Sego Lily
Newsletter of the Utah Native Plant Society
March 2010 (volume 33 number 2)

Utah's Mojave Desert Flora

By Walter Fertig

It is no accident that the words "desert" and "deserted" share the same origin. Both refer to areas that seem desolate and empty. Ecologists define deserts more precisely to include those lands where annual rates of evaporation and transpiration of water by plants exceeds precipitation from rain and snow. Lack of moisture for much of the year helps explain the "deserted" appearance of deserts, which, with few exceptions, have a very sparse covering of plants. High rates of evaporation and transpiration are facilitated by high temperatures, and not surprisingly most deserts fall within latitudes of high solar radiation, low humidity, and minimal cloud cover. High temperatures alone, however, do not define deserts, as some of the driest areas on Earth are the cold polar deserts of the high arctic and dry valleys of Antarctica. For our purposes, [continued pg 6]

Above: Joshua trees, chollas, creosote bush, bur-sage, and other Mojave Desert shrubs on the flanks of the Beaver Dam Mountains. Photo by Douglas N. Reynolds.

Utah Native Plant Society

Website: For late-breaking news, the UNPS store, the *Sego Lily* archives, Chapter events, links to other websites (including sources of native plants and the digital Utah Rare Plant Field Guide), and more, go to unps.org. **Many thanks to Xmission for sponsoring our website.**

For more information on UNPS: Contact Bill King (582-0432) or Susan Fitts (801-756-6177), or write to UNPS, PO Box 520041, Salt Lake City, UT, 84152-0041 or email unps@unps.org

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Sego Lily
March 2010
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In this issue:

Chapter News

Escalante (Garfield County): On Tuesday, April 13, Walter Fertig will speak about the Deer Creek bio-blitz held near Boulder in 2007-2008.

Fremont (Richfield area): The Fremont Chapter is going strong spreading the word about native plants. With new President Lisa White, the chapter has planned many activities over the next few months to get the community involved and excited about natives. For any of you Facebookers, be sure to fan our new page (search for Fremont Native Plant Society), and keep checking back there or on the UNPS website for upcoming events.

The chapter has once again done a calendar as a fund-raiser, and we now have a PayPal account set up so folks can pay for them online. For more information (or to purchase a calendar!) contact Janet Nielson at jbnielson@sisna.com. As another way to raise funds, chapter members are again offering spring yard clean-up services to anyone who would like us to come get their landscapes in tip-top shape.

Aside from weeding and maintaining the native plant gardens the chapter has planted over the past couple of years, members will be going on hikes, having campouts, participating in fairs and festivals,

and having wonderful food at potluck meetings. The chapter is also trying to get local schools involved in many of the activities, and is working with science teachers at all levels to try and get natives into their curriculum. - *Lisa White*

Manzanita (Kane County): On Monday, March 8, Carolyn Shelton (a.k.a. Professor CZ Shelton, certified botano-therapist) will dust off her lab coat for another entertaining performance as she discusses Companion Plantings. Regular Manzanita meeting attendees may recall Professor Shelton's previous one woman, off Broadway show about "Sex in the Garden" a few years ago. In her new presentation, the Prof will describe garden plants that work well together to ward off insect pests, attract pollinators, and look good at the same time. The meeting will be held in the Grand Staircase Visitor Center at 7 PM.

Our April meeting will be on Tuesday, April 6 at 7 PM and feature retired Forest Service fire ecologist Roger Hoverman speaking on wildland fire and prevention measures.– *W. Fertig*

Utah Valley: We are starting Plants and Preschoolers in April. On Thursday, April 8th at 10 AM we will be hiking up the main trailhead in Rock Canyon. If you are coming from Salt Lake, get off I-15 at University Parkway and follow it until you are near BYU and turn east onto 2230N which becomes 2200N until you get to North Temple Dr (2300N), then follow this east to the parking lots at the trailhead. The road makes a sharp turn to the south and becomes Foothill Drive. Do not turn south—just head straight into Rock Canyon. There is a Utah Heritage Garden just as you enter the parking lot. Drive to the top parking lot near the restrooms.

Utah Valley will be hosting a trip to Price Recreation Area the first weekend in June. On June 5th, we will be hiking to some Bristlecone pines on a trip led by Kim Despain. More details to follow in the next issue of the *Sego Lily*, or by contacting me at celeste@byu.edu —*Celeste Kennard*

Bulletin Board

Utah Annual Rare Plant Task Force Meeting, March 9-10, 2010: Red Butte Garden and the Utah Native Plant Society are sponsoring this year's state rare plant meeting. The main meeting is on Tuesday, March 9th from 8:30 AM to 5 PM and will be held at the Fort Douglas Officer's Club on the University of Utah campus in Salt Lake City (this was the same site as our 2008 meeting). This meeting will include talks and posters on various topics related to rare plants and plant conservation biology in Utah and the region. There is a registration fee of $15 for the Tuesday meeting which includes lunch and free parking. To register, see an updated agenda, find a map to the meeting site, or sign up to give a presentation, see the Red Butte Garden website (www.redbuttegarden. org/conservation/RPTF) or contact Rita (rita.dodge@ redbutte.utah.edu) or Kipp (Kipp_Lee@ comcast.net).

On Wednesday, March 9th rare plant enthusiasts can participate in a working group meeting on revising the 2009 UNPS rare plant list (published in the November 2009 issue of the *Sego Lily* and available on the UNPS website as a downloadable excel file). This meeting will be held at Red Butte Garden and Arboretum, 300 Wakara Way, Salt Lake City from 9 Am-12 PM. Rather than go through the entire list from A-Z, we plan to only discuss those species for which there is new information or which may need a change in status.

***Phragmites* Workshop, March 10:** The US Fish and Wildlife Service, Utah Division of Wildlife Resources, Utah State University, and Bear Lake Watch are sponsoring a one-day workshop on the Common reed (*Phragmites australis*) at the Bear River Bird Refuge, Brigham City, UT from 10 AM to 3 PM. Dr. Karin Kettenring from USU will be on hand to discuss new research on differentiating native vs non-native strains of Common reed, its spread, and possible control mechanisms. For more information or to RSVP, contact Phragmites@bearlakewatch.com.

16th Wildland Shrub Symposium, May 18-20, Utah State University: Since 1983 the Shrub Research Consortium (a group of 27 different institutions) has sponsored meetings of researchers and land managers interested in shrubland ecology. This year's theme is "Threats to Shrubland Ecosystem Integrity: Linking Research and Management". The meeting will include invited keynote speakers, six concurrent technical sessions, a poster session, and field trips. For information on submitting an abstract, registration, and accommodations, go to http://wss2010.usu.edu/.

Purge Your Spurge and Native Plant Sale, May 15, 10 Am-3 PM: On May 15 the Salt Lake County Weed Program, Bonneville CWMA, Salt Lake Conservation District, and Utah Native Plant Society invite you to the 4th annual "Purge Your Spurge" event. Don't miss out on this great opportunity to rid your landscape of the garden thug, Myrtle spurge (a.k.a. Donkeytail spurge or *Euphorbia myrsinites*) and receive 5 free native plants from the Intermountain West in exchange. After receiving your free plants, consider adding to your landscape by purchasing companion plants from our native plant sale.

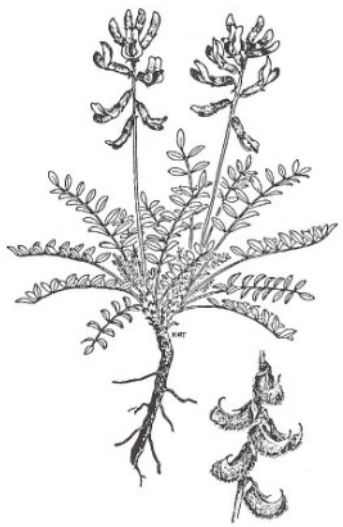
Bring your bagged Myrtle spurge to the Salt Lake REI located at 3285 East 3300 South on May 15 from 10 AM to 3 PM. For more information contact the Salt Lake City Weed Program at 801-468-2861 or on the web at www.weeds.slco.org. For a list of plants available at the native plant sale, go to the Salt Lake Conservation District website at www.saltlakeconservation.org or call Noelle at 801-542-8208.

UNPS Life Member Update: UNPS board member Ty Harrison became the society's 36th life member in December 2009. Thank you, Ty.

Utah Botanica

Odds and Ends from Utah Botany

Astragalus equisolensis back on BLM Sensitive list: As reported in the September 2008 issue of the *Sego Lily*, Horseshoe milkvetch (*Astragalus equisolensis*) was dropped as an official candidate for potential listing under the Endangered Species Act in 2006. This narrow endemic of the Uinta Basin in NE Utah and adjacent NW Colorado is known from an estimated 10,000 plants and is threatened by habitat loss from ongoing oil and natural gas exploration and development. Although candidate status does not confer the same legal protection as actual listing as Threatened or Endangered, land management agencies typically attempt to minimize activities that might harm candidates and lead to their official listing by the US Fish and Wildlife Service. With its candidate status lost, Horseshoe milkvetch was potentially off the radar screen in planning and implementing energy projects in the Uinta Basin.



In June 2009, the Utah state BLM stepped in and added Horseshoe milkvetch back to the bureau's official list of state Sensitive plant species. Sensitive species are those identified by the BLM that might qualify for listing as Threatened or Endangered in the future, especially if populations trend downward or habitat is lost. The BLM action means that on-going and future development actions on BLM-administered lands (including mineral leases) will need to consider the needs of this species before moving forward.

White Dome Update: The Nature Conservancy recently purchased another 161 acres of White Dome from the School and Institutional Trust Lands Administration (SITLA). The White Dome Preserve is located south of St. George on the Arizona state line and is a gypsum-rich desert site that provides habitat for two federally listed rare plants, the Dwarf bearclaw poppy (*Arctomecon humilis*) and Siler's pincushion cactus (*Pediocactus sileri*) as well as many other uncommon Mojave plants and animals. More land remains to be purchased by TNC and the Utah Department of Transportation toward the ultimate goal of an 800 acre preserve that will not only protect rare plant habitat but also provide open space in the growing St. George area. Plans to construct a series of walking trails and educational signs in the preserve are still being developed. TNC is also working to purchase additional SITLA acreage in the vicinity to protect the Endangered Holmgren's milkvetch (*Astragalus holmgreniorum*).

Zion National Park Pulls into the Lead on Plant Species Richness: In the July 2009 issue of *Sego Lily*, I reported on the relative species richness of Utah's 14 national parks, monuments, recreation areas, and historic sites managed by the National Park Service and the Bureau of Land Management's National Landscape Conservation System. At that time, Grand Staircase-Escalante National Monument held a slim lead over Zion National Park in the total number of documented species, 999 to 991 (Glen Canyon National Recreation was a distant third with 889 species).

Now that the dust has settled on the 2009 field season, Zion National Park has emerged as the new and undisputed champion. Twenty-one new species were discovered in 2009 and another 12 new species for the park came to light from examination of unmounted specimens from the Zion herbarium. With a net increase of 32 species (correcting for one false report), Zion now has 1023 confirmed and reported vascular plant taxa, of which 871 are native species.

Exotic species make up a large component of the new species for the park. Ryan Meszaros and colleagues from Northern Arizona University documented a number of introduced species in the Crater Hill and Kolob Terrace areas of Zion while monitoring the recovery of vegetation following recent wildfires. Among their discoveries were Forage kochia (*Bassia prostrata*), Common sow-thistle (*Sonchus oleraceus*), Wild oats (*Avena fatua* var. *fatua*), Chilean chess (*Bromus trinii*), and Grain sorghum (*Sorghum bicolor*). I found some other exotics in trailside settings and at the East Entrance burn, including Redroot pigweed (*Amaranthus retroflexus*), Holosteum (*Holosteum umbellatum*), and two alien alyssums (*A. desertorum* and *A. parviflorum*). Park vegetation and fire staff also recorded Common hackberry (*Celtis occidentalis*) and Himalayan blackberry (*Rubus discolor*).

Not all the new plants were exotics, however. Among the natives were Desert milkweed (*Asclepias erosa*), Wright's perezia (*Acourtia wrightii*), Woolly desert-marigold (*Baileya pleniradiata*), Greasewood (*Sarcobatus vermiculatus*), Fluffweed (*Filago californica*), and Grand Valley desert trumpet (*Eriogonum inflatum* var. *fusiforme*). What additional discoveries await in 2010? - *Walter Fertig*

What's in a Name: Hilaria

By Walter Fertig

Left: Galleta (Hilaria jamesii) *from Chase (1950). The spike-like inflorescence of* Hilaria *consists of clusters or fascicles of three spikelets (bottom right) with two staminate spikelets on either side of a one-flowered, seed-bearing pistillate spikelet. The whole unit falls from the grass stem as one, exposing the distinctively zigzag shaped stalk. As grasses go, Galleta is one of the showiest native species, especially when the spikelets are fully opened.*

There is nothing funny about the name *Hilaria*. It commemorates the 19th century French naturalist and author Auguste Saint-Hilaire. From 1816-1822 Saint-Hilaire traveled extensively in South America and amassed nearly 60,000 specimens of vascular plants, insects, birds, mammals, and other animals. Most of these collections represented species that were new to science. Saint-Hilaire co-authored an early flora of Brazil along with works on plant geography, morphology and a popular account of his travels across South America. German botanist Carl Sigismund Kunth (of Humboldt, Bonpland, and Kunth fame) was a contemporary of Saint-Hilaire and also worked extensively in South America in the early 1800s. Kunth honored St. Hilaire by naming the new grass genus *Hilaria* after him.

Depending on the authority, between seven and ten species are currently recognized in the genus *Hilaria*. These species are found primarily in the deserts of the southwestern United States and Mexico but some taxa extend south to Central America and Venezuela. As a group, the *Hilaria*s can be recognized by their distinctive, spike-like inflorescence consisting of clusters of three spikelets at each node. The outer pair of spikelets contains staminate flowers, while the central spikelet produces a single, seed-bearing pistillate flower. When mature, the cluster of fuzzy flowers is surprisingly showy for a wind-pollinated species. The flower clusters fall as a unit when the seed ripens, revealing the distinctive zigzag pattern of the upper stem. True *Hilaria* species have the hardened, outermost bracts of the three spikelets fused at the base into a cup and are called vine mesquites. Other species with more membranous and unfused bracts are sometimes segregated into the genus *Pleuraphis* and include the grasses commonly called galleta and tobosa.

Galleta or *Hilaria* (*Pleuraphis*) *jamesii* is the most common and widespread of the *Hilaria* species in the United States, where it ranges from southern Wyoming and northern Nevada to southern California, northern Mexico, and southwestern Kansas. It is especially abundant in desert grasslands and rocky canyons of southern Utah, Arizona, and New Mexico. As a warm season or "C4" perennial grass, Galleta is more water efficient than many grasses, and so can photosynthesize at high temperatures and under relatively droughty conditions. The species also flowers and produces seed in mid-summer rather than spring, and so tends to be less impacted by winter and spring grazing than "cool season" grasses. Galleta provides nutritious forage for native herbivores and domestic livestock when it is green, but is less palatable once its curly leaves have dried and cured. Galleta is nonetheless an important range grass and tends to be more tolerant of heavy grazing than many other natives.

Big galleta (*Hilaria rigida*) replaces Galleta over much of the Mojave Desert. In protected situations it can form dense clumps with stems over 3 feet tall. Although the flowers of the two galletas are very similar, *H. rigida* can be easily recognized by its white-woolly leaf sheaths (those of *H. jamesii* are glabrous). In Utah, Big galleta occurs commonly on the rocky slopes of the Beaver Dam Mountains and in some areas is the dominant grass. It can also grow among Joshua trees, Creosote bush, Blackbrush, and other warm desert scrub species. According to the *Utah Flora* Big galleta is restricted to Washington County, but Mary Barkworth and colleagues also include San Juan County in its range in their recent *Manual of Grasses for North America*.

In warm climates, Galleta is sometimes grown in reclamation projects or as an alternative to a Kentucky bluegrass lawn. Once established it needs little water and can withstand heavy foot traffic. It can even out-compete weedy annuals in well-drained sites and facilitate the recovery of other native species. And that is no laughing matter.

Utah's Mojave Desert Flora

[continued from page 1]

though, deserts can be defined as hot, dry, arid lands with minimal cover of plant life.

Biogeographers typically recognize five major desert areas in the lower 48 states, three of which occur in Utah. Two of these, the Great Basin and Colorado Plateau, are considered "cold deserts", an oxymoron perhaps, but relevant in that winter temperatures are commonly below freezing and much of the year's precipitation comes in the form of snow. By contrast, the state's third desert, the Mojave, is a "warm desert" characterized by relatively mild winters and most precipitation coming as rain.

The Mojave Desert extends from south central California and southern Nevada to extreme southwestern Utah and northwestern Arizona. In Utah, the Mojave is essentially restricted to the vicinity of St. George, the Beaver Dam Mountains and Beaver Dam Wash to the west. Elements of the distinctive Mojave flora creep northward to the base of the Bull Valley and Pine Valley mountains where it merges with the Great Basin Desert. To the east, the Hurricane Fault forms a good boundary between the floras of the Mojave and the Colorado Plateau. Outside of Utah, the Mojave abuts the Sonoran Desert of southeast California, southern Arizona, and northwestern Mexico. The only desert it does not border is the Chihuahuan which is centered in north-central Mexico, southern New Mexico, and western Texas. At 140,000 square km, the Mojave is the smallest desert in North America.

Like the Mojave, the Chihuahuan and Sonoran deserts are classified as warm deserts. The Chihuahuan is distinctive in that the majority of its rainfall comes in the summer months. In the Sonoran desert, rain comes in two seasonal pulses: winter and a summer monsoon. The Mojave differs in primarily having winter rain , though occasionally snow will fall at higher elevations and a slight monsoon effect may be present in the eastern Mojave. These differences in the timing of precipitation, coupled with variations in soil, bedrock geology, and base elevation account for the floristic differences between the major warm desert types.

The Chihuahuan is dominated by Creosote bush (*Larrea tridentata*) and Tarbush (*Flourensia cernua*), an aromatic, fall-flowering shrub with sticky leaves in the sunflower family. Desert grasslands were an historically important component,

*Above: Limey sandstone in the Beaver Dam Mountains support the yellow-rayed Baird's nakedstem (*Enceliopsis nudicaulis *var.* bairdii*) and a variety of low shrubs and bunchgrasses. Photo by Douglas N. Reynolds.*

though their abundance has diminished in recent decades. A high number of summer annuals occur in the Chihuahuan Desert in response to the seasonality of its rainfall.

Saguaro (*Carnegiea gigantea*) is often considered the signature species of the Sonoran Desert (especially in the highlands of Arizona), but other dominant species include Creosote bush, White bur sage (*Ambrosia dumosa*), Blue palo verde (*Cercidium floridum*), and Teddybear cholla (*Opuntia bigelovii*). Because of its two main periods of rainfall, winter and summer annuals are abundant in the Sonoran Desert.

Due to its geographic location, the Mojave has floristic elements of the Great Basin, Colorado Plateau, and Sonoran deserts. Some ecologists have questioned whether the Mojave should even be recognized as a biological region distinct from the Great Basin at its north end or the Sonoran at its southern boundary. Floristically, however, the Mojave Desert has more than 200 endemic annual plants (found nowhere else). Dr. Steven McLaughlin of the University of Arizona recently conducted a Principle Components Analysis of species lists from across the western US that confirmed the existence of a distinctive Mojavian floristic component. Centered in south-central California, the Mojave element defines the flora of the Mojave Desert and influences species composition of adjacent areas.

In terms of vegetation, the boundaries of the Mojave Desert closely matches the native range of Johsua tree (*Yucca brevifolia*). Named for its outstretched arms that reminded pioneer settlers of the biblical story of Joshua wildly gesticulating in the direction of the Promised Land, Joshua tree is the most arborescent of all the *Yuccas* of North America. Joshua tree forests typically occur on the midslopes of rocky colluvial fans or bajadas that form below steeper limestone-sandstone bedrock outcrops. It is found mostly at higher elevations in the Mojave Desert and becomes replaced by the ubiquitous Creosote bush on lower slopes and valley bottoms and by Single-leaf pinyon

*Above: Joshua tree (*Yucca brevifolia*) is one of the signature plants of the Mojave Desert. It is unusual in the* Yucca *genus (and among monocots in general) for its tree-like growth form and clusters of relatively short leaves (the specific epithet* brevifolia *means short leaf). In many years Joshua trees produce dense spikes of creamy white flowers in late March or April. Photo from the Beaver Dam slope by W. Fertig.*

(*Pinus monopylla*) and Utah juniper (*Junip-erus osteosperma*) at higher elevations. In Utah, Joshua tree is largely restricted to the slopes of the Beaver Dam Mountains and adjacent outwash plains (plants in St. George itself were planted). Much of this area burned in 2005 from lightning-caused fires that spread rapidly through the unnaturally dense understory of introduced annual grasses.

Creosote bush occurs in all of the warm deserts of North America but is conspicuously absent from the Great Basin and the Colorado Plateau. In the Mojave, Creosote bush is the dominant species of lower bajada slopes and rocky valley bottoms, especially where soils are well-aerated and non-saline. Stands of Creosote bush are often remarkably uniform, with individual shrubs evenly spaced rather than clumped (as most plant species usually are). Creosote plants are connected underground by creeping rhizomes and the spacing of plants may be due to toxic secretions that prevent new plants from growing in the gaps between shrubs. Clones of Creosote bush tend to grow outward in a ring from their point of origin, reminiscent of the "fairy rings" of mushrooms. Some clones have been aged to 9000 years, making Creosote bush one of the most long-lived of all plants.

Geneticists have also discovered that Creosote bush populations in the Mojave, Sonoran, and Chihuahuan deserts differ in base chromosome number. Chihuahuan plants have a base of N = 13 chromosomes, while those of the Sonoran Desert are double (N = 26) and the Mohave are triple (N = 39). Morphologically, the shrubs also differ between the deserts, with Chihuahuan plants generally having a V-shaped form and Mojave plants being rounded (Sonoran plants are intermediate).

Perhaps the most unusual feature of the Mojave *Larrea* plants is the orientation of their leaves. All Creosote bush leaves have a characteristic butterfly-like shape, with the leaf divided into 2 wedge-shaped segments tilted towards each other at a slight angle (much like the half-open wings of a lepidopteran). In the Mojave, Creosote bush leaves generally face towards the southeast, and can provide a compass of sorts for those who are lost.

*Above: Creosote bush (*Larrea tridentata*) is one of the predominant species of the warm deserts of the Southwest, including the Mojave. It can be recognized by its bright yellow 5-petaled flowers that yield white-fuzzy round fruits and the distinctive "butterfly wing" leaves covered by shiny resin. Photo by W. Fertig.*

The sticky foliage of *Larrea tridentata* imparts the characteristic aroma of the Mojave Desert. It is also irresistible to a number of desert insects, including several moths, midges, and other bugs that are largely dependent upon the plant for their livelihood. One of the more interesting of these insects is the Lac Scale which forms the black gummy bands commonly seen on Creosote bush twigs. During World War II scientists studied the potential use of this gum as a replacement for shellac when supplies from Burma were cut off due to the Japanese occupation.

Differences in landscape position and soil properties help explain the distribution of other important vegetation types in the Utah Mojave. Blackbrush (*Coleogyne ramosissima*) is abundant on a variety of soils that overlie a subterranean hardpan or caliche layer. Often composed of calcium carbonate, the stone-like caliche layer restricts water and root penetration. White bur-sage (*Ambrosia dumosa*), wolfberry (*Lycium* spp.), Nevada ephedra (*Ephedra nevadensis*) and various cacti may be dominant or co-dominant with Creosote bush on gravelly colluvial fans and valley bottoms. Low-lying areas with fine-textured saline soils support communities dominated by various shrubby members of the goosefoot family (Chenopodiaceae), including Shadscale (*Atriplex confertifolia*), Fourwing saltbush (*A. canescens*), and Winterfat (*Krascheninnikovia lanata*). Many of the shrubby chenopods are able to grow in soils with a high salt content that inhibits moisture uptake for most plants. Chenopods are able to remove excess salt from their internal fluids to retain a functioning osmotic balance. When nibbled, these species have a salty flavor.

In those rare areas with perennial water, the Mojave can support desert riparian vegetation. Streamsides and seeps may be lined by forests of Fremont cottonwood (*Populus fremontii*), Velvet ash (*Fraxinus velutina*), Goodding's willow (*Salix gooddingii*), Red willow (*S. laevigata*), Coyote willow (*S. exigua*), and Seep-willow (*Baccharis* sp., not really a willow, but a relative of sagebrush and rabbitbrush). Establishment of cottonwood and willow forests is strongly linked with periodic major flooding events which create barren, alluvial terraces suitable for seedling establishment. Tamarisk (*Tamarix chinensis*), an introduced species, has displaced native riparian vegetation over much of the desert.

An estimated 2400 vascular plant species occur in the Mojave, of which nearly 1000 range into southwestern Utah. The rich diversity of Mojave species contributes to Washington County having the highest vascular plant species richness of any county in the state. Many of the Mojave species are uncommon in Utah, because they occur at the very edge of their main range (what are often called peripheral species for being at the periphery of their distribution, not for being unimportant). Other rare Mojave taxa have limited global distributions centered on southwest Utah or adjacent parts of Arizona and Nevada. These so-called endemic species include several that are listed as Threatened or Endangered (like the Dwarf bear-claw poppy, *Arctomecon humilis* and Holmgren milkvetch, *Astraglus holmgreniorum*) or are candidates for listing (such as Gierisch's globemallow, *Sphaeralcea gierischii*).

The great diversity of plant species in the harsh Mojave Desert might seem perplexing given the great challenge all species face in deriving adequate moisture from a generally parched landscape. But desert plants have several tricks to help them cope. These can be boiled down to three main strategies: avoid, ignore, and adapt.

Avoiders grow, flower, and set seed only during those times following heavy winter or summer rains. The best known of the avoiders are the several hundred species of annuals that germinate, grow, flower, set seed, and die all within one growing

season. Nearly 38% of all plant species in the Utah Mojave Desert employ this strategy. Annuals are especially common in the spring following an atypically moist winter, when they may carpet bare ground with their colorful flowers. A smaller subset of Mojave annuals respond to rarer summer moisture events. In dry years annuals may be quite uncommon or even fail to emerge, persisting underground as seeds.

Some perennial plants also act like annuals in that they remain below ground during unfavorable years as dormant bulbs, corms, or roots. They may flower in profusion following a wet winter, but do not typically complete their life cycle and die in the weeks immediately following their emergence. An exception are some of the monocarpic perennials, like Utah century-plant (*Agave utahensis*) that only flower once following extended periods of vegetative growth (though not for a century) and then die after expending all of their food reserves on a massive fruit and seed crop.

Ignorers are a small subset of mostly perennial species that occur where water is available at or near the surface or within reach of their deep roots. These species include cottonwoods, willows, seep-willows, Catclaw acacia (*Acacia greggii*), Desert willow (*Chilopsis linearis*), Honey mesquite (*Prosopis glandulosa*), and various cattails, grasses, and forbs restricted to perennial streams and springs. Ignorers don't technically possess adaptations to persist drought conditions and cannot survive in areas where water is no longer available.

The adapters are plants that have evolved physiological or anatomical defenses to minimize water loss. The most common trait of adapters is the reduction of leaf size. In wet climates, plants tend to maximize their leaf area so as to capture more sunlight for photosynthesis. Big leaves are a severe handicap in the desert as their large surface area and abundant stomates (microscopic holes in the leaf surface for taking up atmospheric gases) are prone to severe evaporation of water and potential over-heating. Desert plants typically have small leaves to reduce water loss and may also protect themselves from further evaporation by being coated in waterproof waxes or dense hairs, orienting their leaves away from maximal exposure to the sun, and having light, reflective coloration. Many species will even shed their leaves in mid-summer to reduce water loss. Such species often have green stems that take the place of leaves as the main surface for conducting photosynthesis.

Cacti have taken leaf reduction to the extreme. The protective spines of most cacti are the only remnants of their former leaves. The swollen stems of the cactus are green for photosynthesis and also store moisture for later use. This water is held within fibrous and gummy tissue. It is only in B Western movies that one can procure drinking water by slicing a cactus in half!

Many desert grasses and shrubby members of the goosefoot family have developed an alternative photosynthetic system to more efficiently absorb carbon dioxide from the atmosphere while reducing water loss. These "C4" plants (shorthand for the four-carbon sugars used in their version of photosynthesis, as compared to the three-carbon sugars used by most "C3" plants) are able to capture atmospheric gases during the night when air temperatures are cooler and evaporation of precious water less likely.

*Above: Woolly eriohphyllum (*Eriophyllum lanosum*), a common annual of the Utah Mojave Desert. Photo by Laura Fertig.*

Despite all of these adaptations, life is still a challenge for the plant species of the Mojave Desert. Their survival has only gotten more difficult in recent years with the advance of civilization. Extensive areas of habitat have been lost to new development as St. George and other cities have grown and spread. Expanding populations bring increasing demand for outdoor recreation and impacts on fragile desert soils from off-road vehicles and mountain bikes. Increased disturbance facilitates the invasion of exotic annual weeds, such as Mediterranean and Arabian grass (*Schismus barbatus* and *S. arabicus*), Red brome (*Bromus rubens*), Filaree (*Erodium cicutarium*), and Sahara mustard (*Brassica tournefortii*). These aggressive species compete with native annuals for water, nutrients, and space and often provide less cover or nourishment for desert wildlife. Worse still, the dense growth of annuals provides tinder for summer wildfires, like those that consumed much of the Joshua tree forest in the Beaver Dams in 2005.

Get out and enjoy the Mojave wildflowers this spring, but remember, their continued survival may depend on each of us lending a hand.

Penstemon grahamii *and* Penstemon scariosus *var*. albifluvis *on Oil Shale*

By Robert and Susan Fitts

Surveys for *Penstemon grahamii* have been conducted for the past three years by the Utah Natural Heritage Program and Red Butte Gardens. *P. grahamii* had been a candidate for listing as an Endangered species for many years but was recently dropped from the candidate list by the U. S. Fish and Wildlife Service. The renewed interest in mining oil shale has led to a lawsuit for listing the species, and the BLM has sponsored surveys by Red Butte Gardens, while the Endangered Species Mitigation Fund, Uintah County and the U. S. Fish and Wildlife Service have funded the Utah Natural Heritage Program surveys. We began the Heritage Program surveys in 2007 near Park Canyon and Evacuation Creek near the Colorado – Utah border, where geologic maps showed the most oil shale. *Penstemon grahamii* had been mapped there in the 1980's. We found them in most of the known locations and many other sites. In 2008 we surveyed canyons south of the White River and found *Penstemon scariosus* var. *albifluvis* and *Penstemon grahamii* with other unique Uinta Basin plants: *Aquilegia barnebyi, Astragalus lutosus,* and *Eriogonum ephedroides.*

Penstemon grahamii is a perennial. The waxy blue leaves of the rosettes can be found at all times of the year. Our first experience looking for *Penstemon grahamii* was in October. We traveled to the site where Red Leaf Resources would demonstrate their technique for extracting shale oil. The *Penstemon grahamii* flower stalks were brown, and the seeds had fallen but the leaves stood out against the white shale chips of the Green River Formation.

In May, large pink flowers appear. The flowers are glorious, but the green rosettes stand in contrast to barren soil and are often spotted before the flowers. The ratio of flowering plants to rosettes was nearly the same for the past three years of the Heritage Program study; 46% for 2007 and 2008 and 44% for 2009. This is surprising considering we were looking in different places each year. It is not unusual to see *Penstemon grahamii* rosettes with flower stalks from the previous year, but no flowers at all in the present year. Insects and mammals feed on the plants. Red Butte Gardens kept track of the number of plants damaged by herbivores. The number ranged from 4.7% to 68% in the years 2004 to 2005. *Penstemon scariosus* var. *albifluvis* also showed signs of damage: 18% in 2008 and 42% in 2009.

Above: White River penstemon (Penstemon scariosus *var*. albifluvis) from the Uinta Basin. By Robert and Susan Fitts.

Dark layers of oil shale are often seen near colonies of *Penstemon grahamii*. The Heritage program surveys were in the plateau and canyon landscape south of the White River. The dark oil shale layers are found in the cliffs just below the canyon rims, in the eroding slopes below the cliffs, and on the white knolls of the Green River Formation. The Mahogany layer is the thickest oil shale layer, and is found near the top of cliffs in the White River area. Thinner layers of oil shale are found in the steep slopes below the cliffs.

Walking along the canyon rims above the Mahogany layer is the easiest way to find *Penstemon grahamii*. For some reason, the points on the canyon cliffs seem to be especially good habitat for *Penstemon grahamii*. Other good places to look include the heads of small canyons, along shelves of oil shale on eroding slopes, saddles in ridgelines, and low white knolls. Over six thousand *Penstemon grahamii* plants were found in the canyons south of the White River by the Heritage Program surveyors in 2008 and 2009. Many more were also located in the Evacuation Creek area by Red Butte Gardens and the Utah Natural Heritage Program. This is significant in that a previous estimate of *Penstemon grahamii* numbers was about six thousand total.

Penstemon scariosus var. *albifluvis* is also found south of the White River. In fact the name *albifluvis* means White River. It was named by Larry England of the US Fish and Wildlife Service. The two *Penstemon* species have their own favorite habitats, and *Penstemon scariosus* var. *albifluvis* often grows in areas with some sandstone where no oil shale can be seen. It is common to find it along dry waterways. It grows in places with pinkish-colored rock chips and emerges from talus on steep slopes, where it would be unusual to find *Penstemon grahamii*. *Penstemon scariosus* var. *albifluvis* is blue, but we found a few specimens of beautiful white flowering plants along the Colorado border. It is taller than *Penstemon grahamii* and always stands out in its habitat.

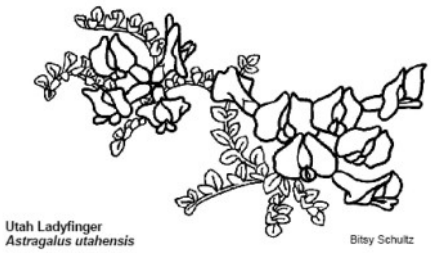
After nice camping in May, swarms of mosquitoes, gnats, and no-see-ums descended on us in June. We had to resort to head nets, long sleeves, and gloves for surveying, camping, and even eating.

Other endemic plants in the area, including *Aquilegia barnebyi, Eriogonum ephedroides,* and *Astragalus lutosus*, seem to grow right along with *Penstemon grahamii*.

Department of Corrections: Update on Erigeron glabellus

In our January 2010 issue, Tony Frates described his re-discovery of Smooth fleabane (*Erigeron glabellus*) in Salt Lake County. Two astute readers questioned whether the photo on page 4 of the issue was actually *E. glabellus* or one of the other tall, aster-like daisies. Closer inspection of the photo suggests that it actually depicts three individuals of *Erigeron speciosus*, which can be distinguished by their leafier stems. The photo at right was provided by Tony but was left on the cutting room floor during final production of the issue. It comes from the same area that Tony described and is a better example of true *E. glabellus*. My apologies for not catching this before the January issue was finalized.

While on the subject of daisies, reader Peter Lesica from Missoula, Montana provided another photo of Smooth fleabane (above) that he calls "Have a nice daisy".—*W. Fertig*



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