

Using Community Science to Help Conserve Saguaro National Park's Amazing Plant Diversity

Report to Western National Parks Association, Project #22-08



A park employee descends a rocky canyon amidst cypress trees during a plant survey trip.
Upper Paige Creek, east side of Rincon Peak. September 2022.

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Abstract

The Rincon Mountain District of Saguaro National Park features a remarkably biodiverse Sky Island mountain range that rises from cactus-studded Sonoran Desert flats all the way up to pine and mixed conifer forests at the high summits. Shifting habitats in between include grasslands, oak woodlands, and riparian forests. Rare mountain plants, especially those that rely on cool and wet niches, are increasingly threatened by climate change as temperatures rise, precipitation decreases, and destructive megafires become more frequent. High elevation plant surveys beginning in 2017 resulted in “rediscoveries” of plants that were feared to be lost, and many additional findings of rare plants that had never been recorded.

In 2022, to continue learning about vulnerable resources in the park, we scaled up this rare plant survey program, expanding our coverage of the Rincon district’s remote mountain wilderness through multi-day backpacking trips. We also called on volunteer naturalists and park visitors to help us document plant diversity in the Rincons through the citizen science platform iNaturalist. Through backpacking trips and day surveys, we explored under-surveyed areas of biological interest. We supplemented this effort by engaging with volunteer and visitor observations and followed up on their significant findings. In total, we added 22 native plant species to the known flora of the Rincon Mountain District, many of them globally or nationally rare. Collections, photo observations, and associated data from this project will serve as permanent scientific records of plant diversity in the park. By highlighting certain biodiversity hotspots, they will also guide adaptive management and monitoring as the park strives to preserve and document its unique biodiversity in the face of a rapidly changing climate.

Introduction

Though most famous for its iconic giant cactus and Sonoran Desert landscapes, Saguaro National Park also includes the majority of the Rincon Mountains, a Madrean Sky Island range east of Tucson that rises to 8,666 ft (2,641 m). Local mountain ranges like the Rincons are known as Sky Islands because they are biologically isolated, rising out of large valleys or “seas” of lowland desert or grassland. The Madrean Sky Island region is binational, including southeastern Arizona, northeastern Sonora, and adjoining areas of New Mexico and Chihuahua. These isolated mountain chains form biological linkages between the Colorado Plateau of the Four Corners region and the Sierra Madre Occidental of Mexico. Given this geographical placement along with highly variable elevation zones and topography, the Sky Islands are known as biodiversity hotspots, including species associated with the Sonoran Desert, Chihuahuan Desert, Rocky Mountains, Sierra Madre, and subtropics.

The plant life of the Rincons has been formally studied by botanists since the late 19th century, starting a major wave of collections and studies that continued through the early 20th century. In the 1980s, two prominent local botanists compiled previous records with new surveys to complete a flora of the Rincons (Bowers & McLaughlin 1987), including an annotated checklist of all vascular plant species known to occur there. They also included a list of 41 plant species previously recorded in or around the Rincons that they were not able to relocate. This list became the basis for a new project initiated in 2014 by Saguaro National Park biologist Don Swann, to first research these potentially “lost” species and then conduct targeted field surveys to look for

them. Field surveys began in 2017, after settling on a refined list of 14 species that were certainly or plausibly collected in the park historically but not recorded since.

From 2017-2020, we conducted these targeted plant surveys, primarily through work trips based out of Manning Cabin, the park's high elevation workstation at 8,000 ft (2,438 m). The results set the stage for this project. Not only did we "rediscover" 9 of the 14 target species, but we also found 22 native species that had never previously been recorded in the Rincon Mountains (Beckman & Swann 2021). Our experience taught us there was still a lot more to learn about the rich Rincon flora, especially if we strategically explored promising habitats. In 2021, a limited continuation of rare plant surveys, plus opportunistic collecting during a wet summer, yielded 16 additional native species for the park's Rincon district flora (some were already known just outside the park). Notably, some of these were first documented by visitors and park neighbors via iNaturalist and Facebook.

Documenting rare species is particularly urgent given the current realities of climate change. Isolated mountaintop species often have nowhere to go if local conditions become unsuitable. This is especially relevant for many of the plants we are documenting which rely on cool, wet microhabitats within a predominantly hot, dry landscape that is trending further in that direction. High intensity "megafires" are also becoming more common in the region, accelerating habitat loss for rare species. The current situation means we run the real risk of losing species in the park before we ever knew they existed.

Our goals for 2022 were to greatly expand our survey coverage while applying lessons learned from the previous 5 years of field work. Expanded coverage was achieved largely through backpacking trips, targeting areas of likely interest that are far from trails and difficult to access in a day. The other major strategy was to harness the power of citizen science, volunteers, and new digital platforms. In addition to crowdsourcing additional plant data, this strategy aligned with WNPA's emphasis on community-centered science that is accessible and relevant to the public.

Methods

Park surveys

Since the previous 5 years of surveying had heavily focused on high elevation areas of Mica Mountain (accessible in a day from Manning Cabin), we shifted our sights to other portions of the Rincon Mountain District. In choosing priority locations, we first looked at distribution maps of all previous plant collections to identify obvious gaps of past survey coverage. Unsurprisingly, these gaps were found in large off-trail areas far from trailheads or campgrounds. The Rincons are notably a roadless wilderness, meaning all journeys up the mountain must be made on foot. We further prioritized by considering factors including watershed size, aspect, local biogeography, and plant communities. To inform these considerations, we consulted sources like aerial imagery and a detailed vegetation communities map produced by our research partners at the NPS Sonoran Desert Inventory and Monitoring Network (Galvin & Studd 2021). We outlined and ranked 5 key priority areas, with the 3 highest-rated being the north, east, and west sides of Rincon Peak. Rincon Peak is the 2nd-tallest peak in the Rincons, slightly shorter than Mica Mountain, but with generally steeper terrain and only a single trail on its north side. The

lower-rated priority areas were survey gaps on the north and east sides of Mica Mountain where high water availability and soil richness could be expected. From these outlined priorities we developed a rough calendar of survey trips, subject to change depending on what we found in early season surveys.

Given the remote and rugged nature of these priority areas, backpacking trips were our best option for achieving a decent inventory of local plants. We conducted 7 trips during the active survey season (April – October), averaging 2 to 3 nights per trip. In between trips, we added to our survey coverage, conducting about 10 day-surveys into promising but more easily accessed areas, typically low elevation canyons. The backpacking trips followed a standard format of hiking in and establishing a base camp on the first day, aiming for a location that would centrally locate us among multiple promising survey routes. That set us up for (typically) two full survey days covering as much ground as possible in the local area, without having to worry about an approach hike or a particularly heavy pack. The park botanist was accompanied by at least one co-surveyor on each trip, including “Next Gen Ranger” interns, park employees, and volunteers. Obviously, crew selection was critical for these trips, as challenging days required strong physical fitness, off-trail hiking skills, and enthusiasm for the project. We did adjust our initial schedule as we learned more – a June trip revealed the east side of Rincon Peak to be an especially rich area of unique diversity, so we returned there twice in the summer.

Surveys typically followed canyons and waterways, as these tend to be corridors where rare plants are concentrated. However, ridge lines and slopes were used as approach or return routes and were often sites of opportunistic findings. During surveys, plants were extensively photographed, especially any that were uncommon, flowering, or of uncertain identification. Plants were collected at the botanist’s discretion, especially anything known to be significant for the park (a first record, range extension, etc.) or likely unidentifiable from photos alone (i.e. many grasses, sedges, etc.). Rare plants with very small local populations were only photographed to ensure sensitive populations were not harmed. All photos were georeferenced with location data. All collections (and photo sets taken instead of a collection) included field notes that covered habitat description, associated plant species, population size, and local abundance.

In addition to backpacking trips and day surveys, we took advantage of opportunities for casual plant surveying in the course of other Resource Management work, most successfully during biannual leopard frog monitoring surveys. By simply bringing a plant press and camera along, we were able to document additional new plant species outside of official surveys.

Community science

We encouraged visitors to submit their own observations of plants in the Rincons through an iNaturalist project called [“Plants of the Saguaro NP High Country”](#). iNaturalist is a free digital platform through which anybody can post georeferenced photos of living things and get them identified by amateur and expert naturalists. We publicized the project by directly tagging active local iNaturalist users, pitching it in multiple park social media posts, adding a blurb to our online campground reservation portal, and mentioning it in our interview with a local journalist.

Data management

Time was taken in between trips to upload photo observations onto iNaturalist, input collections data into the SEINet database, and identify unknown specimens. For many specimens, workdays at the University of Arizona Herbarium were essential for confirming IDs or at least arriving at probable IDs. Visiting researchers have access to a vast library of reference collections, often identified by leading experts. These reference collections expedite stronger IDs, especially when consulted alongside written descriptions and dichotomous keys. Collections from this project were donated to the UA Herbarium as permanent scientific records if they were of sufficient quality or local/national significance. For each collection, associated data from SEINet was copied onto a physical collection label and also duplicated for the University of Arizona's digital database. At the end of the season, the project lead also preserved data in the park's internal database, digitizing survey routes and copying over rare plant waypoints.

Results

Through collections and photo-vouchered records, we formally documented 22 new native plant species and one new hybrid for the flora of the park's Rincon Mountain District. This is the most species we have added to the Rincon district flora in a single year since our division resumed intensive rare plant surveying in 2017. Four of these (plus the hybrid) were follow-ups on plants that had been informally reported or documented by visitors, volunteers, or staff in recent years. The other 18 species had never previously been reported for the Rincon Mountain District. Many of these species are globally or nationally rare. Five of them appear to be first records for Pima County: Pringle's fleabane (*Erigeron pringlei*), Santa Rita ticktrefoil (*Desmodium retinens*), Aztec dodder (*Cuscuta azteca*), Southwestern bushy blustem (*Andropogon eremicus*), and Arizona lipfern (*Gaga arizonica*). For a detailed breakdown of the 23 new native taxa documented during the project, see Appendix.



Arizona lipfern (Gaga arizonica)
Photo by Keeley Lyons-Letts.

Though not a new species for the Rincon district flora, red willow (*Salix bonplandiana*) was a meaningful revisit from this study. First collected in a branch of Rincon Creek in 1978 (Turner 78-112), it had not been recorded in the Rincons since, so we thought it was worth looking for the single known population. Luckily, the historical record included a note about it occurring behind a cement dam. With help from our park archaeologist, we were able to locate the dam, and confirm that the same tree persists in that spot. Though showing signs of drought stress, the multi-trunked tree is still very much alive. This is a plant the park should periodically monitor as climate change continues to challenge rare water-dependent species. That single tree remains the only red willow we know of in the Rincons.

Discussion

Our productive 2022 survey season underscores the value of strategically exploring “the road less traveled” in search of rare biodiversity, especially considering threats posed by climate change. A shift in focus towards remote backpacking trips allowed us to expand our reach into under-explored habitats. This project documented a hidden biodiversity hotspot on the east face of Rincon Peak, where high cliffs and dense Arizona cypress forests (an imperiled Ice Age relict forest type) create unique local habitat conditions. The upper reaches of this remote and rugged area had never been thoroughly surveyed by the park, and our 2022 results (6 new park species including the rare Arizona lipfern and Pringle’s fleabane) indicate this is an area of exceptional diversity that should be prioritized for future surveying, monitoring, and fire planning. A return visit in spring 2023 already yielded another major plant finding: Virginia dwarf dandelion (*Krigia virginica*), a first record for the western U.S.

A secondary biodiversity hotspot was found in an upper branch of Rincon Creek. Multiple rare riparian species were found in this canyon, including red willow and Southwestern bushy bluestem, a seep-dependent large perennial grass. Both species are currently known nowhere else in the Rincons. This is another area that should be prioritized for future monitoring, surveying, fire planning, and invasive species management.



A volunteer botanist investigates a spring on the east side of Mica Mountain. April 2022.

In addition to expanded survey coverage, a wet summer greatly aided our efforts. Though rainfall patterns were not consistent across the Tucson area, the Rincons received above-average monsoon rainfall which was quite evident during surveys. A high percentage of local plants, especially those of Madrean and subtropical origin, bloom in the summer, taking cues from monsoon storms. Wet summers are great opportunities to survey and document biodiversity that may be much rarer or not even present in dry years. A perfect example from this project was the rare subtropical annual “romero macho” (*Pectis linifolia*), found in October.

The emphasis on citizen science and volunteers certainly paid dividends, and we hope to continue and build upon this aspect of the project. One of the new species findings, Carolina vervain (*Verbena carolina*) was independently documented by a highly skilled volunteer botanist who we first met through iNaturalist. He now conducts his own rare plant surveys in

addition to joining some of ours. Other findings in the Appendix were originally observed by visitors on iNaturalist, meaning we simply needed to follow up and formally voucher the plant.

Interpretation, Education, Outreach, and Media

Our major outreach goals were to: 1) increase awareness and appreciation of the park’s lesser-known mountain plants, and 2) inspire visitors and local naturalists to help us document plant diversity through iNaturalist.



Parry's agave (Agave parryi)
First record in Saguaro National Park, September 2022

We published 10 traditional social media posts to the park’s Facebook and Instagram pages, aimed at reaching one or both of these goals through a captivating hook. Perhaps the most popular post (Fig. 1) told an inspiring story about a park neighbor who in 2021 snapped a photo of a mysterious vine and posted it to a local native plants Facebook group – it turned out to be the rare Tumamoc globeberry, a first record for the park’s Rincon district and an eastern range extension for the species. Other popular posts celebrated the Arizona lipfern finding, an exciting Agave finding, and the park’s surprising orchid diversity. Additionally, we collaborated with one of the park’s proven social media stars, “Ranger Freddy” Fernandez-Ramirez. We coordinated with our park Interpretation team for a joint trip to our high elevation workstation at Manning Cabin. Freddy filmed content with our crew that connected digital visitors to an area of the park that few visitors see for themselves. From that footage, the Interpretation team produced four popular videos,

including spotlights on high elevation plants. The project was also featured in a June 2022 Arizona Daily Star article (Chojnacky 2022, Fig. 2) that told the story of recent rare plant surveying in the park and invited readers to get involved through iNaturalist.

We also worked with Interpretation to launch the ongoing “Art in the Park” series, a monthly event inviting the public to make art around a park topic or interpretive theme. The inaugural

event, borne out of a brainstorming session for this project, featured watercolors and was called “Painting the Plants of the Rincons”.

For interpretive products, we commissioned two artists in our division to design stickers and a poster on the theme of mountain wildflowers. These stickers have already been produced and distributed at volunteer/outreach events, featuring watercolor portraits of 4 wildflower species. The poster, entitled “The Secret Gardens of the Rincons” (Fig. 3), includes watercolors, digital illustrations, and a quote from local botanist Janice Bowers, who co-authored the 1987 Rincon flora. We printed a prototype in-house and expect to print final versions for distribution in the next couple months.

Two publications directly inspired by this project are forthcoming. A short manuscript detailing the Arizona lipfern finding and its significance will appear in the peer-reviewed western botanical journal *Madroño* (Beckman 2024, in press). An article on best practices for using citizen science in parks, incorporating lessons from this project along with examples from across the country, will appear in the NPS magazine *Park Science* (Swann 2023, in press).

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Literature Cited

Beckman, D.C. 2024. Noteworthy Collection: *Gaga arizonica*. *Madroño* 70(3). *In press*.

Beckman, D.C., and D.E. Swann. 2021. Results of Surveys for Potentially Extirpated Plants in High Elevations of the Rincon Mountain District, Saguaro National Park, 2017-2020. *Desert Plants* 37(1):1-36.

Bowers, J.E., and S.P. McLaughlin. 1987. Flora and vegetation of the Rincon Mountains, Pima County, Arizona. *Desert Plants* 8(2):51-95.

Chojnacky, Cindy. “‘Lost Plants’ Found in Saguaro National Park.” *Arizona Daily Star*. 6 June 2022.

Galvin J. and Studd S. 2021. Vegetation inventory, mapping and characterization re-port, Saguaro National Park: Volume I, main report. Natural Resource Report. NPS/SODN/NRR—2021/2233. National Park Service. Fort Collins, Colorado. <https://doi.org/10.36967/nrr-2284709>

Swann, Don. “The Devoted People Behind Big Data in National Parks.” *Park Science*. Winter 2023. Forthcoming.

Figures



Figure 1: Instagram post about citizen science and rare plants (February 2022)

TOP STORY

'Lost plants' found in Tucson's Saguaro National Park

Cindy Coffey Chojnacky Special to the Arizona Daily Star Jun 6, 2022 Updated Jul 10, 2023



Surveyors sometimes crawl up steep brushy canyons or dig into lush vegetation on the hunt for montane or rare plants.
photos Courtesy National Park Service

Figure 2: Arizona Daily Star feature (June 2022)



Figure 3: Rincon Mountain wildflowers interpretive poster. Watercolors by Celeste Browne, other artwork and poster design by Keeley Lyons-Letts.

Appendix: Additions to the Rincon Mountain District Flora (2022)

- Organized alphabetically by family name (scientific)
- Voucher records available on SEINet; linked to “Saguaro National Park – Rincon Mountain District” checklist (<https://swbiodiversity.org/seinet/checklists/checklist.php?clid=2537>)

Species format:

Scientific name (common name)

- Habitat of 2022 finding(s). Month of finding. Context of finding. (Voucher number)
- Additional notes on rarity or special context. NatureServe conservation status if available and ranked in a threatened category.

APOCYNACEAE – Dogbane Family

***Apocynum x floribundum* (intermediate dogbane)**

- Mid elevation spring along creek bank. May. Backpacking survey. (Beckman 249)
- Hybrid taxon formed by *A. androsaemifolium* and *A. cannabinum*. Follow-up on previous photo observation. Taxon expert consulted for ID assistance. Reported for the Rincons by Bowers & McLaughlin (1987) but later retracted (Fishbein & Bowers 1996).

***Asclepias lemmonii* (Lemmon’s milkweed)**

- Rocky creek bank in oak woodland. Opportunistic finding. (Beckman 2022-10-26)
- Nationally rare Madrean species - known in 5 other U.S. mountain ranges, all in southern AZ. Photo voucher only (small population). Additional plants found nearby in 2023. NatureServe: imperiled nationally (N2).

ASPARAGACEAE – Asparagus Family

***Agave parryi* (Parry’s agave)**

- High elevation slope in pinyon-oak woodland. September. Backpacking survey. (Beckman & Gonzalez 313)

ASTERACEAE – Sunflower Family

***Erigeron pringlei* (Pringle’s fleabane)**

- Cliffs and outcrops in high elevation forest/woodland. June & September. Backpacking surveys. (Beckman 305)
- First record for Pima County. Endemic to Arizona. NatureServe: imperiled globally (G2).

***Pectis linifolia* (romero macho)**

- Open gravelly desert bajada. October. Opportunistic finding. (Beckman 321)
- NatureServe: vulnerable to critically imperiled nationally (N1N3)

***Pseudognaphalium arizonicum* (Arizona cudweed)**

- Burned clearing in pine forest. June & September. High elevation work trips. (Bromley 1)
- NatureServe: vulnerable globally (G3)

CONVOLVULACEAE – Morning Glory Family

***Cuscuta azteca* (Aztec dodder)**

- Ridgetop in oak grassland. October. Opportunistic finding. (Beckman 2022-10-28)
- Tentative ID but appears to be this species or a different undescribed species based on correspondence with taxon expert. Apparent first record for Pima County. Photo voucher only (small population).

CYPERACEAE – Sedge Family

***Carex praegracilis* (field sedge)**

- Spring channel in juniper-oak-manzanita woodland. April. Day survey. (Beckman 217)
- Tentative ID, planning to revisit and recollect on future survey

FABACEAE – Legume Family

***Desmodium retinens* (Santa Rita ticktrefoil)**

- Cypress-pinyon forest. September. Backpacking survey. (Beckman 309)
- Apparent first record for Pima County (previous ones based on misidentifications). Nationally rare Madrean species known in a handful of U.S. sky island ranges, all in southern AZ

LAMIACEAE – Mint Family

***Hedeoma oblongifolia* (Oblong-leaf false pennyroyal)**

- Rocky slope in oak grassland. October. Opportunistic finding. (Beckman 323)
- NatureServe: vulnerable globally (G3)

***Teucrium cubense* (coastal germander)**

- Shaded low spot in desert bajada. March. Opportunistic finding. (Beckman 211)
- Follow-up on sightings by park visitors (iNaturalist) and former park employee (personal comm.); first formal voucher

LYTHRACEAE – Loosestrife Family

***Lythrum californicum* (California loosestrife)**

- Wet rock crevices in mid elevation bedrock canyon. June. Backpacking survey. (Beckman 266)

NYCTAGINACEAE – Four O’Clock Family

***Mirabilis laevis* var. *villosa* (wishbone bush)**

- Banks of south facing bedrock canyon. December. Day survey. (Beckman 340, 342)

OLEACEAE – Olive Family

***Forestiera pubescens* (New Mexico olive; stretchberry)**

- High walled mid elevation canyon. August. Backpacking survey. (Beckman 293)

POACEAE – Grass Family

***Andropogon eremicus* (Southwestern bushy bluestem)**

- Seeping fractures in bedrock canyon wall. November. Day survey. (Beckman 333)
- First record for Pima County. Rare species dependent on perennial seeps and springs. NatureServe: vulnerable globally (G3).

***Digitaria insularis* (sourgrass)**

- South facing bank of open bedrock canyon. November. Day survey. (Beckman 332)
- Previously observed on iNaturalist by park visitor and volunteer in a different area (around large outcrop in desert scrub)

***Muhlenbergia polycaulis* (cliff muhly)**

- Wet bedrock fracture in mid elevation canyon. December. Day survey. (Beckman 345)

***Tridens eragrostoides* (lovegrass tridens)**

- Deep shade of mesquite on gentle desert slope. October. Opportunistic finding. (Beckman 325)

PTERIDACEAE – Maidenhair Fern Family

***Gaga arizonica* (Arizona lipfern)**

- High elevation ravines, shaded by cliffs. September. Backpacking surveys. (Beckman 302)
- Northern range extension (ca. 40 km). First record for Pima County. Nationally rare Madrean species – known in 4 other U.S. sky island mountain ranges, all further south in AZ. NatureServe: imperiled nationally (N2).

SOLANACEAE – Nightshade Family

***Calibrachoa parviflora* (seaside petunia)**

- Low elevation damp sandy creek margin. April. Opportunistic finding. (Beckman 223)
- Previously observed nearby by park visitor and volunteer (iNaturalist)

VERBENACEAE – Verbena Family

***Verbena carolina* (Carolina vervain)**

- Pine oak forest. September. Volunteer backpacking survey. (Ward 91)

***Verbena plicata* (fanleaf vervain)**

- Disturbed mesquite flat above creek. April. Opportunistic finding. (Beckman 225)
- Follow up on previous sighting by park employee

WOODSIACEAE – Cliff Fern Family

***Woodsia plummerae* (Plummer's cliff fern)**

- Wet rock crevice in steep high elevation ravine. September. Backpacking survey. (Beckman 312)
- Reported by Bowers & McLaughlin (1987), but follow-up research determined these collections to be the similar *W. cochisensis*.