

Results of Surveys for Potentially Extirpated Plants in High Elevations of the Rincon Mountain District, Saguaro National Park, 2017

Dan Beckman

Next Generation Ranger Intern, Saguaro National Park

December 2017



Abstract

In their flora of the Rincon Mountains, Bowers and McLaughlin (1987) included a list of 41 “excluded species” that had previously been documented in this northern Sky Island mountain range but were not encountered during their extensive field work from 1978-1984. This potentially significant loss of plant species in a protected wilderness area was of concern to Saguaro National Park biologists, so in 2014 the park began a follow-up project to revisit the list, determine which species were still unaccounted for, and plan a field survey to look for them. After removing non-native species and accounting for taxonomic changes, misidentification of specimens, and plants encountered since 1980, we narrowed the list to 16 “potentially extirpated” species. In the summer of 2017, we searched for plants that were expected to occur above 6,500 feet in elevation. Through targeted surveys mostly in the vicinity of Mica Mountain, we rediscovered six of the target species, found eight species not previously confirmed in the Rincons, and documented other rare high elevation plants of scientific and conservation interest. In addition, we documented locations and relative abundance of rare plants in the high country of the Rincons so that the park can begin long-term monitoring of these sensitive species. Results of this study suggest that the plant community at high elevations is more stable than previously thought, and provide hope that the remaining lost plants may also be re-discovered with continuing effort.



East Slope and Rincon Peak from Reef Rock (yellow patch is Spud Rock aspen grove) - Photo: Keenan Duncan

Introduction

The Rincon Mountains, like other “Sky Island” mountain ranges in southeastern Arizona, southwestern New Mexico, and Sonora, Mexico, are incredibly rich in plant life: more than

1100 species (not including subspecies and varieties) have been recorded in the Rincon Mountain District of Saguaro National Park alone (SEINet). The park as a whole (including the Tucson Mountain District) is one of the more botanically rich national park units in the United States, despite being much smaller than other parks with comparable or greater species richness (NPSpecies: <https://irma.nps.gov/NPSpecies>). Rising from the Sonoran Desert all the way up to mixed-conifer forests at the mountain tops, the Rincons contain a diverse array of plant communities including riparian woodlands, desert grasslands, oak woodlands, pine forests, and montane meadows. The mountains' large elevation range partially explains its great plant diversity, with another key factor being its geographical placement at the crossroads of many floristic influences, including the Rocky Mountains to the north and the Sierra Madre Occidental to the South.

The Rincon Mountains, which became part of Coronado National Forest in the early 1900s, then Saguaro National Monument in 1933 (and promoted to national park status by Congress in 1994), received a fair amount of attention from botanists in the late 19th and early 20th centuries. Pioneering figures including Cyrus Pringle, Jacob Blumer, John Thornber, and Leslie Goodding made arduous excursions into the mountains to collect and preserve voucher specimens that today serve as evidence for the presence of these species in Saguaro National Park. From 1978 to 1984, Carol E. Jenkins, Janice Bowers, and Steven McLaughlin undertook the ambitious task of completing the first flora of the Rincon Mountains with the goal of collecting and documenting every plant that occurred in the range. They published their results, which included 945 species, in the botanical journal *Desert Plants* (Bowers and McLaughlin 1987) and the project lead, Bowers, went on to write eloquently about her experiences in the Rincons in a collection of personal essays called *The Mountains Next Door* (Bowers 1991).

In their *Desert Plants* article, Bowers and McLaughlin listed 41 plant species previously known to the Rincons that they were not able to re-locate. Of these 41 species, 22 had been collected during the pioneering turn-of-the-century period, but not documented since. Of this group the authors highlighted 6 species, all classified as "moisture-loving, cold-tolerant plants", which they specifically searched for but could not find. They believed that these 6 species might be extirpated (locally extinct) and hypothesized several explanations, including climate change and habitat disturbance (from fire or development).

The extirpation of species from protected natural areas, and especially national parks that have the highest level of protection, has long been a major concern in conservation biology. In a controversial paper about U.S. national parks, Newmark (1995) provided evidence that many western parks have lost native mammals since they were established, and a series of papers have addressed similar evidence in national parks in Canada (e.g., Rivard et al. 2000). Nevertheless, studies of extirpation are complicated because while it is easy to document the *presence* of a species through a voucher specimen or photograph, it is much more difficult (and theoretically impossible) to document the *absence* of a species. In addition, historic voucher specimens may have been misidentified or mislabeled, or taxonomic changes may have created a species "loss" when all that really changed was a name. Therefore, while the potential loss of

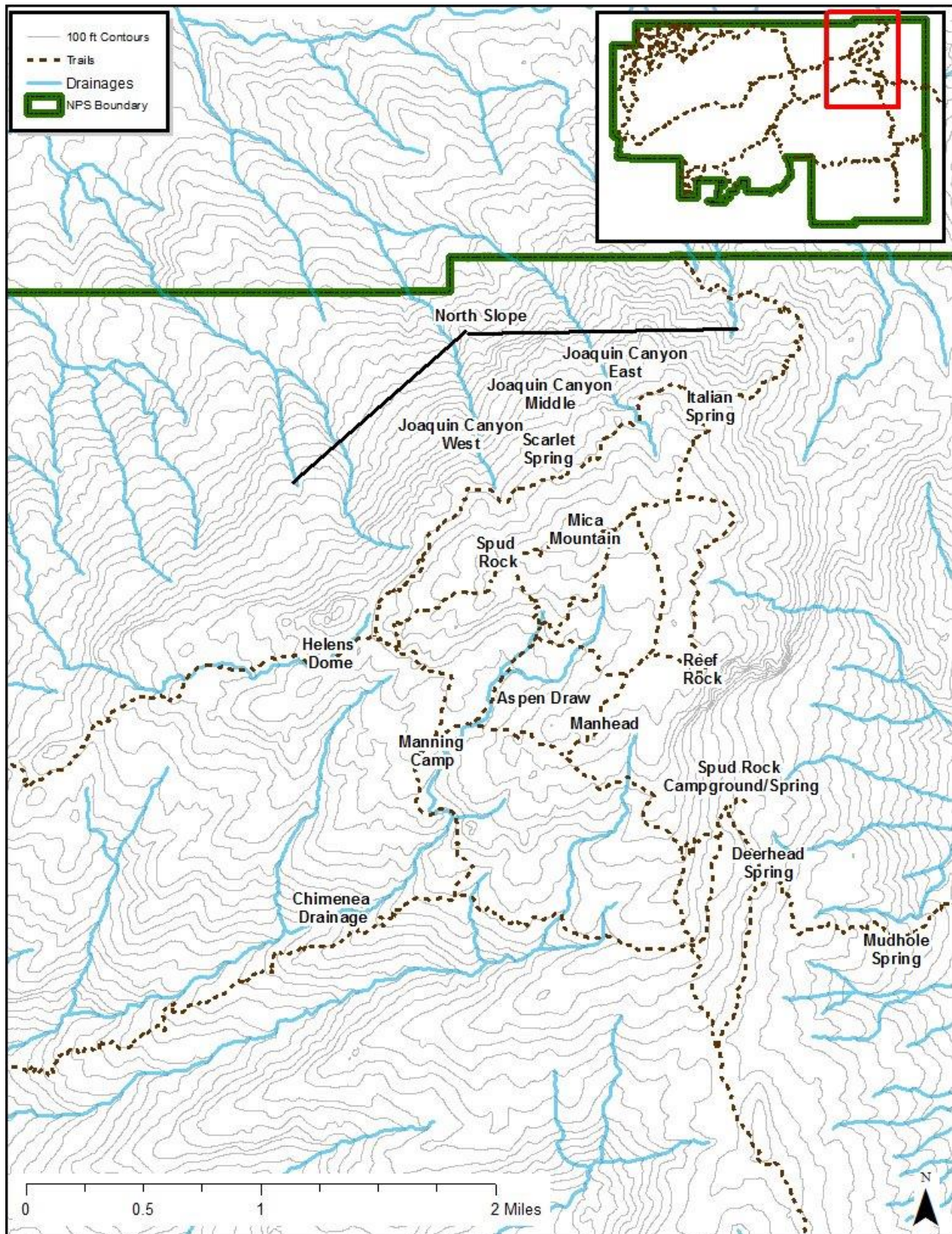
multiple plants species from Saguaro National Park, which is 78% designated Wilderness, was of great concern to the park, biologists felt that more information was needed.

The goal of this study was to create an updated and a definitive list of “lost” or potentially extirpated species, including a more thorough examination of results since 1980, and then follow up with targeted field searches of specific species in appropriate habitat. Although this study is on-going, here we report the results of our first comprehensive field effort with a focus on high elevations in the northern part of the Rincons near Mica Mountain during summer 2017.

Methods

The first step of this project was to sift through the Bowers and McLaughlin list of 41 species and see if each one should still be considered as potentially extirpated from the Rincons. For this undertaking, we assembled a team of people to search collection records, check taxonomic changes, and compare notes with other botanists who had worked in the Rincons. For a species to make the list it needed to have been collected in the Rincons before 1980 (pre-dating the Bowers and McLaughlin flora project) and not collected or documented in the range since. In addition, we excluded several non-native species on the Bowers and McLaughlin list because we did not feel they were relevant for assessing native biodiversity. To confirm that a species had not been documented since its original collection, we consulted a variety of sources, including the University of Arizona herbarium, the SEINet online floral database (which includes collection records from herbaria across the country), a USGS report on plant inventories at Saguaro National Park conducted in the early 2000s (Powell et al. 2006), and records from the NPS Sonoran Desert Inventory & Monitoring Network. We also relied heavily on records by Dr. Steve Buckley, an expert NPS botanist who spent significant time in the Rincons as part of the Sonoran Desert Network monitoring crew. Steve also helped us sort through the confusing and ever-changing topic of plant taxonomy. With new research constantly re-classifying and renaming species, it can be quite difficult to track a single species through time. Open-access taxonomic authorities like ITIS (Integrated Taxonomic Information System) and the Tropicos botanical database were also invaluable in addressing these issues.

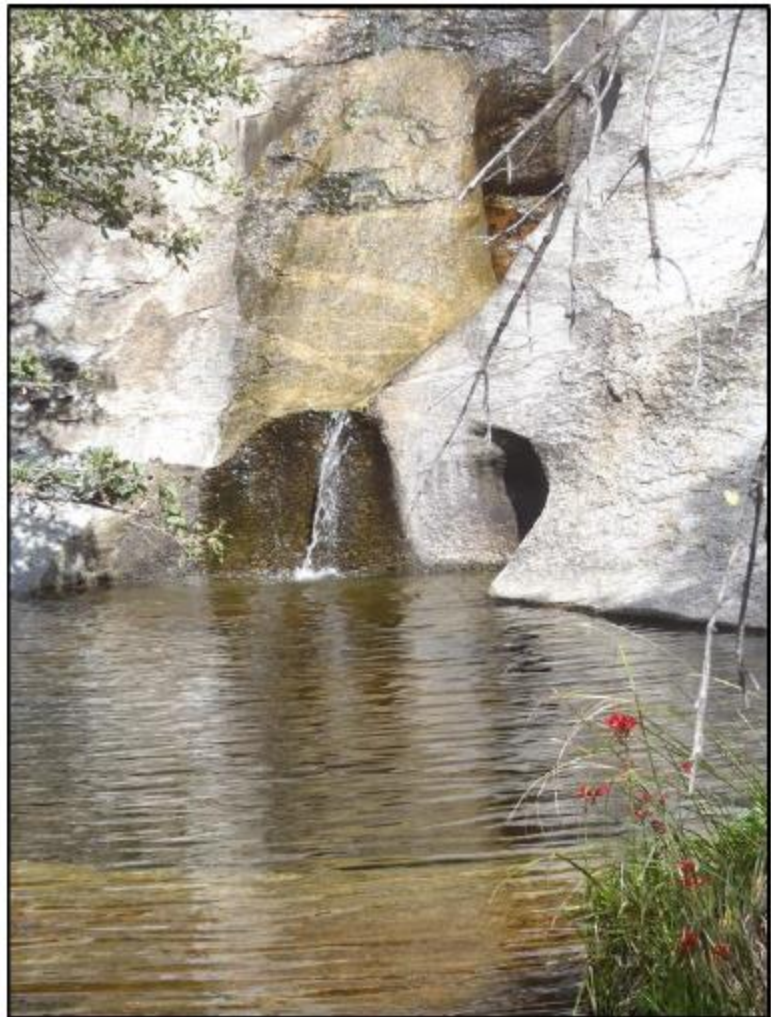
After removing non-native species and species that had already been documented in recent years, we were left with a target list of 16 potentially extirpated species (see Appendix A for an annotated and updated version of the Bowers and McLaughlin list). Park biologist Don Swann had already planned for Resource Management crews to conduct extensive surveys of the Rincon high country in the summer of 2017, so it made sense to start with surveys for high elevation species. This also aligned nicely with Bowers and McLaughlin (1987), who had been puzzled by their inability to find those six particular “moisture-loving, cold-tolerant” plants that had once been collected at the top of the mountain. Three of these six high-elevation targets remained on our list: mountain alder (*Alnus incana* subsp. *tenuifolia*), red osier dogwood (*Cornus sericea* subsp. *sericea*), and Thurber’s bog orchid (*Platanthera limosa*). In total, 13 of



Location Map: Mica Mountain vicinity

our 16 targets could plausibly be considered high elevation species, though some of these are more mid-elevation plants that can range into higher elevations. To prepare for our summer plant surveys, we made identification materials for each target species. We created double-sided laminated note cards that included photos showcasing key identifying features, descriptions of these features in plain language (avoiding botanical jargon), as well as a full technical botanical description. Resource Management crews kept these identification guides on hand while conducting general transects, water surveys, archaeological assessments, and other high elevation work. This proved to be extremely worthwhile, as many of our most exciting plant discoveries were made by non-experts and occurred when we were not specifically searching for rare plants. We also shared our target list and identification materials with partners from the Sonoran Desert Network. They were collecting their own plant data in the Rincons this summer, mapping vegetation communities and monitoring springs. Again, this collaboration proved fruitful, as their vegetation mapping crew found one of our target species.

When it came time to search for our target plants, we used habitat descriptions and historical collection information to choose suitable survey areas. Most of our target species had not been documented since that late 19th - early 20th century collecting boom. These historical collections typically provided a vague location at best, like “Manning Camp, gravelly knoll” or “Spud Ranch, rocky east slope”. At worst, they said nothing more than “Rincon Mountains”. In these cases, we consulted field guides for a given species’ preferred habitat(s) and started surveying locations on the mountain that fit these descriptions. We mostly hiked drainages, conducting linear surveys well-suited to two-person teams. With water so often being a limiting factor for rare species in this dry environment, drainages usually seemed like the most promising places to look for multiple target species at once. When searching for species that fit that Bowers and McLaughlin description of “moisture-loving, cold-tolerant plants” living at the extremes of park habitat, we specifically focused on areas with



Pool in Chimenea Canyon – Photo: Dan Beckman

perennial or nearly-perennial water (our concurrent water surveys were helpful here) and shady north-facing sites (where snow might linger and moisten the soil). Our base of operations this summer was Manning Camp, a present-day campground and historic cabin located at 8,000 feet near the top of Mica Mountain. This was a convenient base for multiple reasons. The Manning Camp vicinity received plenty of attention from turn-of-the-century botanists, so we were able to follow up on many old collections close to camp. It also put us within striking distance of unique high elevation habitats like the North Slope (full of cool shady microhabitats and mixed conifer forests) and Spud Rock Spring (a former ranch site where many of our target species were once collected).

We traveled with a lightweight field plant press so we could make collections when we found a target species or something close enough that it merited a second opinion. We also periodically collected other plants of interest – plants with very localized populations or species of conservation concern – as a way of documenting their continued presence in the range. Along the way, we were fortunate to also identify some new species to the park, and we made voucher collections of these species when appropriate.

When looking to make a collection, we operated from a general ethical principle of not collecting from any population so limited that the collection might have a significant impact on that population's future. For shrubs and trees, it was easier to justify collections because we could usually take a single leafy branch and a single flower or fruit cluster without significantly altering the individual plant. For small single-stemmed herbaceous plants, it was trickier because a legitimate collection required taking an entire plant. In certain cases, our choice was made easier by finding a plant that was unlikely to survive: we collected one that had already been trampled and another growing directly in a trail corridor. In other cases, we had to make a judgment call. We settled on a rough guideline of not collecting an entire plant unless we had encountered at least twenty plants of that species. For smaller populations, we submitted a photo voucher as a reasonable alternative, including all the detailed notes that would accompany a physical collection.

Plant collections were taken to the University of Arizona Herbarium. If there was any doubt on an identification, herbarium staff took a close look at the specimen and consulted botanical keys to confirm. These collections will remain in the Herbarium (with both UA and NPS specimen labels) as permanent records of these species' presence in the Rincon Mountains. Each collection record is also publicly accessible on the SEINet online floral database (swbiodiversity.org), complete with a photo of the collection and all the accompanying location and habitat information. The photo-vouchered records are also available on SEINet.

Results: Rediscovered species

We were able to locate six of the “lost” target species, which reduced the Saguaro National Park “potentially extirpated” list down to ten species. The following is a brief discussion of each rediscovery, in chronological order:

***Rhus glabra* (smooth sumac)**

Rhus glabra is a thicket-forming deciduous shrub or small tree with dark green divided leaves. It is a common and recognizable species throughout much of North America, though evidently less common in this region. This is likely due to its preference for rich soils, a rarity in this dry landscape. Its historical presence in the Rincons was based on a citation by Jacob Blumer from 1910. Blumer was one of the turn-of-the-century botanists who collected extensively in the Rincons and other southeastern Arizona ranges. Jeff Galvin, crew lead for the Sonoran Desert Network vegetation mapping crew, noticed it within a surprising hillside box elder thicket on the Rincons' East Slope in March 2017. Box elder (*Acer negundo*) typically only occurs in the park's riparian corridors, so this particular slope must be unusually wet, perhaps indicating some hydrological dynamics worthy of further study. Our crew followed up on this finding in July, locating a second population at the bottom of the closest drainage and making a collection from the first population. This appears to be the first-ever collection of *Rhus glabra* in the Rincons.



Smooth sumac leaves and old flower cluster – Photo: Dan Beckman

***Cornus sericea* subsp. *sericea* (red osier dogwood) and *Alnus incana* subsp. *tenuifolia* (mountain alder)**

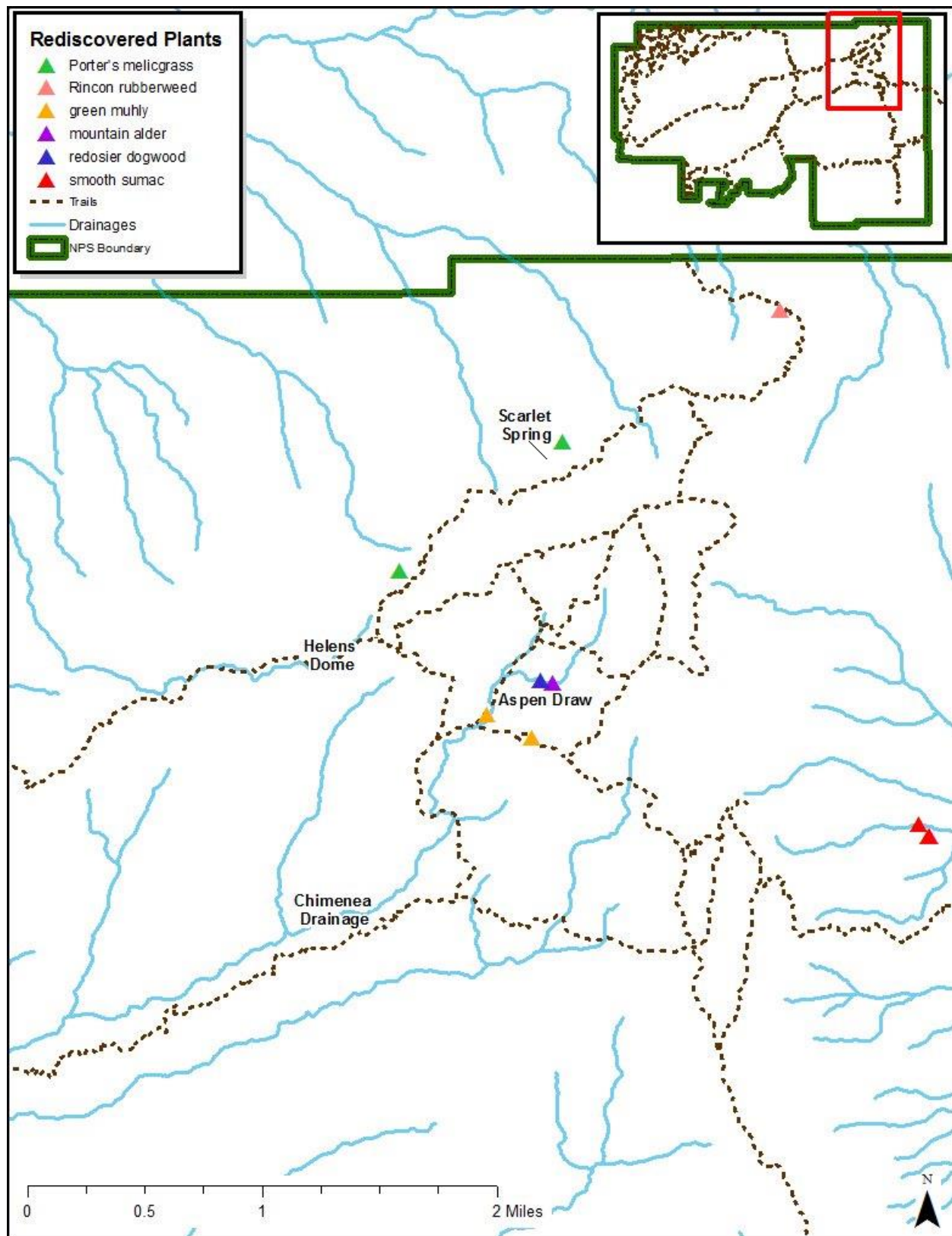
Our crew's first plant rediscoveries of the season turned out to be two of the "moisture-loving, cold-tolerant" species for which Bowers and McLaughlin had mourned a likely disappearance: red osier dogwood (*Cornus sericea* ssp. *sericea*) and mountain alder (*Alnus incana* ssp. *tenuifolia*). These species were found in close proximity to each other in a shaded tributary to Chimenea Canyon, half a mile above Manning Camp and bordered by an aspen grove. We will refer to this spot as "Aspen Draw" for short in the remainder of this report. Our crew was drawn to this perennially wet area as part of our water monitoring efforts. It is not surprising that this well-shaded spot with spring-fed pools serves as a perfect refuge for some of the park's rare high-elevation species. During a later re-visit, we also spotted red baneberry (*Actaea rubra*), a new species for the Rincons that was found at only one other high-elevation spring. Red osier dogwood is a shrub that spreads and forms thickets along creek banks and bottoms by sending out stolons (aboveground stems running parallel to the ground). Though our population is very localized, it does dominate a brief stretch of the tributary in this typical fashion. It was stunning and unmistakable when our crew noticed it in early June, with strikingly dark-green opposite leaves and dense clusters of white flowers. Just upstream of the dogwood



population, around the spring-fed pools we were monitoring, one crew member was struck by how the alders looked slightly different than our common Arizona alder (*Alnus oblongifolia*). A closer inspection using a botanical key and field guide descriptions led us to believe that this was indeed our target alder species. Some of the differentiating characteristics we observed were a shrubbier, sprawling growth form and larger leaves with coarser teeth along the margins. We collected both species and got a confirmation of our alder identification at the herbarium. Both of these species had last been documented in the park by Blumer in 1909, with all collections referencing some proximity to Manning Camp. It was incredible to realize we were following in his footsteps over a hundred years later, looking at the same rare species in at least the same general area. This lovely stretch of riparian habitat appears to be truly special: we did not locate these species anywhere else.

Top: Red osier dogwood in bloom – Photo: Drew Jackson

Bottom: Mountain alder leaves – Photo: Don Swann



Rediscovered Species Locations Summer 2017

***Melica porteri* (Porter's melicgrass)**

Helen's Dome is a towering rock outcrop on the Rincons' North Slope, the most visible feature on Mica Mountain from the city of Tucson. It casts a long shadow on the mixed-conifer slope below it, creating a unique cool and sheltered habitat. In *The Mountains Next Door*, Bowers describes how she finally spotted two of her most elusive plant finds in this exact area: "No doubt snow lingers on the deeply shaded slopes below Helen's Dome after it has melted elsewhere. This probably helps to keep the soil moist through the dry, hot months before the summer rains start. If not for Helen's Dome, Rocky Mountain maple [*Acer glabrum*] and shield fern [*Dryopteris filix-mas*] might well be extinct in the Rincon Mountains" (pg. 51). This selection from Bowers inspired us to check back on those isolated maple and fern populations (we re-located both) during a late July trip, but we also knew to be on the lookout for *Melica porteri*, one of our target grass species said to grow in "moist, open woods." To our surprise and delight, we found it growing in abundance on that deeply shaded slope, with thousands of plants clearly enjoying the extra soil moisture (aided no doubt by the record-breaking July precipitation). In full bloom, it stood out with its purple-tinged spikelets (the flowering structures of grass) dangling gracefully from the rachis (flowering stalk). Once again, it had last been documented in the Rincons by Blumer in 1909, though he collected it from north-facing rock shelves around Spud Ranch (now known as Spud Rock Campground). Though we did not find it growing in this kind of abundance anywhere else, we did see small populations in a couple other similar sites on the North Slope, in drainages with good canopy cover and boulders or cliff faces to offer additional shade.



Melica porteri flowering on slope beneath Helen's Dome – Photo: Tony Palmer

***Hymenoxys quinquesquamata* (Rincon rubberweed)**

Hymenoxys quinquesquamata is a rare perennial in the sunflower family known only to Arizona and possibly New Mexico. The only place it has been repeatedly and widely documented is the Huachuca Mountains southeast of Tucson near the Mexico border. It has been collected a few times in the Santa Catalina Mountains (close neighbor to the Rincons), but documentation in other ranges is sparse. The one and only collection from the Rincons dates back to 1881. This summer, while hiking back from our Italian Spring drainage survey, Manning Camp Ranger Tony Palmer noticed a different-looking yellow sunflower along the Italian Spring Trail and snapped a few quick photos. Having already finished our official survey for the day, a few of us walked by it, and Tony did not realize it was one of our target species. The wildflower show along the trail was spectacular on that late August day, and in the absence of careful surveying, the plants would have blended in with other common yellow sunflowers. Fortunately, Tony posted his photos to iNaturalist, an online community platform that calls on expert and amateur naturalists alike to identify photo observations from users around the world. Though they remained unidentified and lost in a backlog of plant photos for months, we eventually revisited the photo and realized it was almost certainly this rare target species. The coordinates tied to his photos will allow us to revisit this population next summer to confirm the identification, take more photos, and make a collection if we are able to find a larger population in that vicinity. Four plants are visible in Tony's photos. *Hymenoxys quinquesquamata* is known to grow in open areas at the edges of pine-oak forests from 5,000-7,000 feet. Though our location is a little above that elevation range, it occurs in an area that burned severely in 2003. That recent fire history likely contributed to making this trail section an ideal sunny and exposed habitat.



Left: Green muhly growing from stream bank near Manning Camp - Photo: Dan Beckman
Right: Rincon rubberweed on Italian Spring Trail – Photo: Tony Palmer

***Muhlenbergia ramulosa* (green muhly) – see previous page for photo**

Muhlenbergia ramulosa is a tiny summer annual grass growing only 5-25 cm. tall. We did not notice it coming up until September, and even then we were not sure if it was the right species. It seemed strangely abundant around camp to be a “lost” species and it is so small that a definitive identification is nearly impossible without looking under a microscope. After looking at it more carefully around some of the gravelly stream beds upstream of Manning, we decided that it looked pretty close and was certainly worthy of a closer look at the herbarium. Two botanists there compared our collections to other herbarium specimens and worked through botanical keys, both arriving at *Muhlenbergia ramulosa* as the correct identification. Though the grass is fairly nondescript to the naked eye, it distinguishes itself under magnification with its plump white spikelets (mottled with green and black patches) clinging closely to the panicle branches. This species was last collected in the Rincons by Blumer in 1909. Our two collections, over a hundred years apart, took place at the same time of year (mid-September), in the same general location (Manning Camp), and in similar habitat (his label reads “gravelly knoll”).

New species

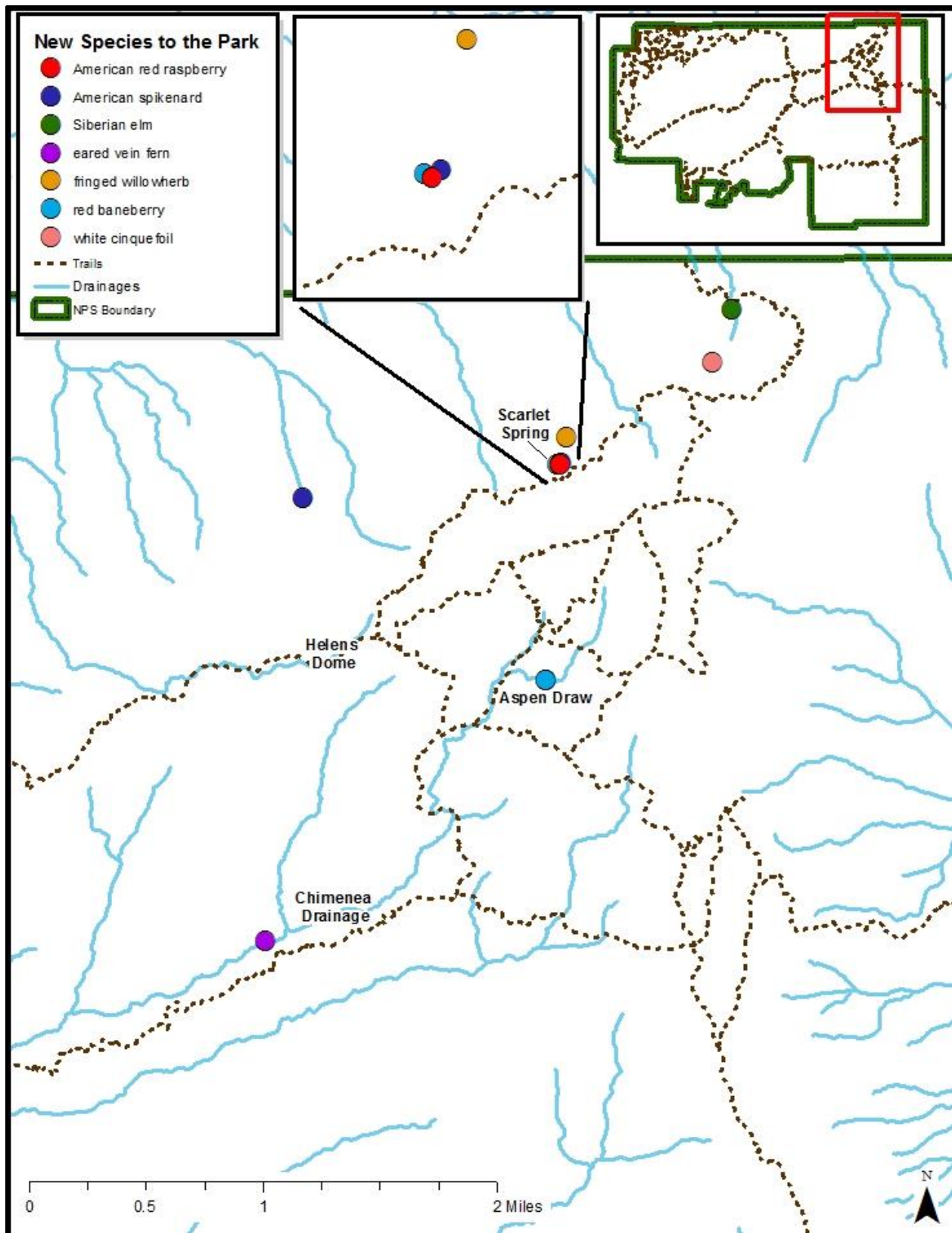
Finding new species to the park was a pleasant surprise. Our plant searches were focused on the potentially extirpated target list, but a couple of us were in the habit of photographing any flower or interesting plant that we did not already recognize. During or following Manning trips, we would attempt to identify species from these pictures using a variety of resources, including field guides, the SEINet floral database, and iNaturalist. Thanks to these efforts, we learned along the way that we were periodically seeing plants that had not previously been known to occur in the park! In total, we documented eight new species for the Rincon Mountains.

Scarlet Spring: *Actaea rubra*, *Aralia racemosa*, *Rubus ideaus* ssp. *strigosus*, and *Epilobium ciliatum*

The most unique place we stumbled upon in our surveys this summer was a new spring in the middle fork of Joaquin Canyon, just below the North Slope Trail. This spring, newly named Scarlet Spring for its stunning carpet of scarlet monkeyflower (*Erythranthe cardinalis*, formerly *Mimulus cardinalis*), was lush with flowing water even in May and June, when water is scarcest on the mountain and many well-known springs are dry or nearly dry. Scarlet Spring is also within an area that was severely burned in 2003, so it has the unique combination of plentiful water at high elevation with minimal canopy cover. This unique habitat profile likely explains the four new species we found in the spring’s immediate vicinity, red baneberry (*Actaea rubra*), American spikenard (*Aralia racemosa*), American red raspberry (*Rubus ideaus* ssp. *strigosus*), and fringed willow herb (*Epilobium ciliatum*), all fairly abundant. Later in our field season, we encountered a smaller population of red baneberry in Aspen Draw, the same tributary where we found dogwood and mountain alder. We also located a separate population of American spikenard in a drainage directly north of Helen’s Dome.



Scarlet Spring with its namesake scarlet monkeyflowers – Photo: Dan Beckman



Locations for New Park Species Found Summer 2017 (Inset Map of Scarlet Spring)

Italian Spring Drainage: *Potentilla albiflora* (white cinquefoil) and *Ulmus pumila* (Siberian elm)

Elsewhere on the North Slope, we found two more new species in the drainage flowing down from Italian Spring, a well-known and reliable water source. White cinquefoil (*Potentilla albiflora*) is a small herb in the Rose family (*Rosaceae*) with leaves resembling wild strawberry (*Fragaria vesca*). This is an important addition to the Rincons' flora, as this species is endemic to Arizona and globally rare. NatureServe, a conservation science non-profit organization, categorizes it globally as imperiled to critically imperiled (G1G2) likely due to its extremely limited range, with most collections coming from the nearby Santa Catalina and Pinaleño Mountains. An interagency committee of botanists from across Arizona also included it in a list of state "potentially rare plants," likely due to this limited range (Arizona Rare Plant Committee 2000). We took photos of very similar-looking leaves in two other North Slope drainages, but given how closely they resemble strawberry, we cannot identify these populations with certainty until seeing them with flowers or fruits. Further down this same Italian Spring drainage, we found a new species more troubling than exciting. Siberian elm (*Ulmus pumila*) is a terribly invasive non-native tree that has spread through much of the United States. It is difficult to know how it got up in the Rincons, but it has clearly been in that spot for a long time, as one tree was at least ten meters tall. We only noticed one other plant, a much shorter shrubby form beside the large tree. Our invasive plant team will develop a plan to remove these trees, no simple undertaking due to the remote backcountry location and enormous size of the older tree.



Red baneberry at Scarlet Spring
Photo: Dan Beckman

***Stenorrhynchos michuacanum* (Michuacan lady orchid)**

We were also thrilled to find a new orchid species for the park this summer. Orchids hold a special intrigue for many people with their uniquely beautiful flower structures. They are most abundant in tropical regions of the world, so the handful of species that manage to survive in desert mountain ranges are fascinating on an additional level. The Michuacan lady orchid (*Stenorrhynchos michuacanum*) grows in open sites in middle elevation woodland habitats. It starts from fleshy basal leaves before sending up a thick stem featuring densely-clustered pale yellow flowers all facing one side. We found an isolated population of about twenty plants in full bloom in a flat open site alongside grasses and low shrubs. This site was over 7,500 feet in

elevation but resembled lower habitats with its complete lack of canopy cover and shallow rocky soil. Because we only found one small localized population, we submitted a photo voucher to SEINet rather than remove a plant by making a collection. This species was previously known in the nearby Santa Catalina and Huachuca Mountains of Arizona, as well as a couple mountain ranges in Texas.

***Phanerophlebia auriculata* (eared vein fern)**

Near the end of our high country field season, a few of us had the opportunity to backpack down from Manning via Chimenea Canyon, one of the major drainages coming down the west face of Mica Mountain. We descended about 3,000 feet in elevation before topography and time constraints forced us to leave the canyon and finish our descent on trail. Along the way, we surveyed promising habitats for more of our “potentially extirpated” target species and any other interesting plants we could find. At around 6,600 feet elevation, we encountered an unusual fern growing out of a crevice in a shaded cliff face. Its pinnae (the divided segments of a fern frond) looked strikingly wide and had irregularly shaped bases. Perfectly circular sori (clusters of spore-producing sporangia) were present on the undersides of the pinnae. We extensively photographed the small population, but did not know what it was until posting the photos on iNaturalist, where a fern expert and a local botanist settled on *Phanerophlebia auriculata* (eared vein fern), a new species for the Rincons. It has been documented in other nearby sky island mountain ranges in similar habitats: mostly wet shaded rock crevices. Like many of our plant findings from the season, this rare



Michuacan lady orchid flower stalk
Photo: Tony Palmer



Eared vein fern in Chimenea Canyon – Photo: Tony Palmer

species was hanging on in a unique microhabitat that protected it from the extreme heat and aridity of the surrounding landscape.

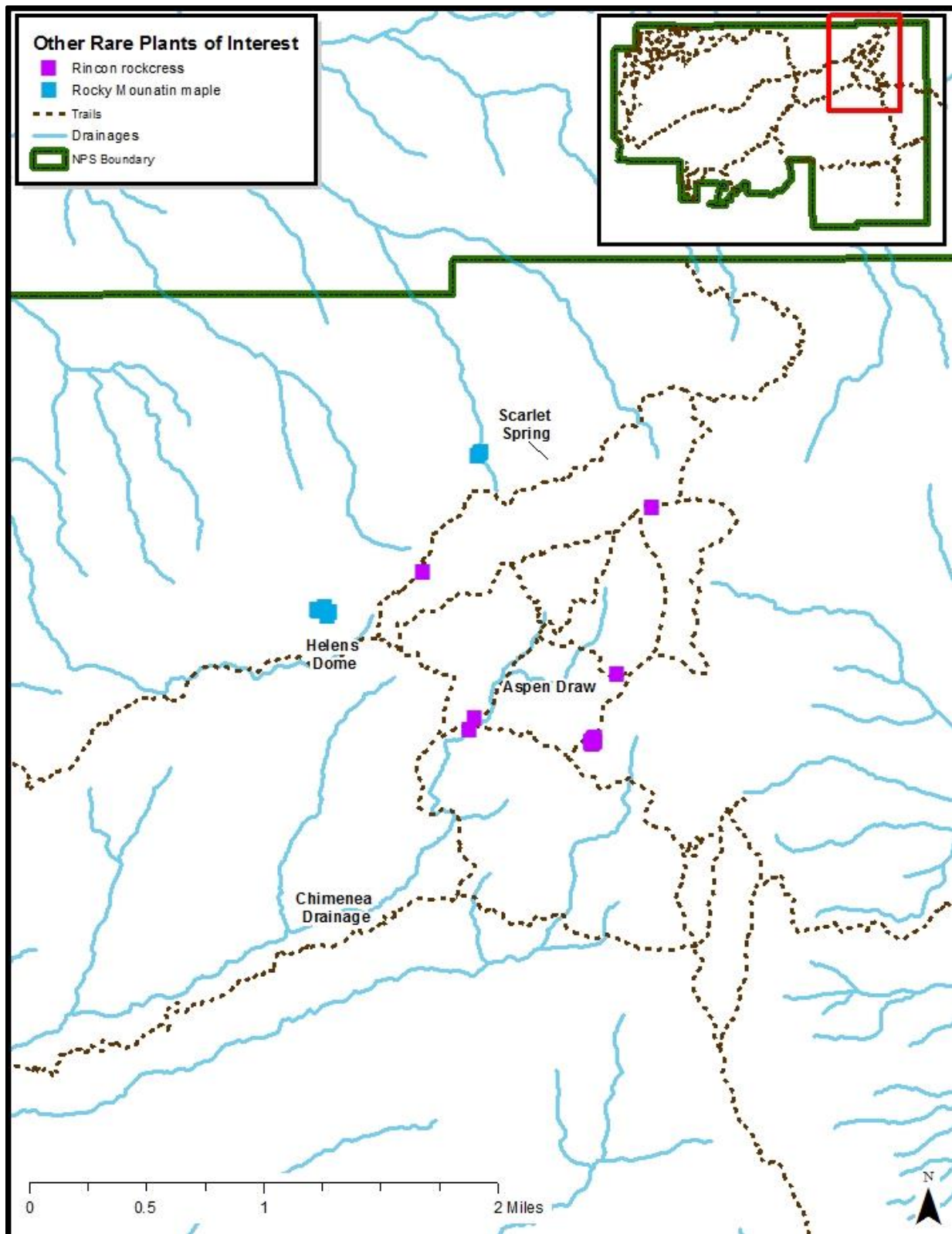
Other Rare Plants of Interest

As mentioned earlier, we relocated a population of Rocky Mountain Maple (*Acer glabrum*) on the north side of Helen's Dome. We noted about twenty scrawny trees growing in the steep drainage heading down the north face of the outcrop, often clinging to the sides of steep cliff walls that provide additional shade. We also found a separate population (including one impressively tall tree) about a mile away in the west fork of Joaquin Canyon. Nestled below a cliffy section of canyon among mixed conifer forest, these trees were similarly sheltered from the sun. Like the Helen's Dome population, trees were located below a steep rock face where water could rush down in a rain event and moisten the soil.



Rocky Mountain Maple at Helen's Dome
Photo: Tony Palmer

We also documented fairly widespread populations for another species of global conservation concern. *Pennellia tricornuta* (formerly *Arabis tricornuta*) is a slender mustard species known either as the Rincon rockcress or Chiricahua rockcress. Its known distribution is entirely restricted to a band of major mountain ranges to the south and east of Tucson: the Rincons, Chiricahuas, Huachucas, and Santa Ritas. Because of this extremely limited distribution, *Pennellia tricornuta* is categorized globally as imperiled to critically imperiled (G1G2), translating to a high or very high risk of extinction (NatureServe). It was included in the Arizona Rare Plant Field Guide (under *Arabis tricornuta*), an interagency document that highlighted about 140 of the rarest species across the state. It was encouraging to come across many scattered populations near the top of Mica Mountain this summer, confirming its secure presence in this range. *Pennellia tricornuta* has small white bell-shaped flowers that appear along its slim stalk in mid-summer, followed by long flat seed pods in late summer. These seed pods (known in mustards as siliques) are the species' clearest identifying features, so we had to wait a while before we could confirm populations that we observed earlier in the season. These populations ranged in habitat from forested trail corridors, to north-facing drainages, to steep rocky slopes of pine forests (its classic habitat).



Other Rare Plants of Interest Found Summer 2017

Another exciting find was *Malaxis porphyrea* (Cochise adder's mouth orchid), a fairly inconspicuous species that first appears as a very short stem with a single oval leaf before sending up a stalk featuring rows of tiny purple flowers. These flowers, the smallest of any Arizona or New Mexico orchid (Coleman 2002), are truly stunning in form and color, especially when viewed under magnification. Known in Arizona, New Mexico, and northern Mexico, this species is not considered globally rare, but it has been listed as imperiled for the state of Arizona (S2) because of its limited distribution (NatureServe). It was also chosen for the *Arizona Rare Plant Field Guide*.

In the Rincons, it had only been collected once before (in 1990 as part of fire effects monitoring under *Malaxis ehrenbergii*, a different species from which it has since been reassigned). There are very few official records in Pima County. We found *Malaxis porphyrea* in pine forest habitats near the top of Mica Mountain, often along trails or around drainages. Its initial stem and leaf growth corresponds with the onset of summer rains, with blooming usually following from late July through September (Coleman 2002).

Unsolved mysteries

In all, there are still ten target species we have yet to rediscover, though only seven of these are species we spent significant time searching for in 2017 (the other three being low-to-mid elevation species deemed unlikely to occur in the study area) One of these elusive species stood out to us in particular:

***Platanthera limosa* (Thurber's Bog Orchid)**

We may have spent more time searching for this species than any other. The lone historical record of it being in the Rincons is a collection dating back to 1891. Unfortunately, the collection label includes no specific location information beyond the mountain range, though Bowers & McLaughlin (1987) include a passing reference to its historical location being Deer Head Spring (pg. 60), a well-known spring on the East Slope of the Rincons. We have not yet found another source to confirm that location, but in any case, Bowers & McLaughlin were



Cochise Adder's Mouth Orchid
Photo: Tony Palmer

unable to find it there. This species requires a high elevation site (at least 7,000 feet) with permanently wet soil, considerably narrowing its potential habitat in the Rincons. Our staff spent a lot of time at Deer Head Spring this summer studying water and geology, and we observed a habitat that appears increasingly unsuitable for such a water-loving plant. Whatever the cause (fire has certainly played a role in changing the dynamics of Deer Head Spring), this once-reliable spring now dries up seasonally. After failing to find it around any of the known high elevation seeps and springs that came to mind, we got in touch with local orchid expert Ron Coleman, author of *The Wild Orchids of Arizona and New Mexico*. He generously showed two of us some sites where it grows near the top of the neighboring Santa Catalina Mountains, a range with striking botanical similarity to the Rincons. The Catalinas do, however, hold plenty of high-elevation species that have never been found in the Rincons, such as Arizona mountain ash (*Sorbus dumosa*) and fivepetal cliffbush (*Jamesia americana*). Bowers & McLaughlin point out that the Catalinas are nearly 500 feet taller than the Rincons and have 2.5 times as much area above 8,000 feet (pg. 61), making them more likely to provide the kind of habitat that *Platanthera limosa* requires. In the Catalinas, we saw it growing both in shady and open sites, but the presence of reliable water was a constant. Scarlet Spring, the particularly lush spring we found on the North Slope, seemed like the potential habitat that matched up best with these Santa Catalina sites. Unfortunately, multiple meticulous surveys of that spring area yielded no sightings. We hope to seek out more promising habitat next summer so we can



Thurber's Bog Orchid in the Santa Catalina Mountains – Photo: Jim Fowler

Discussion

Between rediscovered species, new species, and other notable finds, the summer of 2017 was enormously successful in terms of increasing our botanical knowledge of the Rincon Mountains. A number of factors worked to our advantage; for one, we had many skilled naturalists working in locations all around Mica Mountain. Though most of our crew members were not botanists or even primarily interested in plants, everyone took a keen interest in the rare plant project

and kept an eye out for our “lost” target species and other uncommon plants. Two of our most exciting finds, the mountain alder (*Alnus incana* ssp. *tenuifolia*) and red osier dogwood (*Cornus sericea* ssp. *sericea*), were found “by accident” while crew members were hiking to collect a water sample. We were especially fortunate that the summer’s Manning Camp ranger (a seasonal position charged with caring for the cabin and overseeing high country operations) was Tony Palmer, a former Resources crew member and amazing all-around naturalist with a solid botany background. He was responsible for our orchid findings, both spotted in the course of routine patrol and maintenance tasks. Between his nearly constant presence on the mountain and our rotating schedule of Resources crew trips, we had trained eyes all over the high country for most of the spring, summer, and early fall.

Despite being situated in a national park close to a major metropolitan area, the Rincons are still underreported for plant species, at least partially because the high country is so difficult to access. With almost the entire range protected as designated Wilderness, roads only reach the mountains’ periphery before giving way to hiking trails that climb steeply through rugged terrain. In contrast, anyone with a car can reach the top of the Santa Catalina Mountains in a little over an hour’s drive from downtown Tucson. These accessibility challenges have certainly kept some local botanists from ever visiting the Rincon high country and limited the frequency of visits for others. Simply being up there almost continuously from March through October allowed our staff to witness the many blooming periods that accompany subtle shifts in the seasons. Additionally, we were able to search for plants in steep drainages and other challenging terrain because our crew members were experienced in off-trail hiking and trained in wilderness first aid. This allowed us to access out-of-the-way places that had rarely or possibly never been surveyed.

Finally, the year’s record-breaking July precipitation probably made the summer an especially great time to look for plants. In Tucson, it was the wettest July on record (6.8 inches recorded at the airport, 14 inches recorded on Mt. Lemmon), as well as the second wettest month in recorded history (Mace 2017). At the top of the Rincons, we witnessed multiple high-intensity rain events that filled up drainages, transforming them overnight into raging rivers. Summer-blooming plants in the sky island region use the onset of the monsoon season (typically early-to-mid July) to cue flower production (Crimmins et al. 2011), so the unusually wet July may have spurred higher numbers for annual species as well as widespread blooming for perennials that may remain dormant in other years.

Whether or not the July moisture was a contributing factor, we learned that rare species sometimes grow in relative abundance within their local niches. *Melica porteri* dominated a section of the north-facing slope beneath Helen’s Dome, though it clearly had very specific habitat requirements as we only saw it in a couple other wet north-facing spots. In some cases, a plant appeared to be so common that we initially doubted it could be one of our target species. Green muhly (*Muhlenbergia ramulosa*) was easy to miss (and misidentify) because of its size, but we actually saw it pretty frequently around Manning Camp by late summer, leading to some initial skepticism. Supposedly “rare” plants can sometimes appear quite common,



North Slope Trail showing major burn area – Photo: Dan Beckman

depending on factors like phenology (the timing of plant life cycles), weather patterns, and a given area's collection history.

Another theme that emerged was the importance of rare microhabitats to biodiversity. In our searches for rare and new species, we focused on some of the coolest and wettest sites on the mountain, particularly shaded north-facing slopes/drainages and perennial springs. Special places that fit this profile included the north side of Helen's Dome, Scarlet Spring, and Aspen Draw. In these three sites alone, we encountered three of our "lost" target species (alder, dogwood, and Porter's melicgrass), four new species (baneberry,

spikenard, willowherb, and raspberry), and isolated

populations of Rocky Mountain maple (*Acer glabrum*). The locally rare species at these sites are clearly hanging on in the cool, wet extremes of available habitat in the Rincon Mountains. With their existing populations so localized and their potential habitat on the mountain so limited, these species must be considered vulnerable to environmental threats, particularly climate change. With climate models for the southern Southwest region predicting even hotter and drier conditions going forward (Garfin et al. 2013), these cool, wet microhabitats might cease to be suitable for some of the rare species they currently support. Though it was encouraging to rediscover some of the "moisture-loving, cold-tolerant" plants that were thought to be lost, future monitoring is necessary to look for species we did not find and check on the continued viability of localized rare populations.

Finally, our results underscore the importance of not drawing too many conclusions from negative data, especially when searching for rare species in an area as vast and rugged as the Rincon Mountains. Bowers and McLaughlin searched diligently for those six “moisture-loving, cold-tolerant” high-elevation species but came up empty. Through targeted and repeated visits to cool, wet microhabitats, we were able to find two of those species (the alder and dogwood), while three others (*Agrimonia striata*, *Humulus lupulus*, and *Rosa woodsii* ssp. *woodsii*) had previously been accounted for by NPS botanist Steve Buckley and others. This means that, from their list of six, we are only still looking for that elusive orchid species, *Platanthera limosa*. It is a reminder to stay conservative in your conclusions, knowing others may look in a spot that you had never considered, or simply happen to be in the right place at the right time. In *The Mountains Next Door*, Bowers describes searching for red osier dogwood in the creek below Manning Camp, thinking this was the site of its historical collection (pg. 50). We ended up finding it not far away, in the creek half a mile *above* Manning Camp. We may have never looked there if not for the systematic transects and water revisits that highlighted this site as a perennial water source. It goes to show that there are almost always more places to look, and special habitats that we have yet to encounter. Some of the species that we did not find, including *Platanthera limosa*, may be persisting somewhere off our current radar.

With additional years of rare plant surveys, we can continue adding to our knowledge of the Rincon Mountains. Between new species, rediscovered species, and species that we have failed to relocate, we gradually paint a clearer picture of the rich biodiversity of this sky island mountain range, as well as how it has changed and continues to change over time.

Acknowledgements

We are grateful for expert botanical assistance from NPS botanist Dr. Steve Buckley, University of Arizona Herbarium collections manager George Ferguson, Ron MacDonald, Ron Coleman, iNaturalist curator Steve Jones, Sonoran Desert Network ecologist Sarah Studd, and Sonoran Desert Network crew lead Jeff Galvin. We would also like to thank former Saguaro restoration ecologist Dana Backer for being instrumental in the early stages of this project.

This study would not have been possible without the financial support of the Friends of Saguaro National Park and the Next Generation Ranger Corps program. Many thanks to Executive Directors Bob Newton and Fred Stula and Vista coordinator Oliva Otero. We are very appreciative for support from Superintendent Leah McGinnis and the many Saguaro National park staff members who assisted with logistics, packing, and safety for our crews. We particularly thank Dan Green and Tim Onstott in Maintenance, Miranda Cook in Visitor and Resource Protection, Michelle Torok and Kim Byers in Administration, and Scott Stonum and Perry Grissom in Resource Management. We thank everyone on the Resource Management team who helped with plant surveys: Nic Perkins, Drew Jackson, Lauren Nichols, Kei Ann Mandanas, Courtney King, Sam Merrens, Brittany Sandoval, Lupe Sotelo, Olivia Thorp, Emily Fule, Britt Garcia, Megan Grubbs, Haley Hersham, Cynthia Norton, David Riddell, Vicki Tozer, and Ashlee Cowles. A special shout-out to Jeff Galvin for finding smooth sumac, Luke

Hetherington for finding red osier dogwood, Don Swann for finding mountain alder, Mike Turner for finding white cinquefoil, and Keenan Duncan for finding Porter's melicgrass and helping on numerous surveys. Thanks to Tony Palmer for finding the orchids and Rincon rubberweed, as well as many other contributions to the project. Thanks to Lauren Kramer for creating the database and managing the large amount of data collected, and Kara O'Brien for producing the final maps. We are endlessly grateful to Don Swann for developing and supporting this project.

Cover page photo collage: Top L: Looking toward Rincon Peak (Photo: Drew Jackson); Top R: Surveying at Scarlet Spring (Photo: Dan Beckman); Bottom R: Surveying East Branch of Joaquin Canyon (Photo: Dan Beckman); Bottom L: Pressing a plant collection (Photo: Keenan Duncan)

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Appendix A: Summary of plants that were “re-discovered” in the Rincon Mountains in 2017, or were new to the park, or are rare plants of management concern.

Scientific Name	Common Name	Location	Previous Rincons Collection
<u>Rediscovered species</u>			
<i>Alnus incana</i> ssp. <i>tenuifolia</i>	Mountain alder	Upper tributary to Chimenea Canyon above Manning Camp (“Aspen Draw”)	1909 by Blumer at “Manning Trail” and “Manning Camp (falls)”
<i>Cornus sericea</i> ssp. <i>sericea</i>	Red osier dogwood	Upper tributary to Chimenea Canyon above Manning Camp (“Aspen Draw”)	1909 by Blumer at “brook, Manning Camp”
<i>Hymenoxys quinquesquamata</i>	Rincon rubberweed	Italian Spring Trail	1881 by Nealley at “Rincon Mountains”
<i>Melica porteri</i>	Porter’s melic grass	Slope north of Helen’s Dome and Joaquin Canyon	1909 by Blumer at “Spud Ranch, north rock shelves”
<i>Muhlenbergia ramulosa</i>	Green muhly	Gravelly wash banks near Manning Camp	1909 by Blumer at “Manning Camp, gravelly knoll”
<i>Rhus glabra</i>	Smooth sumac	East Slope: branch of Bear Creek and adjacent slope	None. Cited based on Blumer (1910).
<u>New species to park</u>			
<i>Actaea rubra</i>	Red baneberry	Scarlet Spring (middle branch of Joaquin Canyon) and upper tributary to Chimenea Canyon (“Aspen Draw”)	N/A
<i>Aralia racemosa</i>	American spikenard	Scarlet Spring (middle branch of Joaquin Canyon) and drainage directly north of Helen’s Dome	N/A
<i>Epilobium ciliatum</i>	Fringed willowherb	Scarlet Spring and elsewhere in middle branch of Joaquin Canyon	N/A
<i>Phanerophlebia auriculata</i>	Eared vein fern	Chimenea Canyon in vertical rock face	N/A
<i>Potentilla albiflora</i>	White cinquefoil	Italian Spring drainage	Appears to have

		(downstream of spring)	been collected in 2001 by Saguaro Fire Effects crew, but it was misidentified as <i>P. glandulosa</i> (which is not known to occur in southern AZ). The collection only features leaves, however, so while it does look like <i>P. albiflora</i> , it is hard to say definitively.
<i>Rubus idaeus</i> ssp. <i>strigosus</i>	American red raspberry	Scarlet Spring (middle branch of Joaquin Canyon)	N/A
<i>Stenorrhynchos michuacanthum</i>	Michuacan lady orchid	Flat sunny site in undisclosed location (due to rarity and special considerations for orchids)	N/A
<i>Ulmus pumila</i>	Siberian elm	Italian Spring drainage just above trail crossing near park boundary	N/A
<u>Other rare plants of interest</u>			
<i>Acer glabrum</i>	Rocky Mountain maple	Helen's Dome and west branch of Joaquin Canyon	1983 by Bowers at Helen's Dome
<i>Malaxis porphyrea</i>	Cochise adder's mouth orchid	Scattered: pine forest habitats along trails and around drainages	1990 by Saguaro Fire Effects crew under the name <i>Malaxis ehrenbergii</i> (U.S. populations have since been reassigned to <i>M. porphyrea</i>). Also previously noted by Sonoran Desert Network.
<i>Pennellia tricornuta</i>	Rincon rockcress	Scattered: Man Head, trails, drainages	1982 by Bowers at North Slope Trail

Appendix B: Bowers & McLaughlin “Excluded Species” List Revisited

*Note: We are also considering *Euphorbia cyathophora* a “lost” species because it did just barely meet our criteria - it was collected by McLaughlin himself in 1978 but strangely did not appear on any checklist in the 1987 Bowers & McLaughlin report, perhaps because it was lumped in with *E. heterophylla* (it has sometimes been considered a variety of that species). In any case, *E. cyathophora* is a low-to-mid-elevation species so it was not a focus of our 2017 survey efforts.

**We are not counting non-native species as “lost” target species, even if they have not been seen in a long time. See Methods section for further discussion.

Family	Original Scientific Name	Common Name and Current Scientific Name (if different)	Still lost?	Update and Comments
<i>Acanthaceae</i>	<i>Elytraria imbricata</i>	Purple scalystem		Observed by Sonoran Desert Network during Sonoran upland long-term vegetation monitoring (1998-2004) and collected by Meg Quinn in 2002 around Rincon Creek.
<i>Anacardiaceae</i>	<i>Rhus glabra</i>	Smooth sumac		FOUND summer 2017 by Sonoran Desert Network vegetation mapping crew.
<i>Apiaceae</i>	<i>Cymopterus multinervatus</i>	Purplenerve springparsley		Observed by Dr. Steve Buckley in multiple locations.
<i>Asteraceae</i>	<i>Aster coerulescens</i>	Willowleaf aster – now <i>Symphyotrichum praealtum</i>	x	This 1909 collection from Spud Rock Campground was determined to be <i>Symphyotrichum lanceolatum</i> var. <i>hesperium</i> (a different species) in 2005, but this has also not been seen since, so it is on our target list.
	<i>Chaenactis carphoclinia</i>	Pebble pincushion		Never collected in park. 1905 collection from “foothills, Rincon Mountains” has coordinates which place it around Julian Wash near present day intersection of Old Vail Rd. and Colossal

				Cave Rd.
	<i>Conyza sophiifolia</i>	Leafy marshtail – now <i>Laennecia sophiifolia</i>		Collected by Saguaro Fire Effects crew in drainage plot just NW of Manning Camp in 2000 and 2003. 1909 collection (ARIZ #55529) from Spud Rock Campground.
	<i>Hieracium lemmonii</i>	Lemmon's hawkweed – now <i>Hieracium crepidispermum</i>		Collected by Saguaro Fire Effects crew in 1998 (specific location not listed on herbarium sheet). Collection part of SNP Fire Herbarium (presently housed in Resources Office). Also collected and documented extensively by Resources crew in summer 2017 (trails and slopes all over Mica Mountain).
	<i>Hymenoxys quinquesquamata</i>	Rincon rubberweed		FOUND summer 2017 by Resources crew, based on photos posted to iNaturalist. We will revisit next summer for final confirmation.
	<i>Melampodium strigosum</i>	Shaggy blackfoot	x	Still not found. Mid-elevation species. 1907 collection.
	<i>Solidago canadensis</i> var. <i>scabra</i>	Late goldenrod – now <i>Solidago altissima</i> subsp. <i>altissima</i>	x	Still not found. 1909 collection (ARIZ #59641) from Spud Rock Campground.
<i>Betulaceae</i>	<i>Alnus incana</i> ssp. <i>tenuifolia</i>	Mountain alder / thinleaf alder		FOUND summer 2017 by Resources crew.
<i>Boraginaceae</i>	<i>Phacelia arizonica</i>	Arizona scorpionweed		Collected in 1998 and 2001 on E side of Rincons in Forest Service land. Possibly never collected within park boundaries.
<i>Brassicaceae</i>	<i>Arabis tricornuta</i>	Rincon rockcress – now <i>Pennellia tricornuta</i>		Never really lost. Bowers made a collection that was later determined to be this species. Collected and

				documented by Resources crew in summer 2017.
	<i>Brassica nigra</i>	Black mustard		Non-native. 1913 collection from “Tanque Verde, Rincon Mountains”, likely outside park boundaries.
	<i>Nasturtium officinale</i>	Watercress		Non-native. 1913 collection from “Tanque Verde, foothills of the Rincon Mountains”, likely outside park boundaries.
<i>Cornaceae</i>	<i>Cornus sericea</i> ssp. <i>sericea</i>	Red osier dogwood		FOUND summer 2017 by Resources crew.
<i>Cucurbitaceae</i>	<i>Sicyos ampelophyllus</i>	Streamside burr cucumber	x	Still not found. Mid-elevation species. Included based on a 1907 collection by Goodding, but we could not find a record of this collection through SEINet. Worthy of further investigation.
<i>Cyperaceae</i>	<i>Eleocharis parishii</i>	Parish’s spikerush		Collected by Bowers herself, strangely enough. Also observed many times by Steve Buckley. Collected by Resources crew at Mudhole Spring on the East Slope in summer 2017.
	<i>Scirpus acutus</i>	Hardstem bulrush –now <i>Schoenoplectus acutus</i>		1913 collection from “Tanque Verde, near base of Rincon Mountains”, likely outside park boundaries.
<i>Fabaceae</i>	<i>Vicia leucophaea</i>	Mogollon Mountain vetch	x	Still not found. 1909 collection (ARIZ #67579) from “divide, lower trail...under oaks and in brush” at 7200 ft.
<i>Juncaceae</i>	<i>Juncus balticus</i>	Baltic rush		Observed by Mark Fishbein in 1995 (Powell et al. 2006).
	<i>Juncus tenuis</i>	Poverty rush		Observed by Fishbein et al. in 1994 and 1995 (Powell et al. 2006).
<i>Moraceae</i>	<i>Humulus americanus</i>	Common hop – now <i>Humulus lupulus</i> var.		Not a Southwestern species. The park has <i>H. lupulus</i> var.

		<i>lupuloides</i>		<i>neomexicanus</i> at Spud Rock Campground and elsewhere. Likely a misidentification, especially considering these are two varieties sharing the same root taxon.
<i>Orchidaceae</i>	<i>Habenaria limosa</i>	Thurber's bog orchid – now <i>Platanthera limosa</i>	x	Still not found. 1891 collection by Nealley in "Rincon Mountains". See "Unsolved Mysteries" section of Results for more information.
<i>Poaceae</i>	<i>Calamagrostis canadensis</i>	Bluejoint		Never collected in park. Included based on a description in Kearney and Peebles (1960), but Dr. Steve Buckley definitively refutes it ever having been here.
	<i>Critesion murinum</i> ssp. <i>glaucum</i>	Smooth barley – now <i>Hordeum murinum</i> ssp. <i>glaucum</i>		Non-native. Collected by University of Arizona personnel (Powell et al. 2006).
	<i>Festuca sororia</i>	Ravine fescue	x	Still not found. 1909 collection (ARIZ #303470) from "Spud Rock, north side of cliff".
	<i>Gastridium ventricosum</i>	Nit grass – now <i>Gastridium phleoides</i>		Non-native and probably never collected in park. Included based on a 1905 collection by Thornber in "foothills, Rincon Mountains" (likely outside park boundaries). In any case, we were unable to find a record of this collection.
	<i>Hordeum vulgare</i>	Common barley		Non-native. 1909 collection from Spud Rock Campground.
	<i>Melica porteri</i>	Porter's melicgrass		FOUND summer 2017 by Resources crew.
	<i>Muhlenbergia arenicola</i>	Sand muhly	x	Still not found. Mid-elevation species. 1900 collection (ARIZ #54482) by Griffiths in

				"Rincon Mountains".
	<i>Muhlenbergia wolfii</i>	Green muhly – now <i>Muhlenbergia ramulosa</i>		FOUND summer 2017 by Resources crew.
	<i>Polypogon interruptus</i>	Ditch rabbitsfoot grass		1913 collection from "Tanque Verde Ranch, foothills of Rincon Mountains", likely outside park boundaries.
	<i>Setaria viridis</i>	Green bristlegrass		Non-native. 1913 collection from "Tanque Verde, foothills of Rincon Mountains", likely outside park boundaries.
<i>Polygonaceae</i>	<i>Rumex altissimus</i>	Pale dock		1913 collection from "Tanque Verde, near base of Rincon Mountains", likely outside park boundaries.
<i>Ranunculaceae</i>	<i>Delphinium virescens</i> ssp. <i>wootonii</i>	Organ Mountain larkspur – now <i>Delphinium wootonii</i>		Never collected in park. Probably originally cited based on a 1906 collection by Thornber on Mescal Rd. around railroad crossing.
	<i>Myosurus minimus</i>	Tiny mousetail	?	1960 collection (ARIZ #151252) was determined to be <i>M. aristatus</i> (now <i>M. apetalus</i> var. <i>borealis</i>). Though the collection record states "east side of Rincons" as location, the given coordinates place it west of Tucson on the Tohono O'odham reservation. This is worth looking into further as it could be a different "lost" species.
<i>Rosaceae</i>	<i>Agrimonia striata</i>	Roadside agrimony		Steve Buckley saw it commonly in drainages on the mountain. We also observed it around Manning.
	<i>Cercocarpus montanus</i>	Alderleaf mountain mahogany	x	Still not found. Mid-elevation species. 1908 collection (ARIZ #50275) by Goodding

				in "Rincon Mountains".
	<i>Rosa woodsii</i> var. <i>woodsii</i>	Woods' rose		Observed by Dr. Steve Buckley, who considers it to be common, although we did not encounter it.
<i>Salicaceae</i>	<i>Salix amygdaloides</i>	Peachleaf willow	?	Dr. Steve Buckley is convinced it has never been collected in the park. Kearney and Peebles (1942) cite it for the Rincons, but a footnote adds "Benson and Darrow stated that [<i>S. amygdaloides</i>] is present in Arizona, but its occurrence farther west than New Mexico is questionable. Arizona specimens that had been identified as [<i>S. amygdaloides</i>] were referred by C. R. Ball to <i>S. gooddingii</i> ."