juriquipa. Photo courtesy Michael McNulty. Right Tiger lily (*Tigridia pavona*). Photo courtesy Robert A. Villa.

170 Years of Natural History in Cuenca Los Ojos, Sonora, Mexico *by Thomas R. Van Devender and Ana L. Reina-Guerrero¹*

Boundary Surveys

The Treaty of Guadalupe Hidalgo in 1848 at the end of the United States-Mexico War established the boundary between the two nations, and expanded the United States to the Pacific Ocean. In 1853, the Gadsen Purchase added the area along the modern Arizona-New Mexico-Sonora border to the United States. The expeditions to survey the border between 1848 and 1855 were the first biological inventories of the borderlands. Many common Sky Islands plants were named for survey botanists Arthur Schott, Charles Wright, Christopher Parry, George Thurber, John Bigelow, and expedition director Major William H. Emory, U.S. Army.

Biologists on the Second U.S.-Mexico (1892-1894) boundary survey, led by U.S. Army Captain Edgar A. Mearns, inventoried the Sierra San Luis and Cajón Bonito. The area between Monument 73 at Arroyo Guadalupe (now Rancho Puerta Blanca) and Naco, Arizona/Sonora was visited in August 1893. In Mearn's 1907 report on the mammals of the boundary, Lieutenant David Dubose Gaillard described the Arizona-Sonora borderlands as "bare, jagged mountains rising out of the plains like islands from the sea," the first time that this powerful "sky island in a desert sea" image was used. He wrote the general vegetation descriptions for sites visited on the expedition. Later he was the lead engineer on the Panama Canal construction project.

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Left Sierra San José. Photo courtesy Dale Turner. Center and Right Edgar A. Mearns and David D. Gaillard. Public domain photos, courtesy Wikipedia.

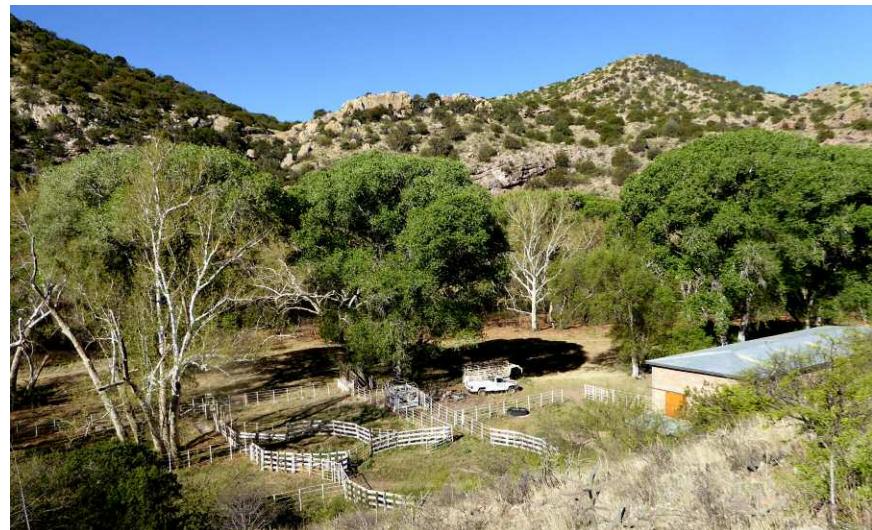
Cuenca Los Ojos *continued*

The Rivers

Cajón Bonito is the finest riparian habitat in northwestern Mexico and adjacent Arizona with dense cottonwood-willow riparian forest along a permanent stream in deep rocky canyons. It begins on Cerro Pan Duro, flows north to the foothills of the Sierra San Luis, west through the southern extension of the Peloncillo Mountains, and south into the Río Bavispe/Yaqui drainage. The Río Yaqui drainage extends into Cochise County, Arizona, in Arroyo Guadalupe; Blackwater Draw (Arroyo San Bernardino in Sonora); and Whitewater Draw (Río de Agua Prieta in Sonora). Cajón Bonito and the Río San Bernardino are northern tributaries of the Río Yaqui. The Río San Bernardino (as Blackwater Draw) originates in southeastern Arizona, where it flows through the San Bernardino/Leslie Canyon National Wildlife Refuge (NWR) just east of Douglas.

The Biotic Communities

The vegetation of northeastern Sonora is diverse. Chihuahuan desertscrub and desert grassland reach their western limits in southeastern Arizona and adjacent Sonora. Chihuahuan desertscrub is well developed on the limestone hills in the Agua Prieta area. At higher elevations, open, grassy oak woodlands are found in the Peloncillo and San Luis Mountains. After a severe fire on the west side of the Sierra San Luis in 1996, oak woodland converted to dense interior chaparral, dominated by shrub oaks. Lower slopes of the Sierra San Luis have extensive montane grassland. Pine-



Rancho los Ojos Caliente on Cajón Bonito. Photo courtesy Ana L. Reina-G.

oak forest is present in the higher areas in the Sierras San Luis and Pan Duro. The riparian vegetation in the upper parts of Cajón Bonito, on Ranchos el Pinito and Pan Duro, is dominated by Arizona cypress (*Cupressus arizonica*) and Douglas fir (*Pseudotsuga menziesii*).

After the Mearns Expedition in 1894, the *la frontera* zone in northeastern Sonora was neglected biologically. Interest picked up again when Joe T. Marshall's 1954 studies of breeding birds, dominant trees, and vegetation in the Sierra San Luis were reported in his 1957 book, *Birds of Pine-Oak Woodland in Southern Arizona and Adjacent Sonora*. From 1975 to 1981, Stephen M. Russell and Gale Monson observed birds in Cajón Bonito for their 1998 book, *The Birds of Sonora*.

Charles T. Mason, Curator of the University of Arizona Herbarium, and his student Roger McManus made 29 plant collections in Cajón Bonito in May 1976. Richard S. Felger

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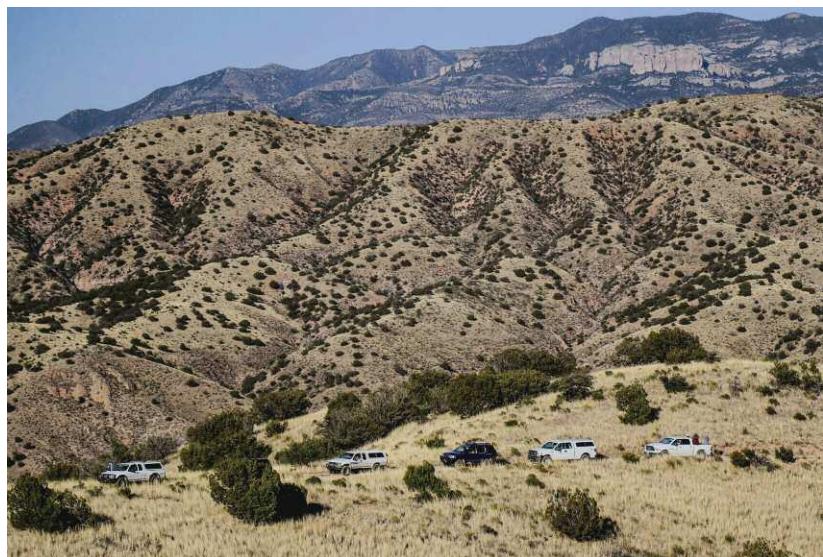
Interior chaparral and montane grasslands in the Sierra San Luis. Photos courtesy the authors.

Cuenca Los Ojos *continued*

and owner Rubén Ruíz collected 55 plant specimens from Rancho Pan Duro in July 1993.

In 1986, David G. Barker surveyed the reptiles and amphibians of the Sierra San Luis for a master's degree at the University of Texas at Arlington. The threatened Animas ridge-nosed rattlesnake (*Crotalus willardi* subsp. *obscurus*) was common in Cajón del Diablo (now part of Cuenca los Ojos, or CLO). In 2008, Matt Goode, University of Arizona, inventoried the reptiles and amphibians of Rancho Pan Duro in the upper Cajón Bonito.

Dean A. Hendrickson, Wendell L. Minckley, and Robert R. Miller began studying native fishes in the Río San Bernardino and Cajón Bonito in 1980. Eight species of Río Yaqui fishes occur in these streams. Seven species are protected as endangered, threatened, or rare in the United States and/or Mexico. The Yaqui catfish (*Ictalurus pricei*), which formerly occurred in San Bernardino Creek in Arizona, still survives in Cajón Bonito. Retired U.S. Fish and Wildlife fisheries biologist Charles Minckley (Wendell's brother) monitors the CLO fishes today. The San Bernardino springsnail (*Pyrgulopsis bernardina*) is a U.S. federally endangered species that only occurs in springs in CLO and the San Bernardino NWR.



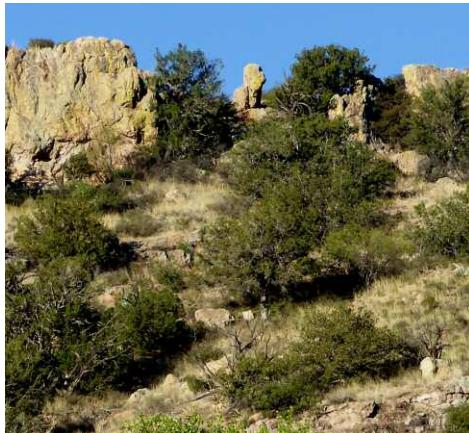
View to the Sierra San Luis. Photo courtesy Luis Gutierrez.

In 1993, the Centro Ecológico de Sonora (CES) proposed the Sierra San Luis in the Sistema de Áreas Naturales Protegidas del Estado de Sonora (SANPES). The proposed area included the Sierra San Luis in both Chihuahua and Sonora as far south as Rancho Pan Duro and west to Rancho Nuevo. In 2011, the Comisión de Ecología y Desarrollo Sustentable del Estado de Sonora (CEDES, formerly CES) did another study for a proposed Sonoran state-protected natural area that included the western slopes of the Sierra San Luis, all of CLO, Rancho Pan Duro, and south along the Río San Bernardino. Neither proposed reserve was established.

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Clockwise from top left Mexican roundtail chub (*Gila minacea*). Ornate shiner (*Cobitis ornata*). Cajón Bonito. Photos courtesy James C. Rorabaugh.



From left Fremont cottonwood (*Populus fremontii*) and desert grassland, Rancho Ojos Calientes. Valer Clark. Photos courtesy the authors.

Cuenca Los Ojos *continued*

Cuenca los Ojos Foundation

Valer Clark and her husband Josiah Austin bought five ranches in Sonora, from the Sierra San Luis west to Ranchos las Anitas and San Bernardino east of Agua Prieta. They established the Cuenca los Ojos Foundation (cuencalosojos.org) in the early 1990s to administer the land. This began an intense conservation effort. Cattle were removed from the ranches to allow recovery from severe overgrazing. Without grazing, the native bunch grasses are today very diverse and dense, surely one of the best desert grasslands in the Southwestern United States. Large gabions were built along the Río San Bernardino on Rancho San Bernardino to manage stream flow and floods, and to restore riparian vegetation and fish habitats. The riparian vegetation in Cajón Bonito dramatically recovered to its present glorious condition.

The establishment of CLO stimulated a variety of research. Robert Minckley (son of Wendell) of the University of Rochester studied bees and pollination in the San Bernardino valley from 2000–2007. Large collections of bees and plants were made. The job of one summer intern was to

stretch out the tongues of bees as they were pinned! Minckley identified 383 species of bees and concluded that the bee fauna was one of the richest in the world.

In 2002, Robert Hunt and Walter Anderson of Prescott College publish their two-part study on the ecology and birds of Cajón Bonito in *Desert Plants*. Hunt's studies of the area have continued with a focus on the relationships between politics and ecology in the region.

In 2002–2004, Carlos A. López-G. and his students from the Universidad Autónoma de Querétaro studied beaver (*Castor canadensis*), black bear (*Ursus americanus*), bobcat (*Lynx rufus*), and mountain lion (*Puma concolor*) at Rancho el Pinito in the Sierra San Luis and in Cajón Bonito. Beaver were only found at Rancho el Diablo in Cajón Bonito. Their results were published in the 2005 proceedings of the second Madrean Archipelago symposium entitled "Connecting Mountain Islands and Desert Seas: Biodiversity and Management."

In April 2009, the authors and Nancy Zierenberg (Arizona Native Plant Society) led a field trip to CLO, and stayed in Rancho Puerta Blanca. The group observed plants in Arroyo Guadalupe, Cajón Bonito, and El Valle.

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From left Beaver. Photo courtesy Wayne Van Devender. Black bear. Photo courtesy Rubén Ruiz. Bobcat. Photo courtesy Memo Galaz-G.



From left Nancy Zierenberg on Rancho San Bernardino. Photo courtesy Thomas R. Van Devender. AZNPS group at border monument on Rancho Puerta Blanca. Photo courtesy Nancy Zierenberg.

Cuenca Los Ojos *continued*

In 2009-2011, Jesús Sánchez-Escalante, Curator of the Universidad de Sonora Herbarium (USON), did extensive plant collections in northeastern Sonora under a grant from the Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO), the Mexican national biodiversity agency. In the summer of 2011, CLO sponsored student interns from the Universidad de Sonora to help with inventories of plants, birds, and mammals on the Sonoran ranches.

In May 2012, the third Madrean Archipelago symposium, “Merging Science and Management in a rapidly changing World: Biodiversity and Management,” was held in Tucson, Arizona. In the 2013 conference proceedings, Van Devender and Sky Island Alliance colleagues provided an overview of the biogeography and conservation of the Sky Islands Region, a map and definitions of the Sky Islands, and the regional biogeography of the pines. About 25 additional oral presentations and published articles were on Sonoran Sky Island topics.

Arizona-Sonora Desert Museum (ASDM) Plant Inventories

The authors have had a long-term interest in the flora of *la frontera* within 100 km of the Arizona border in northeastern Sonora. In 2006-2007, we searched for the Cochise

pincushion cactus (*Coryphantha robbinsorum*) in Sonora under a USFWS Section 6 grant. John Wiens at ASDM and Jesús Sánchez at USON helped with field surveys. The Cochise pincushion is a federally threatened species only known from the Magoffin Hills east of Douglas in Cochise County, Arizona. In 1984, Vincent Lopresti reported it in a publication in Spanish from limestone hills in Sonora (now on CLO). Limestone hills throughout the Agua Prieta area were searched without finding the cactus.

In 2007-2008, we searched for the false rainbow cactus (*Echinocereus pseudopectinatus*) and the Chihuahuan night-blooming cereus (*Peniocereus greggii* var. *greggii*) in the Agua Prieta area under a grant from the Tucson Cactus and Succulent Society. The false rainbow cactus is locally common from Cabullona east to Mesa las Víboras. The night-blooming cereus is scattered throughout the area, but is especially common on Mesa las Víboras. This is a large area of dwarf (a meter or less in height) velvet mesquite

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From left Cochise pincushion cactus. Photo courtesy Erik F. Enderson. Cerro Caloso limestone ridge east of Cabullona. Photo courtesy Thomas R. Van Devender.



From left False rainbow cactus. Dwarf mesquite on Mesa la Víboras. Photos courtesy Thomas R. Van Devender. Chihuahua night-blooming cereus. Photo courtesy Erik F. Enderson.

Cuenca Los Ojos *continued*

(*Prosopis velutina*) habitat on pure clay soils. The *Peniocereus* were taller than the mesquites!

Plant specimens collected on these projects were deposited with the University of Arizona and USON herbaria. The ASDM plant projects overlapped with Minckley's bee studies, and several times both groups worked out of CLO's Rancho Puerta Blanca.

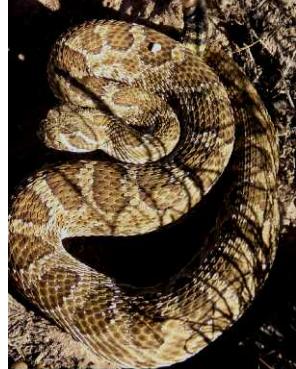
MABA and MDE Expeditions

The Madrean Archipelago Biotic Assessment (MABA) Program was created at Sky Island Alliance in 2009 to document the biodiversity in the Sky Island mountain ranges of Sonora. The first MABA Expedition was to CLO, where biologists observed plants and animals of Rancho el Pinito in Cajón Bonito and Puerta Blanca in Arroyo Guadalupe. In 2015 the Madrean Discovery Expeditions program at [GreaterGood.org](#) was created to continue biotic inventories in Sonoran Sky Islands. To date, expeditions have gone to twelve Sky Islands, and mini-expeditions to eight others. An MDE Expedition of 57 biologists went to Cajón Bonito on Earth Day in April 2017.

After each Expedition, there were follow-up trips in other seasons or to nearby areas to make additional observations. El Valle, the cold, windy southern extension of the Animas Valley in CLO, was visited several times. About a dozen species of plants and the prairie rattlesnake (*Crotalus viridis*) found in El Valle were additions to the flora and fauna of Sonora. After MDE Cajón Bonito, herpetologist Jim Rorabaugh returned to take more data on the lowland leopard frogs (*Rana yavapaiensis*). Richard Bailowitz and Doug Danforth returned to Rancho San Bernardino twice, recording 60 species of damselflies and dragonflies — 13 of them in the damselfly genus *Argia*! These observations supplement decades of their observations from San Bernardino NWR in Arizona.

Documenting the biodiversity of the Sonoran Sky Islands to support conservation efforts is a primary objective of the MABA/MDE programs. All of the plant and animal collections and observations from expeditions and many other sources, and many high-resolution images from the region, are publicly available in the Madrean Discovery Expedition database ([madreandiscovery.org](#); linked to the MABA database). The MDE database serves as the primary repository of biological records for many protected areas in

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From left Wheel milkweed (*Asclepias uncialis*). Photo courtesy Michael F. Wilson. View of Sierra San Luis from plains grassland with Texas beargrass (*Nolina texana*) in el Valle. Spinystar (*Coryphantha vivipara*). Prairie rattlesnake. Photos courtesy Thomas R. Van Devender.

BOTANIST SPOTLIGHT *continued*

sorting, ordering, and filing the many specimens that are part of the Herbarium's specimen loan program. She has also spent a good part of her time at the Herbarium helping with plant identifications as well as joining in conversations about current taxonomy and what plants are being seen in the area. Joan is one of the most prolific botanical collectors in the Catalinas. She has collected over 1,000 specimens from the Catalinas that are deposited in the UA Herbarium and which represent an invaluable permanent record of the Mount Lemmon flora. Jim Verrier, who has collected extensively in the Santa Catalinas says, "One of the most impressive things about Joan is that she doesn't shy away from even the tiniest of plants. Most people walk away from them because they are difficult to identify. Joan is fearless about taking a specimen and putting it under the scope and researching until she can nail down the ID." Her enthusiasm inspires

so many of us to be courageous about learning the terminology and keys for the flora.

I have had the good fortune to spend many delightful days with Joan botanizing in Sabino Canyon, Mount Lemmon, and the White Mountains of Arizona. Joan lives in Tucson where she and her husband, John, have a lovely new apartment overlooking the Catalina skyline, the mountains that she loves and knows so well. Although Joan has recently retired from her active field and herbarium work, she does get together for lunches and visits with friends. She is surely missed at the Herbarium and on the trails, but her contributions and friendship continue to educate and inspire so many of us who have had the good fortune to know her.



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Sonora, including the Cuenca los Ojos Foundation. MDE FLORA is part of the comprehensive SEINet network of 187 herbarium databases and more than 11.6 million plant records. Currently there are 6,277 plant and 4,629 animal records from the Municipio de Agua Prieta.

Some of the finest habitats in northwestern Mexico and a wonderfully diverse flora and fauna are on the Cuenca los Ojos Foundation lands in the borderlands of northeastern Sonora. Valer Clark and Josiah Austin's passion and love for the land and vision to protect it for the future created the finest private protected natural area in the Madrean Archipelago.

Acknowledgements

We thank GreaterGood.org, especially Liz Baker, Noah Horton, and Tim Kunin, for their support of the Madrean Discovery Expeditions program. Robert and Charles Minckley provided information about CLO research on bees and fishes. Alejandro Varela provided a copy of the 1993 Sierra San Luis



Clockwise from top left Cardinal meadowhawk (*Sympetrum illotum*). Bordered patch (*Chlosyne lacinia*). Tarascan dancer (*Argia tarascana*). Photos courtesy Doug Danforth.

SANPES proposal. Dave Barker provided the reptile and amphibian records and images from his thesis in the Sierra San Luis.

