



Sego Lily



Newsletter of the Utah Native Plant Society

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National Park Service Centennial Issue

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Shivwits milkvetch (*Astragalus ampullarioides*) is a leafy, hollow-stemmed perennial with stems up to 2 feet tall and an elongated inflorescence of white or creamy, pea-shaped flowers. It is listed as Endangered under the US Endangered Species Act and is restricted to barren, purplish-brown clay soils of the Chinle and Moenave formations at less than 10 sites in southwestern Utah. The largest population is protected in Zion National Park, where NPS staff have been monitoring the population and learning how to cultivate the species for more than 10 years. Photo by Cheryl Decker.



Utah Native Plant Society



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Utah Native Plant Society Chapters

Unidentified Flowering Object

This month's UFO comes from Jim Case of Cedar City. It looks like a blossom, but might not be a true flower. Can you tell what it is?

The Spring Unidentified Flowering Object was (*Polemonium micranthum*) photographed by Bill Gray in the Salt Lake Valley. This annual member of the phlox family (Polemoniaceae) is found in sagebrush communities and disturbed sites in northern Utah and sporadically westward to British Columbia and California. It is also found in Argentina and Chile, where the sticky seeds (when wetted the seed coat turns gooey) may have hitched a ride from migrating birds. Have a UFO to share? Send it in! - *W. Fertig*

UNPS News

Annual Meeting: The 2016 UNPS annual members meeting will be on Saturday, November 5, from 1-4 PM. UNPS President Robert Fitts will make an opening presentation in honor of the 100th anniversary of our National Parks, followed by a special guest speaker (TBA). The meeting will be hosted by the Utah Valley Chapter and held at the Provo Library (550 North University Avenue, Provo). As always, it will be a New World-themed potluck. For more information, please contact Cathy King (801-867-3595) or consult the UNPS website.

Moving On: Utah Native Plant Society President Jason Alexander announced in early July that he would be leaving his job as curator of the Utah Valley University herbarium and heading to California to be the digital database manager for the University of California-Berkeley herbarium. Jason will be overseeing the Consortium of California Herbaria website, which serves data on the distribution of two million plant specimens from 35 herbaria in California (check it out at ucjeps.berkeley.edu/consortium/).

While this is good career-wise for Jason, it means that he is relinquishing his many duties with UNPS. In addition to being President, Jason has been the co-president of the Utah Valley Chapter with Robert Fitts for the past several years and chair of the UNPS Rare Plant Committee since 2014. As committee chair, Jason has been responsible for organizing the annual rare plant conference in March and for working with the rare plant committee on ranking the conservation priority of plant species in Utah (which Jason summarized in Volume 3 of *Calochortiana*, the UNPS research journal, this past spring).

We all wish Jason and his wife Ann Marie all the best in their new Bay area adventure. Former Vice President Robert Fitts is the new UNPS President until the next election this fall. The board is currently soliciting potential new members to fill Jason's vacancy (and others) on the statewide board. A replacement is still needed for the chair of the rare plant committee. Serving on the UNPS board and its various committees is a great way to help promote the conservation and education mission of UNPS and to work with nice, like-minded plant lovers. If you have time and interest, please contact UNPS and volunteer to help the state board, or assist your own local chapter.

After ten years at the helm of the *Sego Lily*, I have also decided to move on. Three years ago my wife Laura and I relocated to Phoenix, where I took a job as the digital collections manager and lichen curator at Arizona State University. I have now taken a new position as the Assistant Curator and database manager for



Above: Jason Alexander posing in April with monstrous *Geraea canescens* and *Camissonia brevipes* (due to the El Niño rains) near Tecopa Hot Springs in California. Photo by Jason's mom.

the Indiana University herbarium, where I will be developing herbarium databases for the Consortium of Midwest Herbaria. My work commitments are making it increasingly difficult to keep up with the production schedule of the *Sego Lily*, and so it is time to turn the newsletter over to someone else—preferably someone actually residing in Utah! I hope to continue contributing an article from time to time, and to continue the annual or bi-annual production of *Calochortiana*. It has been a lot of fun producing the newsletter this past decade and being on the UNPS board the past 12 years and I'm grateful for the opportunity to have met and worked with so many great plant enthusiasts from across Utah. - Walter Fertig



Above: Your umbel editor, modeling a *Cocklebur* poodle in Zion NP in 2010. Photo by Cheryl Decker.

Chapter News and Events

UNPS Field Trip to Onaqui: The Salt Lake Chapter of the Utah Native Plant Society enjoyed a presentation this past spring by Maria Gaetani about NEON—the National Ecological Observatory Network (www.neonscience.org). Several of us were so intrigued that we wanted to see the Onaqui NEON site for ourselves (www.neonscience.org/science-design/field-sites/onaqui-ault). Raven Reitsttetter volunteered to lead a field trip to the site in Rush Valley, Utah on the 4th of July.

We had a grand time and the field trip was informative, mostly because Raven is especially interested in managing native ecosystems, particularly those that have been overgrazed, and to restore them to their native state. He is a chemist employed by Dugway Proving Grounds, but said that he had also earned a degree in Ecology and Rangeland Management. His personal focus is on the impact of soil biology on the invasion of cheatgrass, *Bromus tectorum*, in the Great Basin Desert. Raven is also a member of the Board of Directors of UNPS.

He gave us an overview of the cheatgrass issue in the Great Basin in Utah and Nevada and some of the research being done to control it. He mentioned that Susan Meyer of the Forest Service Shrub Lab in Provo is developing a fungus to attack cheatgrass and another researcher has developed a bacterial agent (both are still in the developmental and testing stages). Raven is interested in the NEON location because he looks forward to using the data in his own research.

There are two NEON locations in Utah: the Onaqui site in the Great Basin, and a second in

Moab, collecting data from the Colorado Plateau. The installation at the Onaqui site was impressive, and includes a massive tower fitted with scientific instruments located at multiple levels, one close to the ground and the highest position 20 feet off the ground. The instruments are taking meteorological and soil measurements. A long gravel pathway leads away from the tower with multiple smaller instrument panels collecting other data on site to

support plots where certain plant and animal species are being monitored on a scheduled basis.

The area surrounding the NEON location was not in a healthy native condition, but was thick with cheatgrass and sagebrush and few native plants. Raven explained how shrubs like *Artemisia tridentata* and *Juniperus osteosperma* that be-

come dominant, or grow in a decadent state, can preclude understory growth,

leaving the soil open to erosion and further endangering the healthy state of native plants. He talked a bit about how fire suppression, over the long haul, has been bad for the ecosystem, since wildfires naturally thinned out dominant shrub populations.

There are test measures currently being taken by the BLM and the Forest Service to see if there are any methods that could address the issue. Raven took us to a SageSTEP (www.sagestep.org/) location to view an area that has been planted with crested wheatgrass, *Agropyron cristatum*, a perennial non-native grass that competes well against cheatgrass. Then he took us to see another area that was in a healthy, natural condition with a combination of *Artemisia*, bunch grasses, and



Above: Raven Reitsttetter (far right) at SageStep crested wheatgrass site.. Photo by Elise Erler.

other native plants like *Sphaeralcea*. These *Artemisia* were pretty evenly spaced with room for other plants between them and there was little cheatgrass in sight.

The last area we visited was at the top of Johnson Canyon, an area that had been "bullhogged," a heavy-duty piece of equipment that rips up the junipers, chews them up and spits them back out again, creating a giant mulch. That area was showing signs of native plant growth, but it also looked like the junipers would soon be back as strong as ever.

We wrapped up with an impromptu picnic at the BLM Clover Spring campground at the bottom of Johnson's Pass, shaded by trees and further discussion with Raven about what we had seen. On the way out, we all enjoyed the lush moist growth surrounding Clover Spring, a reminder that water is a precious resource, particularly in the desert.

It didn't look like any of the solutions so far hold that much promise, mostly because hands-on, human intervention would be too cost prohibitive over so many millions of acres. As disheartening as the situation is, there are many scientists looking for a solution. It is always a beautiful sight to be in the Great Basin desert surrounded by miles of sagebrush and vistas of distant mountain ranges, something well worth protecting.

The lectures and field trips provided by various chapters of the Utah Native Plant Society give members the opportunity to better understand the many dimensions of native plants and supports the mission statement of the organization:

The Utah Native Plant Society is dedicated to the appreciation, preservation, conservation and responsible use of the native plant and plant communities found in the state of Utah and the Intermountain West.

This field trip is a great example of just that. Many thanks to Raven and to all the other organizers from UNPS chapters around the state that have given their time and energy to organizing and leading these field trips. - *Cathy King*

Canyonlands Chapter News: Seven of us enjoyed a pleasant hike in Hunter Canyon on Saturday, September 17th. We saw twelve different flowering plants blooming (the majority of them yellow-flowered and in the sunflower family) and several grasses. We hiked as far as the arch and found some sweet rock shade where we had lunch.

The marks the final plant walk of our chapter's first season. Thanks to Mary Moran, Bruce Condie, and Diane Ackerman for taking the lead on some of these, and thanks to all who came out to learn about our desert beauties. I will be putting together a brief slideshow later highlighting some of the fun plants and places we saw this year.

Our October meeting will take place at Diane and Scott Ackerman's home in Castle Valley on Friday, the

21st at 6 PM. Our guest speaker will be Jesse Brunson, BLM botanist out of Vernal, Utah. She will be talking about the drone study on Shrubby reed mustard, monitoring studies for several Uinta Basin rare plants (Shrubby reed mustard, Horseshoe milkvetch, Ackerman's green gentian), and new location data for species they have discovered over the last year. This should be super interesting, as using drones as plant monitoring tools is a fairly new application of this technology. And yes, Ackerman's green gentian is named for our own Diane Ackerman!

As usual, there will be a potluck (at 6 PM) prior to the presentation, which starts at 7 PM. For more information, contact me (scarletgilia@hotmail.com) or Diane (dianeackerman13@yahoo.com). - *Sarah Topp*



Above: Onaqui NEON observation tower. Photo by Elise Erler.

National Park Service Centennial, 1916-2016

Utah's National Parks and Monuments: A Century of Plant Conservation

By Walter Fertig

America is known for many inventions, ranging from the airplane and assembly line to the traffic cone and zipper. Some have suggested our greatest invention may be the National Park system.

Never before had a government set aside public lands "... in such manner and by such means as will leave them unimpaired for the enjoyment of future generations". Monarchs and wealthy land barons had long established private nature preserves for their own indulgence, but the notion of having lands preserved in perpetuity for the enjoyment of all people was a revolutionary idea when Congress established Yellowstone as the first National Park in 1872.

Despite good intentions, Yellowstone and the other national parks and monuments created by Congress or the President (under the 1906 Antiquities Act) languished for decades under poor funding and a lack of coordinated management. Many of these national treasures were in remote areas and received little visitation. Most were parks only on paper and lacked staff to protect their resources from commercial exploitation.

This changed one hundred years ago with the creation of the National Park Service. Rather than being managed by a variety of agencies, ranging from the US Army to the Forest Service, the parks were under one agency and subject to uniform rules and a consistent management ethos that stressed preservation and public enjoyment.

Over the past century the National Park system has grown to over 400 units and includes national parks, most national monuments*, national historic sites and battlefields, recreational areas, seashores, lakeshores, and more in all 50 states. In 2015, a record 307 million people visited national park service lands—up 5% from 2014. With the NPS Centennial celebrations, visitation



Above: Utah's 13 National Park Service units. Note that the distribution of parks is strongly skewed towards the Colorado Plateau in southern Utah. Key: ARCH: Arches National Park; BRCA: Bryce Canyon National Park; CANY: Canyonlands National Park; CARE: Capitol Reef National Park; CEBR: Cedar Breaks National Monument; DINO: Dinosaur National Monument; GLCA: Glen Canyon National Recreation Area; GOSP: Golden Spike National Historic Site; HOVE: Hovenweep National Monument; NABR: Natural Bridges National Monument; RABR: Rainbow Bridge National Monument; TICA: Timpanogos Cave National Monument; ZION: Zion National Park.

will likely be even higher in 2016. By comparison, only 326,000 visitors were recorded at the original 35 parks and monuments in 1916. Zion National Park is the most visited NPS unit in Utah (and sixth nationally) with 3.6 million visitors in 2015.

* Some National Monuments, such as Grand Staircase-Escalante NM in southern Utah, are managed by the Bureau of Land Management's National Landscape Conservation System.

Ironically, this high level of visitation creates a threat to the very values for which so many parks were created. Parks are also not immune to impacts from their surroundings. Gateway communities, such as Springdale outside of Zion National Park, or Moab near Arches and Canyonlands national parks, can bring commercial and residential development nearly to the park boundary. Bryce Canyon National Park has been threatened for years by the development of coalfields near Alton, close to the park's border. Nearly all parks are vulnerable to the spread of invasive weed species,



many brought in the muddy wheel wells of automobiles plastered with bumperstickers proudly displaying all the areas of the country the driver has visited. No parks are immune from air pollution, but few have a major regional powerplant within eyesight, as in the case of Glen Canyon NRA and the coal-fired powerplant at Page, Arizona. All parks are potentially vulnerable to changes in vegetation and species distributions that are likely to occur over the next century from climate change.

Despite these challenges, National Parks, Monuments, and the other areas managed by NPS are vital components of a "regional protected areas network" that includes other lands (such as congressionally-designated Wilderness Areas, Nature Conservancy preserves, state parks, and National Wildlife Refuges) that are permanently protected for wildlife and plants. In Utah, the 13 NPS-managed units protect at least one population of 1980 of the state's 3774 native and introduced plant species (52.5%) - despite covering only 4.3% of the state's total area. Park units in Utah are primarily located in the scenic Colorado Plateau country of southern Utah, and thus do not represent all of the ecoregions or important vegetation types of the state, thus protection is biased towards species of scenic slickrock canyons and high deserts.

Until recently, NPS lands were often not well surveyed. In part this was a consequence of

Above: Canaan daisy (Erigeron canaanii) is one of a suite of Navajo sandstone endemics restricted to the Zion NP area. Photo by W. Fertig.

their high degree of protection, which tended to discourage university collectors and amateur naturalists from collecting museum specimens. In addition, many smaller parks have traditionally lacked staff with expertise in taxonomy. To rectify this, Congress passed the National Parks Omnibus Management Act of 1998 to provide guidance and funding for a comprehensive inventory and monitoring program across NPS lands. Since 2000, regional networks of parks have funded teams of scientists to document all of the vascular plant and vertebrate species in each park unit and to map and classify major vegetation types. Additional work has focused on other taxonomic groups and developing long term monitoring studies of impacts of pollution, visitor activity, and climate change on park resources. Reports summarizing the flora, fauna, and vegetation of Utah parks are available for free on NPS websites.

The following pages describe the primary natural values of Utah's 13 NPS-managed units, with an emphasis on their botanical significance. Species checklists exist for each of these parks, but new species are being discovered each year thanks to the efforts of park service scientists and amateur naturalists. More await discovery—perhaps by you on your next visit!

Arches National Park

Location/Size: Colorado Plateau north of Moab and the Colorado River in Grand County, Utah. 76,519 acres.

Established: April 12, 1929 by President Herbert Hoover under the Antiquities Act as Arches National Monument. Designated Arches National Park by Congress in 1971.

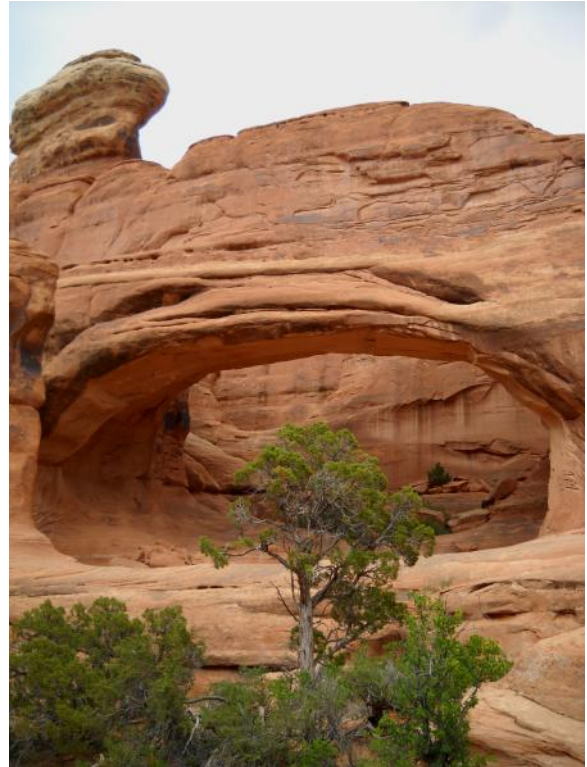
Primary Values: The world's largest concentration of natural stone arches (approximately 200), stone windows, balanced rocks, and rock spires. These geologic marvels were formed when massive slabs of Jurassic-age Entrada Sandstone were cracked and split by uplift of buried salt deposits. Gradually cracks in the exposed sandstone were widened by erosion and faulting and sculpted by wind-borne grit.

Vegetation: Rocky sandstone slopes and ridges are forested by Utah juniper (*Juniperus osteosperma*) and Two-needle pinyon (*Pinus edulits*). Valleys and sandy plains contain stands of Blackbrush (*Coleogyne ramosissima*), with rocky toeslopes dominated by Basin big sagebrush (*Artemisia tridentata*). Salt desert shrub of Shadscale (*Atriplex confertifolia*) is found on Mancos Shale outcrops. Riparian areas along the Colorado River have ribbon forests of Fremont cottonwood (*Populus fremontii*) and marshy areas of willow, cattails, and sedges.

Summary of the Flora of Arches NP (as of 2012):

Total # Plant Taxa	551
# Plant Families	70
# Introduced Taxa	78
# Native Taxa	473
# Rare Taxa	31
# Tree Taxa	16
# Shrub Taxa	82
# Perennial Herb Taxa	236
# Annual Herb Taxa	108
# Perennial Graminoid Taxa	77
# Annual Graminoid Taxa	22
# Fern Taxa	10

Notes: Several early botanists visited the Moab area, including Alice Eastwood and P.A. Rydberg, but it is unclear whether they made collections within Arches itself. The first major collecting effort was by Bertrand Harrison of BYU in the late 1940s. Stan Welsh, Glen Moore, and others (including Harrison) from BYU



Above: Arch in the Klondike Bluffs area of Arches National Park by W. Fertig.

added over 230 new species to the monument's flora in 1963.

Several rare plants are associated with hanging gardens. These mini-oases form along driplines or seeps at the contact of permeable sandstones and impermeable clay formations. The brownish flowered Giant helleborine orchid (*Epipactis gigantea*) is a characteristic hanging garden species. In early spring, Cave primrose (*Primula specuicola*) is one of the first hanging garden species to bloom.

New discoveries continue to be found in Arches. In 2008 Stan Welsh described Cisco mariposa (*Calochortus ciscoensis*) as a new species, with the type coming from the Cisco badlands north of Arches. It had first been collected in the park in 1953 but was misidentified as Seego Lily (*C. nuttallii*) for more than 50 years. Large patches were found at the far north end of Arches NP in the spring of 2010. Mary Moran and others from the park service continue to add 4-5 new species each year.

References: Fertig, W., S. Topp, & M. Moran, 2009. Annotated Checklist of Vascular Flora: Arches National Park. Natural Resource Technical Report NPS/NCPN/NRTR-2009/220. (available online at NPS NCPN website)

Bryce Canyon National Park

Location/Size: Paunsaugunt Plateau west of Cannonville in Garfield and Kane counties, Utah. 35,835 acres.

Established: June 8, 1923 by President Warren Harding under the Antiquities Act. In 1924, the area was renamed Utah National Park by Congress. The park's name was changed to Bryce Canyon National Park and transferred to NPS management in 1928.

Primary Values: Badlands of orange, pink, and white Claron limestone eroded into hoodoos, spires, chimneys, pinnacles, and windows.

Vegetation: Badland slopes of the Claron Formation support cushion plant communities and scattered Bristlecone pine (*Pinus longaeva*) woods. Slopes with deeper soils are clothed by forests of Ponderosa pine (*Pinus ponderosa*) and Greenleaf Manzanita (*Arctostaphylos patula*) interspersed by sagebrush meadows. Above 8500 feet, forests are dominated by Douglas-fir (*Pseudotsuga menziesii*), Engelmann spruce (*Picea engelmannii*), and White fir (*Abies concolor*). Small seeps and springs at the contact of the Claron and Tropic Shale contain wetlands of willows (*Salix exigua* and *S. lutea*) and Narrow-leaved cottonwood (*Populus angustifolia*).

Summary of the Flora of Bryce Canyon NP (as of 2012):

Total # Plant Taxa	628
# Plant Families	73
# Introduced Taxa	62
# Native Taxa	566
# Rare Taxa	51
# Tree Taxa	20
# Shrub Taxa	78
# Perennial Herb Taxa	357
# Annual Herb Taxa	73
# Perennial Graminoid Taxa	88
# Annual Graminoid Taxa	7
# Fern Taxa	5

Notes: Pioneer Utah botanist Marcus E. Jones was apparently the first to explore the Bryce Canyon area, where he collected the type of *Linum kingii* var. *pinetorum* (King's flax), a variety that is no longer recognized. Walter Cottam made the first collections known for certain to have come from the park in 1926.



Above: King's flax (*Linum kingii*) by W. Fertig. Legendary Utah botanist Marcus Jones collected the type of *L. kingii* var. *pinetorum* near Bryce Canyon in 1894.

The Claron Formation is rich in limestone and weathers to form rocky clays that are brick-hard when dry but slippery and goeey when wet. This substrate is difficult for most plants to colonize, and tends to have sparse cover. A small number of local endemics are adapted to this harsh substrate. These include Yellowish cryptanth (*Cryptantha ochroleuca*), Peterson's campion (*Silene petersonii*), Bryce Canyon townsendia (*Townsendia montana* var. *minima*), Claron pepperwort (*Lepidium montanum* var. *claronense*), Paria breadroot (*Pediomelum pariense*), Reveal's paintbrush (*Castilleja parvula* var. *revealii*), Red Canyon beardtongue (*Penstemon bracteatus*), Least spring-parsley (*Cymopterus minimus*), and Least lomatium (*Lomatium minimum*). Cedar Breaks NM also has exposures of the Claron Formation and shares many (but not all) of the same endemics. The Claron endemics resemble alpine species found above timberline in having low, ground-hugging stems and over-sized flowers. Many would make good rock garden species (but all are protected within the national park).

References: Fertig, W. & S. Topp. 2009. Annotated Checklist of Vascular Flora: Bryce Canyon National Park. Natural Resource Technical Report NPS/NCPN/NRTR-2009/153. (available online at NPS NCPN website).

Spence, J.R. and H. Buchanan. 1993. 1993 update: Checklist of the vascular plants of Bryce Canyon National Park, Utah. Great Basin Naturalist 53 (3): 207-221.

Canyonlands National Park

Location/Size: Colorado Plateau, confluence of Colorado and Green rivers south of Moab in San Juan, Grand, Wayne, and Garfield counties, Utah. Includes a disjunct unit at Horseshoe Canyon. 337,570 acres.

Established: September 12, 1964 by Congress and signed by President Lyndon Johnson. Expanded in 1971.

Primary Values: Slickrock canyons, stone arches, hoodoos, and columns carved from Cedar Mesa Sandstone. Numerous archaeological sites are preserved, including the Great Gallery pictograph site in Horseshoe Canyon.

Vegetation: Mesa tops and alluvial benches with relatively shallow soils over bedrock support stands of Blackbrush (*Coleogyne ramosissima*). Salt desert scrub of Garrett's saltbush (*Atriplex garrettii*), Shadscale (*A. confertifolia*), and Budsage (*Artemisia spinescens*) is found on low benches with clay soils. Sites with deeper sandy soils are dominated by Basin big sagebrush (*Artemisia tridentata* var. *tridentata*) or desert grasslands containing Needle-and-thread (*Hesperostipa comata*), Indian ricegrass (*Achnatherum hymenoides*) and Blue grama (*Bouteloua gracilis*). Winterfat (*Krascheninnikovia lanata*) can be locally common in these stands and often attain a large stature. Areas of sandstone bedrock and cliffs support dwarf woodlands of Two-needle pinyon (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). River and streambanks contain forests of Fremont cottonwood (*Populus fremontii*), Black willow (*Salix gooddingii*), Coyote willow (*S. exigua*), and Tamarisk (*Tamarix chinensis*). Shady alcoves

Summary of the Flora of Canyonlands NP (as of 2012):

Total # Plant Taxa	627
# Plant Families	73
# Introduced Taxa	73
# Native Taxa	554
# Rare Taxa	55
# Tree Taxa	20
# Shrub Taxa	98
# Perennial Herb Taxa	273
# Annual Herb Taxa	117
# Perennial Graminoid Taxa	88
# Annual Graminoid Taxa	22
# Fern Taxa	9



Above: Druid Arch in Canyonlands National Park by W. Fertig.

associated with seeps support hanging garden vegetation.

Notes: The idea of a national park to preserve the canyon country of southeastern Utah dates back to the 1930s, but did not reach fruition until the creation of Canyonlands National Park in the mid 1960s. Stan Welsh and colleagues from Brigham Young University conducted baseline research on the flora of the proposed park in 1964 and documented just over 200 species. That number has since more than tripled thanks to efforts by university scientists and park service staff.

Over 100 Colorado Plateau endemics occur in the park. Among the more notable taxa are Ruin Park winterfat (*Krascheninnikovia lanata* var. *ruinina*), a tall woody form named from the Ruin Park area by Welsh, Toft's yucca (*Yucca toftiae*), an especially robust yucca of hanging garden habitats, and Jane's globemallow (*Sphaeralcea janeae*), a narrow endemic of the White Rim area.

The desert grasslands of Canyonlands have been the focus of several long-term studies on the impacts of grazing on biological soil crusts and ecosystem dynamics by Edgar Kleiner, Kim Harper, Walter Loope, and Jayne Belnap.

References: Fertig, W., S. Topp, & M. Moran. 2009. Annotated Checklist of Vascular Flora: Canyonlands National Park. Natural Resource Technical Report NPS/NCPN/NRTR-2009/221. (available online at NPS NCPN website)

Capitol Reef National Park

Location/Size: Colorado Plateau west of Hanksville in Wayne, Garfield, Emery, and Sevier counties, Utah. 241,904 acres.

Established: August 2, 1937 by President Franklin D. Roosevelt under the Antiquities Act as Capitol Reef National Monument. Designated Capitol Reef National Park by Congress in 1971.

Primary Values: Dome-like outcrops of Navajo sandstone (resembling the Capitol rotunda) and other geologic features of the Waterpocket Fold and restored pioneer Mormon farm community at Fruita.

Vegetation: Gypsum and clay badlands at low elevations contain salt desert scrub communities of Shadscale (*Atriplex confertifolia*), Mat saltbush (*A. corrugata*) and Crisp-leaf wildbuckwheat (*Eriogonum corymbosum*). Alluvial terraces and sandy sites at slightly higher elevations support stands of Big sagebrush (*Artemisia tridentata*), Rubber rabbitbrush (*Ericameria nauseosa*) or Fourwing saltbush (*Atriplex canescens*). Rocky mid-elevation sites on sandstone are dominated by Two-needle pinyon (*Pinus edulis*)-Utah juniper (*Juniperus osteosperma*) woodlands. At the highest elevations, Ponderosa pine (*Pinus ponderosa*), Bitterbrush (*Purshia tridentata*) and Alder-leaf mountain mahogany (*Cercocarpus montanus*) predominate. Wetlands occur along perennial watercourses and contain Fremont cottonwood (*Populus fremontii*) and willows (*Salix* spp.). Hanging gardens occur infrequently. Riverside terraces in the Fruita area were converted to fruit orchards by early settlers.

Summary of the Flora of Capitol Reef NP (as of 2012):

Total # Plant Taxa	909
# Plant Families	91
# Introduced Taxa	124
# Native Taxa	785
# Rare Taxa	62
# Tree Taxa	52
# Shrub Taxa	125
# Perennial Herb Taxa	437
# Annual Herb Taxa	143
# Perennial Graminoid Taxa	119
# Annual Graminoid Taxa	23
# Fern Taxa	10



Above: Last Chance townsendia (*Townsendia aprica*), one of several rare plants at Capitol Reef NP. Photo by W. Fertig.

Notes: Local civic leaders promoted a state or national park for the “Wayne Wonderland” area near Fruita, starting in the 1920s. The area received little botanical attention until after it was named a National Monument. Bertrand Harrison of BYU led the first collecting expedition in 1938 and discovered a new species, *Cymopterus beckii*, in a shady Navajo Sandstone canyon.

Several other narrow endemics are also known from the Navajo Formation and from desert clay barrens in the northeast corner of the park. In all, seven species from Capitol Reef are listed as Threatened or Endangered under the Endangered Species Act, the most of any Utah park. According to a 2016 feature in *Natural History* magazine, Capitol Reef NP has the most listed species of any US park outside of Hawaii. Debi and Tom Clark and their colleagues mapped and censused most of the rare plant species in the Capitol Reef area in the late 1990s and early 2000s. The Clarks published a photo guide to the park’s flora in 2009.

References: Clark, D. 2009. Capitol Reef Wildflowers: a Field Guide to Plants of Capitol Reef National Park and Surrounding Areas. Impact Photographics. 238 pp.

Fertig, W. 2009. Annotated Checklist of Vascular Flora: Capitol Reef National Park. Natural Resource Technical Report NPS/NCPN/NRTR-2009/154. (available online at NPS NCPN website)

Cedar Breaks National Monument

Location/Size: Markagunt Plateau 18 miles east of Cedar City in Iron County, Utah. 6154 acres.

Established: August 22, 1933 by President Franklin Roosevelt under the Antiquities Act.

Primary Values: Steep slopes of the orange and white Claron Formation forming a bowl-like amphitheater.

Vegetation: The bottom of the Cedar Breaks Amphitheater is drained by Ashdown Creek and supports a narrow band of riparian Narrow-leaved cottonwood (*Populus angustifolia*)-Engelmann spruce (*Picea engelmannii*)-Water birch (*Betula occidentalis*) forest with occasional sedge-rich bogs. Lower slopes of the canyon are forested by White fir (*Abies concolor*) and Douglas-fir (*Pseudotsuga menziesii*) with occasional patches of Rocky Mountain maple (*Acer glabrum*), Curl-leaf mountain mahogany (*Cercocarpus ledifolius*), and Quaking aspen (*Populus tremuloides*). Along the rim and summit of the amphitheater, forests are dominated by Subalpine fir (*Abies lasiocarpa*) and Engelmann spruce (*Picea engelmannii*), though many of the older spruces have been killed in a spruce bark beetle epidemic dating to the early 1990s. Much of the summit contains subalpine meadows of Bear daisy (*Erigeron ursinus*) and Letterman needlegrass (*Achnatherum lettermanii*) and a variety of colorful wildflowers. Steep Claron slopes and wind-blasted rim areas support a cushion plant community of scattered Western bristlecone pine (*Pinus longaeva*) and Cedar Breaks buckwheat (*Eriogonum panguicense* var. *alpestre*), which despite its ubiquity at Cedar Breaks is essentially endemic to the monument.

Summary of the Flora of Cedar Breaks NM (as of 2012):

Total # Plant Taxa	385
# Plant Families	58
# Introduced Taxa	20
# Native Taxa	365
# Rare Taxa	18
# Tree Taxa	16
# Shrub Taxa	43
# Perennial Herb Taxa	221
# Annual Herb Taxa	18
# Perennial Graminoid Taxa	76
# Annual Graminoid Taxa	3
# Fern Taxa	8



Above: Peterson's campion (*Silene petersonii*), one of the showiest of the Claron endemics. Photo by Douglas N. Reynolds.

Notes: Native Americans referred to Cedar Breaks as “the circle of painted cliffs” or the “place where the rocks are sliding down all the time”. Both of these are quite apt descriptions of the Cedar Breaks Amphitheater with its orange and white layers of Claron limestone that is mostly barren except for small patches of hardy plants (most of which are endemic to the Claron) and loose rubble that makes navigating the steep slopes treacherous. These slopes help protect most of the monument’s 18 endemic or near-endemic plant species. Although some, such as the aforementioned Cedar Breaks buckwheat, are locally abundant, others, such as Reveal’s paintbrush (*Castilleja parvula* var. *revealii*) have very low population numbers or only occur in a subset of seemingly potential sites (the white layer of the Claron seems to have more rare species than the orange layer). Although superficially similar to Bryce Canyon National Park, Cedar Breaks has a smaller flora and does not share the same Claron endemics, making both parks important components of Utah’s protected area network.

References: Fertig, W. 2009. Annotated Checklist of Vascular Flora: Cedar Breaks National Monument. Natural Resource Technical Report NPS/NCPN/NRTR-2009/173. (available online at NPS NCPN website).

Fertig, W. and D.N. Reynolds. 2009. Survey of rare plants of Cedar Breaks National Monument: Final Report. CPCEU Cooperative Agreement # H1200-004-0002. Southern Utah University.

Dinosaur National Monument

Location/Size: Northern Uinta Basin and foothills of the Uinta Range in northeastern Uintah County, Utah and northwestern Colorado (Moffat County). 210,276 acres.

Established: October 4, 1915 by President Woodrow Wilson under the Antiquities Act. Later expanded by Presidents Franklin Roosevelt, Dwight Eisenhower, and Jimmy Carter.

Primary Values: Significant dinosaur fossil beds in the Jurassic Morrison Formation and the undammed confluence of the Green and Yampa rivers.

Vegetation: Lower elevation clay sites are dominated by desert shrublands of Shadscale (*Atriplex confertifolia*) and Wyoming big sagebrush (*Artemisia tridentata* var. *wyomingensis*), while sites with deeper soils support Basin big sagebrush (*A. t.* var. *tridentata*) and shallow soils over bedrock contain Black sagebrush (*A. nova*). Two-needle pinyon (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) form extensive woodlands on sandstone sites at 5500-8000 feet. Quaking aspen (*Populus tremuloides*) woodlands can be found on moist sites above 8000 feet, while drier sites support forests of Douglas-fir (*Pseudotsuga menziesii*) and Ponderosa pine (*Pinus ponderosa*) or sagebrush shrublands. Riparian areas along the Green and Yampa rivers contain wet meadows or Fremont cottonwood (*Populus fremontii*)-Box-elder (*Acer negundo*) woods.

Summary of the Flora of Dinosaur NM (as of 2012):

Total # Plant Taxa	812
# Plant Families	80
# Introduced Taxa	90
# Native Taxa	722
# Rare Taxa	80
# Tree Taxa	16
# Shrub Taxa	93
# Perennial Herb Taxa	417
# Annual Herb Taxa	145
# Perennial Graminoid Taxa	112
# Annual Graminoid Taxa	15
# Fern Taxa	14

Noteworthy Plants: Paleontologist Earl Douglass of the Carnegie Museum in Pittsburgh discovered and publicized the remarkable dinosaur bone beds near Split Mountain in the early 1900s that resulted in the estab-



Above: Ownbey's thistle (*Cirsium ownbeyi*) by W. Fertig. Stan Welsh collected the type of this species from the Split Mountain area of Dinosaur NM in 1955.

lishment of Dinosaur National Monument. Douglass and his colleague O.A. Peterson also made the first botanical collections from the area, collecting 85 species for the Carnegie Museum in 1912. In the 1950s, Stanley Welsh compiled an early species list and described the vegetation of Dinosaur NM for his master's thesis at BYU (Welsh would return to BYU as a freshly minted PhD and assume the curatorship of the herbarium in 1964). Other notable regional botanists spent time documenting the flora of Dinosaur from the 1930s-1960s, including William Weber of the University of Colorado, Arthur Holmgren of Utah State University, and their students. Among the notable discoveries were fifteen locally endemic plant species, including Ownbey's thistle (*Cirsium ownbeyi*), Uinta Basin cryptanth (*Cryptantha oreocarya*), Dinosaur milkvetch (*Astragalus saurinus*), Dinosaur wild buckwheat (*Eriogonum lonchophyllum*) and Blue Mountain penstemon (*Penstemon scariosus* var. *cyanomontanus*). More recently, Tamara Naumann and colleagues made a major effort to document the flora in the late 1980s and early 1990s, discovering nearly 150 new species.

References: Fertig, W. 2009. Annotated Checklist of Vascular Flora: Dinosaur National Monument. Natural Resource Technical Report NPS/NCPN/NRTR-2009/225. (available online at NPS NCPN website)

Glen Canyon National Recreation Area

Location/Size: Colorado Plateau along the Colorado River and tributaries in southeastern Utah (Kane, Garfield and San Juan counties) and north-central Arizona (Coconino County). 1,254,117 acres.

Established: October 27, 1972 by an act of Congress.

Primary Values: Public recreation opportunities associated with Lake Powell and numerous archaeological sites.

Vegetation: Lower portions of Glen Canyon NRA are dominated by desert shrub vegetation of Blackbrush (*Coleogyne ramosissima*) on shallow sandy or clay soils over bedrock and Shadscale (*Atriplex confertifolia*) on shales and siltstones. Deep sand dune sites support Sand sagebrush (*Artemisia filifolia*) mixed with Indian ricegrass (*Achnatherum hymenoides*) and Galleta (*Hilaria jamesii*). Mid-elevation sites contain Two-needle pinyon (*Pinus edulis*)-Utah juniper (*Juniperus osteosperma*) woodlands with an understory of Big sagebrush (*Artemisia tridentata*), Utah serviceberry (*Amelanchier utahensis*) and muttongrass (*Poa fendleriana*). Barren sandstone slickrock may have scattered pockets of vegetation, including Littleleaf mountain mahogany (*Cercocarpus intricatus*). Riparian communities along the Colorado River and its major tributaries may be forested with Fremont cottonwood (*Populus fremontii*), Black willow (*Salix gooddingii*), Coyote willow (*S. exigua*), seepwillows (*Baccharis* spp.), Tamarisk (*Tamarix chinensis*) and Russian olive (*Elaeagnus*

Summary of the Flora of Glen Canyon NRA (as of 2012):

Total # Plant Taxa	889
# Plant Families	90
# Introduced Taxa	99
# Native Taxa	790
# Rare Taxa	56
# Tree Taxa	18
# Shrub Taxa	120
# Perennial Herb Taxa	379
# Annual Herb Taxa	215
# Perennial Graminoid Taxa	119
# Annual Graminoid Taxa	27
# Fern Taxa	11



Above: *Tompkin's phacelia* (*Phacelia sabulorum*) is endemic to clay soils in the Kaiparowits Plateau and vicinity, including Glen Canyon NRA. Photo by W. Fertig.

angustifolia), intermixed with marshy herbaceous cover. Hanging gardens with Southern maidenhair fern (*Adiantum capillus-veneris*), Canyonlands sedge (*Carex curatorum*), Small-flowered columbine (*Aquilegia micrantha*) and other unusual wildflowers occur sporadically at the contact of the Navajo Sandstone and less porous rock layers.

Notes: John Wesley Powell's floating party passed through the Glen Canyon area during their 1869 expedition. Powell commented on the small patches of green associated with seeps high on the canyon walls, calling them "glens" - apparently the earliest reference to hanging gardens. Although many botanists explored the outskirts of the remote canyon area, the first major floristic expedition was not until 1938, when Elzada Clover and Lois Jotter of the University of Michigan explore the Glen Canyon region of the Colorado River by boat. These student botanists documented just over 400 species of vascular plants along the Colorado and its main side canyons. Construction of Glen Canyon Dam (completed in 1964) prompted renewed interest in surveying archaeological sites that would be inundated by flood waters and for searching for new plant species. As a result of this work, the number of species known from the area has more than doubled in the past half century.

References: Hill, M.-E. and T. Ayers. 2009. Vascular Plant Inventory of Glen Canyon National Recreation Area. Natural Resource Technical Report NPS/SCPN/NRTR-2009/264.

Spence, J.R. and J.A.C. Zimmerman. 1996. Preliminary flora of Glen Canyon National Recreation Area. National Park Service, Glen Canyon NRA, Page, AZ.

Golden Spike National Historic Site

Location/Size: Great Basin, north of the Great Salt Lake, approximately 32 miles west of Brigham City in Box Elder County, Utah. 2735 acres.

Established: April 2, 1957 by Congress and transferred to the National Park Service in 1965.

Primary Values: Promontory Summit is the site where the Union Pacific and Central Pacific railroads met on May 10, 1869, completing the first transcontinental rail line across the United States. The Historic site preserves the location where the final “golden spike” was used to secure the rail (it was immediately replaced by an iron spike to avoid being stolen) and about 15 miles of railroad grade.

Vegetation: Most of Golden Spike NHS is a sagebrush grassland dominated by Basin big sagebrush (*Artemisia tridentata* var. *tridentata*), Rubber rabbitbrush (*Ericameria nauseosa*) and Purple three-awn (*Aristida purpurea*). Disturbed soils along the old railroad grade and the gravel access road have an abundance of Cheat-grass (*Bromus tectorum*), Annual sunflower (*Helianthus annuus*), and Broom snakeweed (*Gutierrezia sarothrae*).

Summary of the Flora of Golden Spike NHS (as of 2012):

Total # Plant Taxa	152
# Plant Families	32
# Introduced Taxa	45
# Native Taxa	107
# Rare Taxa	6
# Tree Taxa	0
# Shrub Taxa	25
# Perennial Herb Taxa	65
# Annual Herb Taxa	38
# Perennial Graminoid Taxa	16
# Annual Graminoid Taxa	8
# Fern Taxa	0

Notes: Congress authorized the construction of a transcontinental railroad to link the eastern United States to California and the Pacific coast in 1862. Construction began at opposite ends of the line in Nebraska and California. It took six years of construction, but the two railroads met at Promontory Summit in 1869. The town of Promontory was established at the “Golden Spike” site but was abandoned when the railroad



Above: Each day in the summer locomotives re-enact the meeting of the Union Pacific and Central Pacific railroads near Promontory Summit at Golden Spike National Historic Site. Photo by W. Fertig.

terminus was relocated to Ogden in 1870. The rail line itself fell into disuse when a shortcut was constructed across the Great Salt Lake in 1902. In 1942 the line was completely abandoned and the track removed for metal scrap for the war effort.

Linda Allen, Michael Curto, Robert Fitts and others from Utah State University and the Utah Native Plant Society organized a botanical foray in May 1994 to create the first plant checklist of Golden Spike. The Utah State team returned in 1995 and more than doubled the size of the flora again. With just 152 species, Golden Spike has the smallest flora (and the highest concentration of non-native taxa) of any NPS unit in Utah. The area is still notable, however, in being the only federally protected site in the Great Basin portion of Utah. Golden Spike also provides habitat for Passey’s onion (*Allium passeyi*), a rare local endemic that was once a candidate for protection under the Endangered Species Act.

References: Fertig, W. 2009. Annotated Checklist of Vascular Flora: Golden Spike National Historic Site. Natural Resource Technical Report NPS/NCPN/NRTR-2009/206. (available online at NPS NCPN website)

Hovenweep National Monument

Location/Size: Four Corners region of the Colorado Plateau along the Utah/Colorado state line southeast of Blanding, UT and west of Cortez, CO. Six subunits total 785 acres.

Established: March 2, 1923 by President Warren Harding.

Primary Values: Stone towers and other archaeological sites of ancient Puebloans.

Vegetation: The Square Tower in Utah (site of the monument visitor center) and the Holly, Hackberry, and Cutthroat Castle sites in western Colorado consist mostly of Two needle pinyon (*Pinus edulis*)-Utah juniper (*Juniperus osteosperma*) woodlands with an understory of Cliffrose (*Purshia mexicana* var. *stansburyana*) and Broom snakeweed (*Gutierrezia sarothrae*). Open areas on mesa tops are mostly Big sagebrush (*Artemisia tridentata*) and snakeweed. Seeps below the canyon rim at Squaretop Tower have stands of Fremont cottonwood (*Populus fremontii*) and Nettleleaf hackberry (*Celtis reticulata*). The drier Cajon unit in Utah is mostly Black sagebrush (*Artemisia nova*)-Broom snakeweed, and Galleta (*Hilaria jamesii*). Colorado's Goodman Point unit has sagebrush and Smooth brome (*Bromus inermis*) meadows interspersed with Two-needle pinyon/Utah juniper woodlands and a narrow riparian corridor of Fremont cottonwood and Golden currant (*Ribes aureum*).

Summary of the Flora of Hovenweep NM (as of 2012):

Total # Plant Taxa	345
# Plant Families	60
# Introduced Taxa	57
# Native Taxa	288
# Rare Taxa	17
# Tree Taxa	4
# Shrub Taxa	59
# Perennial Herb Taxa	153
# Annual Herb Taxa	76
# Perennial Graminoid Taxa	41
# Annual Graminoid Taxa	12
# Fern Taxa	0

Notes: The six far-flung subunits of Hovenweep National Monument each contain stone towers constructed by communities of Puebloan farmers around



Above: Sagebrush grows at the base of Square Tower near the Hovenweep NM visitor center in SE Utah. Photo by W. Fertig.

1235-1240 AD and were occupied for about 70 years before being abandoned, possibly during a serious long-term drought. Pioneer western photographer William Henry Jackson visited the area in 1874 and popularized the term "Hovenweep" (from a Ute term for "deserted valley"). Scientists from the Smithsonian conducted archaeological field work at Hovenweep in 1918 and recommended federal protection of the structures.

The most botanically diverse of the subunits of Hovenweep is the Goodman Point unit in Colorado. This site is in a small canyon surrounded on all sides by agricultural fields. Overall plant species richness is relatively low in Hovenweep, in part due to its small size. Several Colorado Plateau endemics are found in the monument, the rarest of which is Thompson's indigo-bush (*Psoralea thompsoniae*) which was once under study for possible listing (it was dropped when populations were found to be larger than originally suspected). Weed diversity is higher than at most parks and higher than the state average for both Utah and Colorado.

References: Fertig, W. 2009. Annotated Checklist of Vascular Flora: Hovenweep National Monument. Natural Resource Technical Report NPS/NCPN/NRTR-2009/207. (available online at NPS NCPN website)

Natural Bridges National Monument

Location/Size: Colorado Plateau , 40 miles west of Blanding in San Juan County, Utah. 7435 acres.

Established: April 16, 1908 by President Theodore Roosevelt under the Antiquities Act. The boundaries were expanded several times, most recently in 1962.

Primary Values: Contains three of the world’s 10 largest natural stone bridges—all located within about three miles of each other in White and Armstrong canyons.

Vegetation: Mesa tops and rims support pygmy woodlands of Utah juniper (*Juniperus osteosperma*) and Two-needle pinyon (*Pinus edulis*). Sites with deeper soils have an understory of Basin big sagebrush (*Artemisia tridentata*), Broom snakeweed (*Gutierrezia sarothrae*) and Rock-goldenrod (*Petradoria pumila*), while shallow, stony areas have Dwarf mountain mahogany (*Cercocarpus intricatus*), Gambel oak (*Quercus gambelii*), and Utah serviceberry (*Amelanchier utahensis*). Steep slopes within shady canyons have small stands of Douglas-fir (*Pseudotsuga menziesii*) and Ponderosa pine (*Pinus ponderosa*). A narrow band of riparian vegetation with Box-elder (*Acer negundo*) and Fremont cottonwood (*Populus fremontii*) lines the bottom of White, Armstrong, and Tuwa canyons. Several small hanging gardens occur in the larger canyons.

Summary of the Flora of Natural Bridges NM (as of 2012):

Total # Plant Taxa	429
# Plant Families	65
# Introduced Taxa	47
# Native Taxa	382
# Rare Taxa	21
# Tree Taxa	14
# Shrub Taxa	74
# Perennial Herb Taxa	201
# Annual Herb Taxa	69
# Perennial Graminoid Taxa	56
# Annual Graminoid Taxa	8
# Fern Taxa	7

Notes: The natural bridges were formed less than 30,000 years ago by meandering streams that eroded away the soft clay and siltstone layers of the Cedar Mesa Sandstone to form deep canyons. Eventually, flood events cut through the base of the narrow fins of



Above: Sipapu Bridge, one of three stone bridges in Natural Bridges National Monument. Photo by W. Fertig.

sandstone separating adjacent canyons, forming a “bridge” of rock. Subsequent downcutting and freeze-thaw erosion have made the bridges progressively deeper. Eventually, the rock buttresses will no longer be able to support the weight of the span and the bridges will collapse—though this is not likely to happen for hundreds or thousands of years.

The first botanists known to explore Natural Bridges were A. O. Garrett of Salt Lake City (namesake of the Garrett Herbarium at the University of Utah) and Per Axel Rydberg of the New York Botanical Garden in 1911. Garrett and Rydberg collected the types of Bridges evening-primrose (*Oenothera longissima*) and Alcove death camas (*Zigadenus vaginatus*) on that trip.

Stan Welsh and his colleagues Glen Moore, Duane Atwood, and Larry Higgins of Brigham Young University discovered nearly 200 new species for the monument during a series of expeditions in the early 1960s. Among their discoveries was the Kachina daisy (*Erigeron kachinensis*), a small, hanging garden endemic from Kachina bridge. This species is listed as Sensitive by the Forest Service and BLM but is no longer a candidate for federal protection under the Endangered Species Act.

References: Fertig, W. 2009. Annotated Checklist of Vascular Flora: Natural Bridges National Monument. Natural Resource Technical Report NPS/NCPN/NRTR-2009/155. (available online at NPS NCPN website)

Rainbow Bridge National Monument

Location/Size: Colorado Plateau on west side of Navajo Mountain and along Bridge Canyon of Lake Powell in San Juan County, Utah. 65 acres.

Established: 30 May 1910 by President William Howard Taft under the Antiquities Act.

Primary Values: The largest natural stone bridge in the world (nearly the height of the US Capitol at 290 feet high and 275 feet across).

Vegetation: The Navajo sandstone slopes and base of Rainbow Bridge contain a mix of Blackbrush (*Coleogyne ramosissima*) and Fourwing saltbush (*Atriplex canescens*) scrub with scattered Utah juniper (*Juniperus osteosperma*) and Gambel oak (*Quercus gambelii*). A small hanging garden is found at the contact of the Navajo and the underlying Kayenta Formation.

Summary of the Flora of Rainbow Bridge NM (as of 2010):

Total # Plant Taxa	234
# Plant Families	53
# Introduced Taxa	15
# Native Taxa	219
# Rare Taxa	19
# Tree Taxa	7
# Shrub Taxa	35
# Perennial Herb Taxa	91
# Annual Herb Taxa	53
# Perennial Graminoid Taxa	34
# Annual Graminoid Taxa	10
# Fern Taxa	4

Notes: Although undoubtedly known to Native Americans for centuries, Rainbow Bridge was not formally "discovered" until 1909. Local explorer John Wetherill, Paiute guide Nasja Begay, and Ute guide Jim Mike led University of Utah dean Byron Cummings and government surveyor William Douglass to the bridge in August of that year. Just a few months later, President Taft designated Rainbow Bridge as a National Monument. Zane Grey immortalized the bridge in his 1915 novel *The Rainbow Trail*, but in the following decades just a handful of visitors made the four day mule trek around Navajo Mountain to visit the bridge in person.



Above: Rainbow Bridge by W. Fertig.

Access improved greatly with completion of the Glen Canyon Dam in 1963 and the filling of Lake Powell Reservoir. Now Rainbow Bridge is accessible by a four-hour boat trip from the Wahweap Marina. Today an estimated 300,000 visitors see Rainbow Bridge each year.

Elzada Clover and Lois Jotter were apparently the first botanists to explore Rainbow Bridge, recording 18 species in 1939 as part of their baseline floristic survey of the Colorado River. In 1985, Jim Holland of Glen Canyon NRA compiled a list of just over 160 species for the monument. In 2006 I became interested in the flora of Rainbow Bridge and over the next four years my wife Laura and I (with the able assistance of John Spence of Glen Canyon NRA) added about 70 new species. Among the more notable plants at Rainbow Bridge is the only Utah population of Lobeleaf daisy (*Erigeron lobatus*) and a suite of rare wetland plants associated with a small hanging garden. These include Western hop hornbeam (*Ostrya knowltonii*), Cave primrose (*Primula specuicola*), Toft's yucca (*Yucca toftiae*) and Welsh's aster (*Aster welshii*). Rainbow Bridge is also noteworthy in having the fewest exotic species of any park unit in Utah with just 15 non-native species.

References: Fertig, W. 2010. Flora of Rainbow Bridge National Monument. *Sego Lily* 33(6):4-14.

Timpanogos Cave National Monument

Location/Size: North side of Mount Timpanogos in the Wasatch Mountains, 12 miles east of Lehi, Utah in Utah County. 250 acres.

Established: October 14, 1922 by President Warren Harding under the management of Wasatch National Forest. The monument was transferred to the National Park Service in 1934.

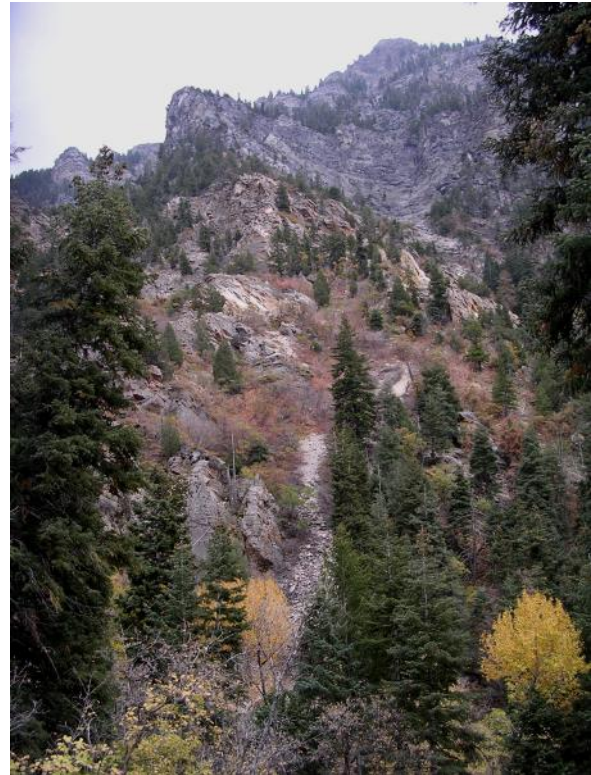
Primary Values: Series of caves with stalactites, stalagmites, flowstones, and other crystalline rock structures formed by dripping, lime-rich water.

Vegetation: The caves occur within the foothills vegetation of Gambel oak (*Quercus gambelii*), Bigtooth maple (*Acer grandidentatum*) and Rocky Mountain juniper (*Juniperus scopulorum*) and montane forests of White fir (*Abies concolor*) and Douglas-fir (*Pseudotsuga menziesii*). American Fork Creek bisects the monument and is lined by riparian woods of Narrowleaf cottonwood (*Populus angustifolia*) and Box-elder (*Acer negundo*).

Summary of the Flora of Timpanogos Cave NM (as of 2012):

Total # Plant Taxa	245
# Plant Families	51
# Introduced Taxa	64
# Native Taxa	181
# Rare Taxa	8
# Tree Taxa	14
# Shrub Taxa	38
# Perennial Herb Taxa	124
# Annual Herb Taxa	38
# Perennial Graminoid Taxa	22
# Annual Graminoid Taxa	7
# Fern Taxa	2

Notes: Sereno Watson, botanist with the King survey of the 40th Parallel, collected plant specimens in American Fork Canyon in 1869, including the types of several uncommon plants (*Brickellia microphylla* var. *watsonii*, *Jamesia americana* var. *macrocalyx*, *Sphaeromeria diversifolia*), but it is unclear whether he made these collections within the future Timpanogos National Monument. The earliest collection known with certainty to



Above: Fall colors in Timpanogos Cave NM by W. Fertig.

come from Timpanogos Cave was made by Bassett Maguire in 1935 (*Mentzelia dispersa*). The first effort to catalogue the monument's flora did not begin until 1963. Duane Atwood, formerly collections manager of the BYU herbarium, along with BYU students and park staff documented 124 species in a 2001 survey. Among the more notable species in the monument are several Wasatch endemics associated with limestone outcrops along the main trail to the caves. These include King's aster (*Aster kingii* var. *kingii*), Wasatch daisy (*Erigeron arenarioides*), Wasatch draba (*Draba brachystylis*), Wasatch jamesia (*Jamesia americana* var. *macrocalyx*) and Broadleaf penstemon (*Penstemon platyphyllus*).

References: Fertig, W. & N.D. Atwood. 2009. Annotated Checklist of Vascular Flora: Timpanogos Cave National Monument. Natural Resource Technical Report NPS/NCPN/NRTR-2009/167. (available online at NPS NCPN website)

Zion National Park

Location/Size: Colorado Plateau along the Virgin River, about 45 road miles northeast of St. George, in Iron, Washington, and Kane counties, Utah. 148,016 acres.

Established: July 31, 1909 by President William Howard Taft under the Antiquities Act as Mukuntuweap National Monument. It was re-named Zion National Park in November 1919. The area around Kolob Arch was established as the separate Zion National Monument by President Roosevelt in 1937. The two park units were merged in 1956.

Primary Values: Massive Sandstone cliffs and deep, shady canyons of Navajo Sandstone carved by the Virgin River and its tributaries. Kolob Arch at the north end of the park is one of the most massive stone arches in the world.

Vegetation: The dry southwestern corner of the park contains badlands of the purplish gray Chinle and reddish Moenkopi formations dominated by warm desert shrublands of Blackbrush (*Coleogyne ramosissima*), Fourwing saltbush (*Atriplex canescens*), Crisp-leaf buckwheat (*Eriogonum corymbosum*) and Nevada ephedra (*Ephedra nevadensis*) with a mix of Mojave grasses and forbs. Lower foothills at 4000-6800 feet consist of woodlands of Two-needle pinyon (*Pinus edulis*) or Singleleaf pinyon (*P. monophylla*) and Utah juniper (*Juniperus osteosperma*), intermixed with Gambel oak (*Quercus gambelii*) and Basin big sagebrush (*Artemisia tridentata*). Areas of barren Navajo sandstone bedrock are locally dominated by Dwarf mountain mahogany (*Cercocarpus intricatus*), Ponderosa pine (*Pinus ponderosa*), and Greenleaf Manzanita (*Arctostaphylos patula*).

Summary of the Flora of Zion NP (as of 2015):

Total # Plant Taxa	1086
# Plant Families	98
# Introduced Taxa	167
# Native Taxa	919
# Rare Taxa	191
# Tree Taxa	41
# Shrub Taxa	138
# Perennial Herb Taxa	498
# Annual Herb Taxa	215
# Perennial Graminoid Taxa	129
# Annual Graminoid Taxa	36
# Fern Taxa	29



Above: Small-sepal lewisia (*Lewisia brachycalyx*) occurs near Lava Point on the Kolob Terrace in Zion NP. Photo by W. Fertig.

Forests at the highest elevations consist of Ponderosa pine, Douglas-fir (*Pseudotsuga menziesii*), and White fir (*Abies concolor*). Wetland forests of Fremont cottonwood (*Populus fremontii*) and Velvet ash (*Fraxinus velutina*) occur along the Virgin River. Hanging gardens, formed at the interface of the porous Navajo sandstone and the clay-lined Kayenta Formation, have Southern maidenhair fern (*Adiantum capillus-veneris*), columbines (*Aquilegia* spp.), Cardinal monkey-flower (*Mimulus cardinalis*), and Zion shooting-star (*Dodecatheon pulchellum* var. *zionense*).

Notes: Zion has the greatest plant richness of any park in Utah and is second only to Grand Canyon NP in the Colorado Plateau, despite its relatively modest size. In the past decade, the number of plant taxa documented in Zion NP has increased by nearly one hundred. Campgrounds and trailsides are important sites for new weeds to become established, but significant areas of remote canyon country remain poorly explored for new native species. Much of Zion's diversity can be attributed to its location near the juncture of the Great Basin, Colorado Plateau, Mojave Desert, and Rocky Mountains and due to the presence of over 100 endemic species restricted to Zion and the vicinity.

References: Fertig, W. & J. Alexander. 2009. Annotated Checklist of Vascular Flora: Zion National Park. Natural Resource Technical Report NPS/NCPN/NRTR-2009/157. (available online at NPS NCPN website).

Fertig, W. 2015. Flora of Zion National Park. *Calochortiana* 2:3-131.

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Noteworthy Discoveries

Rare Plant Hunting in Eskdale

By Jason Alexander

In the fall of 2014, while revising the rare plant list for the UNPS, I came across an odd locality described in *A Utah Flora* for the high elevation species, *Sphaeromeria capitata*. Stan Welsh and Duane Atwood apparently came across this plant in the Snake Valley at a very low elevation in Millard County, much lower than any other records of this taxon. I suspected it was a misidentification. Upon further investigation, I found a digitized record on the Consortium of Pacific Northwest Herbaria of this Millard County record (Atwood 30496, SRP27473), collected 7 miles W of Eskdale on June 29, 2004. However, the collection data was contradictory. Seven miles west of Eskdale is well across the border in White Pine County, Nevada and the TRS, 21S R19W S6, places the locality a few miles south of US Hwy 6-50 and west of Utah Highway 159 along the drainage of Baker Creek a few miles north of Garrison (much further southwest than 7 miles from Eskdale). There was undoubtedly something odd going on here with this information.

Further investigation of the online specimen showed that it had unusual basal leaves for this taxon. The basal leaves appear once-pinnately lobed with linear leaflets. *Sphaeromeria capitata* has basal leaves mostly 1–2-palmately lobed (with a few leaflets pinnately lobed at the base) with wider leaflets. To me, this voucher looks like *Sphaeromeria potentilloides* var. *nitrophila* and the habitat matches better with sites from Nevada than the habitat for *S. capitata*. However, Atwood's specimen is long past flowering and I could not tell if the receptacles are villous and if the achenes were mucilaginous when wet (key distinguishing characters of *S. potentilloides*).

As for the locality issue, Welsh and Atwood were collecting together that day according to specimen labels. Stan's specimens indicate that he also collected adjacent to Atwood's local-



ity. His collections place this site 4 miles W of Eskdale at T19S R19W S31, which is north of the road to Eskdale and east of the Gandy Road. I concluded that Duane was collecting south of the dirt road to Eskdale east of the junction with the Gandy Road. Atwood appears to have been collecting in T20S R19W S6 that day. Incidentally, 4.5 miles is about 7 km, so I attribute Atwood's label error to one of mistaken units in his notes. Armed with these data, I headed out on a collecting trip to find this new record for Utah.

On my first trip, I did not find any likely habitat along the road to Garrison in the Baker Creek drainage, at the TRS indicated on Atwood's label. I then went north to the intersection of the Gandy Road and the road to Eskdale and collected. To my surprise I found an odd plant in the genus *Frasera* in flower in very soft, saline soils where in the spring it would be saturated. I took a few pictures and went on searching. However, the *Sphaeromeria* remained elusive and I could not relocate Atwood's population.

After returning to UVU, I found that this odd plant I did discover was the only known Utah site for *Frasera gypsicola* (photo above). I enlisted Steve Hegji a week later to return to that site so he could photograph this species in flower and continue looking for this elusive *Sphaeromeria*. During the second trip, we searched this area for some time without any signs of a *Sphaeromeria*. Also, I was unable to find two other plants collected by Welsh at this site, *Ivesia kingii* and *Nitro-*

phila occidentalis. I suspect that *Sphaeromeria* and *Ivesia kingii* are growing somewhere farther north and east of this locality in lower elevation, saline playa drainages, where the soil is more saline and saturated for longer periods.

Steve and I visited a few more saline clay playa sites farther north in the vicinity of Gandy before deciding to return home. On the way back, we stopped along the Gandy Road and walked around a reservoir on the east side of the road. To my surprise, on the SE side of that reservoir, I found another population of *Frasera gypsicola*. At this site, the plant was growing on hard, compacted, and cracked, playa clay, very different than the Eskdale locality. The plant was growing with the same associates, but on a very different soil type. There were several hundred plants and I walked around looking for more and kept finding them as I walked south and east. I would not be surprised if one could count 500 or even almost a thousand plants. This site is, to my knowledge, much larger than the Eskdale population in size and density and should be surveyed more completely. Certainly, the different soil type would change the results of potential habitat maps made by Robert Fitts for the Heritage Program.

This population is in the vicinity of 39.151555 -114.031080 at T19S R19W S18. It extends the northern range of this taxon in Utah by around 1.5 miles. The reservoir is old and is present on the topo maps.

This was my last collecting trip in Utah before leaving Utah Valley University for UC Berkeley. The specimens will be deposited at UVU. I expect some intrepid Utah plant explorer will be botanizing in this area sometime in the future and find the elusive *Sphaeromeria* population growing with *Ivesia kingii* and *Nitrophila occidentalis* (like it does in Nevada) and hopefully confirm it as a new record for the state.

New Flatsedge Reports for Utah

by Tony Frates

During an early morning stroll along the Colorado River in Professor Valley and in the moist sand peppered with small gravels to medium and even boulder-sized rocks that were somewhat difficult to walk on, I noticed a *Juncus* species that seemed unusual and that I had not seen before. After studying it for a short while and as I prepared to leave the area, I noticed a single *Cyperus* which I quickly photographed and made some brief notes before hurrying towards breakfast. I figured that it was probably either a low growing *C. esculentus* or more likely *C. erythrorhizos* (the latter of which I had only recently realized I had seen over the last few years in Salt Lake County at two locations along the Jordan River where it hasn't been well known, although it does occur not too far south around Utah Lake).

Upon returning home, the *Juncus* species keyed out to *J. articulatus* which in Utah is a somewhat unusual "medium rare" category species that exists in a variety of scattered locations. I then remembered the picture I had taken of the *Cyperus* and had difficulty keying it out using any of the keys contained in our local floras. At this point, I decided that I would need help if I was ever going to determine its identity, and so I turned to northern Arizonans Glenn Rink and Max Licher (both affiliated with the Deaver Herbarium in Flagstaff) who had co-authored an excellent *Carex* treatment for Arizona that Walt Fertig had earlier brought to my attention, and that I knew would be excellent resources. Luckily, Max is a *Cyperus* expert and he immediately recognized the plant as *Cyperus odoratus*, (Rusty or Fragrant Flatsedge).

While *C. odoratus* is not currently contained in any of the regional floras covering Utah, it turns out that it was collected in the Glen Canyon NRA in October 2002 by Ken Heil (accompanied by several others) on the San Juan Arm in San Juan Co. and again in August 2003 by Mar Elise Hill on the Escalante Arm in Explorer Canyon in Kane County. Max Licher was also the determiner of those specimens.

So for now, we know that this species occurs in Grand, San Juan and Kane counties in Utah (and in probably scattered places in between along the Colorado River and its tributaries).

Rusty Flatsedge has a large distribution which includes South and Central America. In the U.S. it occurs in most eastern states and is scattered in the Midwest extending to the southwest and then to southern California where there are many collections and then up the West Coast to Oregon and Washington.

While largely unknown in the Intermountain West, it has been collected fairly extensively in Arizona's Mohave County along the Virgin River drainage and also in the central-southern portion of Arizona. In the Phoenix area, Walt Fertig advises that it can show up as a



Above: Rusty flatsedge (*Cyperus odoratus*) by Tony Frates.

lawn weed.

As described by Max, *C. odoratus* has terete (round/cylindric in cross section) spikelets that disarticulate at each joint when mature (and in this character is unique among Utah *Cyperus*). It ranges from being a small to very robust annual (although FNA indicates that it can be a short-lived perennial), and will show up in different places in different years.

Including *C. odoratus*, there are now nine species of *Cyperus* that are known to occur in Utah (with one of those being of questionable origin; so at least eight native species). Most of these are annuals. Of the eight clearly native species, just four have prior conservation rankings inasmuch as the genus is generally peripheral to Utah (see table) and this new Flatsedge will probably join that group.

Cyperus species in Utah overall have a very limited distribution and in many of our geographical provinces are either completely or largely absent. While our knowledge about these mostly relictual species in Utah has advanced slowly, botanists from Utah, Arizona and New Mexico in the last several decades have been occasionally locating species in previously undocumented counties (see table.)

Summary of Utah *Cyperus* (Flatsedge) Species

by Tony Frates

Name	A=Annual P=Perennial SLP=short-lived perennial	Subgenus		UNPS conservation status (rarity, where ranked, is peripheral for this genus in Utah)
<i>Cyperus acuminatus</i>	A	PYCNOSTACHYS	Millard	Watch (known from only 5 collections)
<i>Cyperus bipartitus</i> (syn. <i>C. rivularis</i>)	A	PYCREUS	Utah, Weber* (probably was in Salt Lake-Davis pre-settlement)	Watch (known from only 2 collections)
<i>C. erythrorhizos</i>	A	CYPERUS	Garfield, Grand, Kane, Salt Lake*, San Juan, Utah, Washington, Wayne*, Weber*	Low
<i>C. esculentus</i> (two taxa)	P	CYPERUS	Davis, Grand, Salt Lake*, Utah*, Washington	Low (re: var. <i>heermannii</i> , need data)
<i>C. michelianus</i>	A	MICHELIANI (not treated by FNA or Intermountain Flora)	Uintah (suspected introduction by waterfowl)	Low
<i>C. odoratus</i>	A, SLP	DICLIDIUM	Grand*, Kane*, San Juan* (Colorado River drainage)	Not yet ranked probably Medium
<i>C. schweinitzii</i>	P	CYPERUS	Kane (dunes and sandy soil north and west of Kanab; unusual habitat compared to other <i>Cyperus</i> species in UT)	Medium
<i>C. squarrosus</i> (syn. <i>C. aristatus</i>)	A	CYPERUS	Duchense, Emery, Garfield, Grand, Kane, Piute, Salt Lake (rare), San Juan, Uintah, Utah, Washington, Weber	Low
<i>C. strigosus</i>	SLP, P	CYPERUS	Kane*, Washington	Medium

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