Sego Lily
Newsletter of the Utah Native Plant Society
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Cover: A small clump of Claret cup (now called Echinocereus mojavensis*) in the San Rafael Swell. Photo by Dorde W. Woodruff*

The Scarlet-Flowered Species of Echinocereus *in Utah*

By Dorde W. Woodruff

The scarlet-flowered Echinocerei are predominantly hummingbird-pollinated and have large, showy, bright red flowers in cespitose clumps that can reach an impressive size of a hundred or more heads. Sizeable clumps with their bright flowers are a striking feature of late spring. They are a fairly common sight in Utah's canyons, foothills, plateaus, and the higher parts of desert valleys. The clumps commonly grow in rocky places and usually on slopes.

Botanists have often sought to identify cactus specimens from Utah on the basis of keys derived from other states that don't work well here or are not valid. Many cactus populations in our state have not been studied extensively or thoroughly enough.

Unfortunately Utah is a backwater for cactus research, so members of the cactus family are less well understood here than in better-researched states such as Arizona. To my knowledge we have never had a professor at one of our Utah colleges or universities interested in Cactaceae, with a stable of eager graduate students to do the work. In this some- [continued on page 4]

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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

Sego Lily Editor: Walter Fertig (walt@kanab.net). The deadline for the September 2010 *Sego Lily* is 15 August 2010.

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Chapter News

Manzanita (Kane County): On May 28, a dozen Kanab area plant enthusiasts embarked on an expedition to the East Rim of Zion Canyon to view the spring wildflowers of Zion National Park. Part of our mission was also to confirm the presence of Dwarf cryptanth (*Cryptantha humilis,* below), a species which had been previously reported for Zion NP, but not photographed or documented with a museum voucher. We successfully located a small patch of the low-growing, white-flowered, bristly plants along

the trail on Carmel Limestone. Several other plants of interest were found with the cryptantha, including the yellow-flowered Charleston Mountain violet (*Viola purpurea* var. *charlestonensis*) and Rose's spring-parsley (*Cymopterus purpureus* var. *rosei*). In all, we found 132 vascular plant species in bloom.

Our next field trip will be on Saturday, 17 July to the Red Canyon Botanical Area on Dixie National Forest, off UT Hwy 12 west of Bryce Canyon National Park. We will carpool from the Grand Staircase-Escalante NM visitor center parking lot in Kanab at 8 AM and plan to arrive at the botanical area by 9:30 AM for a leisurely half day of searching for Claron endemics among the Bristlecone pines. For more info, contact me (walt@kanab.net).—W. *Fertig*.

Salt Lake: There are three remaining field trips scheduled for summer 2010:

Saturday, July 17: Upper Lambs Canyon with Bill Stockdale and Mindy Wheeler

Saturday, August 7: Brighton to see Wood nymph (*Moneses uniflora*) with Bill Nelsen

Saturday, August 14: Hiking and potluck in Upper City Creek Canyon with Marni Ambrose.

For more information on these trips, contact Bill Gray at cyberflora@xmission.com or 801-532-3486.—*Bill Gray*

Annual Field Trip Highlights

On June 12, the Manzanita Chapter hosted the UNPS state board for its yearly foray to southern Utah. As part of the festivities, the chapter sponsored the first botanical foray of the Best Friends Animal Sanctuary, located 7 miles north of Kanab. Best Friends is a no-kill animal shelter focusing on dogs, cats, horses, rabbits, and exotic birds. The grounds of the sanctuary include several hundred acres of unspoiled redrock canyons, pinyon-juniper forest, sand dunes, and riparian woodlands. Our goal was to develop a plant species list for the sanctuary.

Our small but enthusiastic team of botanists and naturalists spent 6 hours scouring the area in search of new plant species. Entomologist Ken Kingsley (below) provided expert commentary on a number of unusual insects in the area, including the yucca moth and the parasitoid wasp that preys on its developing larvae within the flower of the Narrow-leaved yucca (*Yucca angustissima*).

Prior to the foray, I had collected or observed 179 vascular plant species in the Best Friends area. By day's end our group had observed 129 plant species, of which 36 were new to the sanctuary. Our day's work increased the flora of the area by nearly 17%, bringing the total number to 215 species.

After the board meeting, our group reconvened at the home of Best Friends co-founder Jana de Peyer for a potluck dinner and general merriment.—*Walter Fertig*

Bulletin Board

New San Juan/Four Corners Native Plant Society: Many of you may already be aware of the 'Southwest Colorado Wildflowers' website created by Al Schneider (www.swcoloradowildflowers.com/) - it is a real treasure trove of information and photos about the plants of the Four Corners area. Al has now started a new society dedicated to the native plants of the area called the San Juan/Four Corners Native Plant Society. He invites all UNPS members and especially those from the southeast part of Utah to participate in his field trips and other events. Follow the link above to get more information or contact Al directly if you would like to be included in email notification. - *Bill Gray*

Global Garlic Mustard Field Survey: Do you want to be part of the world's largest scientific research project on invasive species? The 'Global Garlic Mustard Field Survey' is an international collaboration to obtain much-needed data on the abundance and distribution of Garlic mustard (*Alliaria petiolata*) across its native and introduced ranges. In our first field season last year, we received measurements and seed samples from 65 populations, with a majority from Europe. Our goal for this summer is 150 or more, with a stronger emphasis on the southern and mid-west to western United States.

This year we are hoping to increase participation among educators, as well as land managers and citizen scientists who may not have much formal science training. The survey involves a simple protocol that can be followed directly or incorporated into field courses and nature surveys. A population takes two people about 2-4 hours to measure. We are also planning to develop internet-based teaching modules and tools to aid with monitoring and managing this invasive plant. The sampling protocol, along with contact information is available at the Global Garlic Mustard Field Survey website: www.GarlicMustard.org.

Ideal sampling time is 2-4 weeks after flowering finishes (mid to late July in Utah). Please contact me if you would like to participate—*Dr. Robert Colautti*, Biology Dept., Duke University (rob.colautti@duke.edu).

Cedar Breaks Wildflower Festival: The 5th annual Cedar Breaks Wildflower Festival will be held from Friday, July 2 to Sunday, July 18 at Cedar Breaks National Monument in scenic southeastern Iron County, Utah (23 miles east of Cedar City). Volunteer wildflower specialists will be on hand for guided hikes at 10 AM and 1 PM daily. A Junior Ranger "wildflower scavenger hunt" will be held on Fridays and Saturdays during the festival at 3 PM. All activities begin at the Fee Booth area (adjacent to the main parking area, about 1.5 miles inside the monument's south entrance). The visitor center will also be hosting an ongoing electronic display of wildflower images and offer free wildflower photography tip sheets, and discounts on wildflower-themed books. For more information on the festival and associated activities, go to the Cedar Breaks National Monument website, www.nps.gov/cebr or call 435-586-0787. There is an entrance fee of $4 for Cedar Breaks National Monument for persons 16 and older and visitors in July should be prepared for potential afternoon showers and temperatures dropping to the 60s.

The Scarlet-Flowered Species of Echinocereus *in Utah*

(*continued from page 1*)

gloomy picture the large collection of cactus specimens at the Brigham Young University (BYU) is a great asset.

Many botanists don't like to deal with cacti and they are underrepresented in herbaria. Because of their succulence and also their armor, making decent dried specimens out of them is difficult, and the dried specimens are more changed in form from their live state than are those of non-succulent plants. The study of live plants in their environment is more important in this family. Their morphology is different, and botanists who don't deal with them much don't have an eye for them. Consequently, the study of cacti lags behind that of most other plant families, though more advanced in the southern states where there is more academic interest than in Utah.

These red-flowered hedgehog cacti have been placed in a subgenus, section *Triglochidiatus*. Going through the literature on *Echinocereus* shows that this section has not been at all well understood. Various authorities have subdivided the basal species *E. triglochidiatus* into a confusing array of species or varieties.

Quoting the late Lyman Benson, the largest single figure in cactus research, "Twenty-nine years of this [research] has not produced the ultimate answer" to resolve "…the instability of the populations of the proposed species and their extensive and bewildering intergradation with each other." In recent years most experts have used Benson's classification for this section, in which he reduced the various scarlet-flowered species to varieties of *E. triglochidiatus*. He did produce some order for these plants in his varieties, which others have built on. It was not a perfect analysis, but was the best available. I have followed Benson in determining all the scarlet-flowered hedgehogs in Utah as *E. triglochidiatus* but without the varieties, which didn't seem to work well in Utah.

Above: Hedgehog in the city: A clump of Echinocereus mojavensis *perches high above Salt Lake City in quartzite. Photo by Tony Frates.*

Most of Benson's work was finished well in advance of publication of his 1982 major work *The Cacti of the United States and Canada*. Not only must so comprehensive a work necessarily be done over a period of years, but also because it is a large and expensive volume, the Stanford University Press had to wait several years after completion of the manuscript until it had accumulated funds to print it, so in spite of Benson's long and patient work on the cacti, it was outdated even when it first was published. Nevertheless, it was the most comprehensive work on the family for a long time.

In 1985 Nigel Paul Taylor's monograph "The Genus *Echinocereus*" was published. Taylor is a botanist specializing in the Cactaceae at the famous Royal Botanic Gardens at Kew, England. This book covers the whole genus (not just those of the U. S. and Canada), and includes three species in Sect. *Triglochidiatus*: *E. scheeri*, a complex Mexican species, *E. triglochidiatus*, and *E. polyacanthus* (which is now considered a synonym of *E. coccineus*).

The treatment of *Echinocereus* for the 2003 volume of *Flora of North America* (FNA) was written by Allan Zimmerman and Bruce Parfitt, both one-time students of Donald Pinkava's at Arizona State University in Phoenix. They included three U.S. species in Sect. *Triglochidiatus*: *E. coccineus*, *E. triglochidiatus* and *E. arizonicus*. Although recognizing *E. coccineus*, they did not include Utah in its distribution.

Like Benson, Pinkava is one of the Grand Old Men of cactus research; unlike Benson, he is still with us and still active. His specialties are counting chromosomes and studying polyploidy, and also the genus *Opuntia*. Now retired from Arizona State University, he is still consulting with botanists of the Desert Botanical Garden in Phoenix and others. The work of Pinkava and his students in studying chromosome numbers has been important in sorting out *Echinocereus*.

Last fall, in one of my periodic tours of herbaria, I visited the Garrett Herbarium at the University of Utah (U of U) and found that in preparation for his treatment of the genus for *Intermountain Flora* (IMF), Marc A. Baker (also once a student of Pinkava's) had visited the three major Utah herbaria: Utah State University and BYU, in addition to the U of U, and annotated the specimens of *Echinocereus*. Specimens formerly determined as *E. triglochidiatus* or one of its varieties were annotated by Baker mostly as *E. mojavensis* and a few as *E.*

coccineus. Before this *E. mojavensis* was usually recognized as a variety of *E. triglochidiatus*, and in previous years *E. coccineus* was not generally recognized as occurring in Utah.

Preparation for major works like the various volumes of the continuing series of IMF and FNA offers a great opportunity in making results of research accessible, as the experts who were chosen to write up the genera review data and visit herbaria.

Scientific papers on the cacti don't always appear in the most obvious place, the *Cactus and Succulent Journal* of the Cactus and Succulent Society of America, or its more technical offspring *Haseltonia* but are scattered in many journals. The Internet makes it easier, but even so, it takes a formidable amount of time spent searching to keep up with current botanical literature, even in this one family.

The forthcoming volume of IMF that includes the Cactaceae will bring us a much better understanding of the species of section *Triglochidiatus*. So how did this new understanding occur? Baker, now an environmental consultant in Arizona, has been working on *Echinocereus* for years. Baker determines the boundaries of taxa on the basis of morphology, geographic distribution, polyploidy, and floral dimorphism (in some species male and female flowers are produced on separate plants). For morphology, he measures sizes in a set of 22 characters of flowers and stems, and analyzes them using advanced statistical techniques: analysis of variance (ANOVA), discriminant analysis (DA), multivariate analysis of variance (MANOVA), principle component analysis (PCA), and unweighted pair group method with arithmetic mean (UPGMA). He also has extensive field experience and has counted many a chromosome set. As good botanists do, he studies type specimens and the occurrence of the plant at the type locality to understand what the author intended, and does not recognize taxa until he has enough data to do so.

So what does Baker recognize? U. S. species recognized by him in sect. *Triglochidiatus* are *E. arizonicus, E. coccineus, E. mojavensis*, *E. santaritensis, E. triglochidiatus*, and *E. yavapaiensis*. And he recognized some Utah specimens as *E coccineus*. Our limited population of *E. coccineus*, as far as is known, is only in the eastern part of Washington County and mostly in and near Zion. The Utah plants are different than typical *E. coccineus*. Ours are part of the group named by Michigan botanists Elzada Clover and Lois Jotter (professor and student), the first women to run the entire Colorado River, as *E. canyonensis*, with the type specimen collected down in the Grand Canyon at Hermit Falls.

Above: Claret cup (Echinocereus coccineus) *near the Petrified Forest Trail in Zion National Park. Photo by Tony Frates.*

They are characterized by smaller flowers, by some (but not all) plants displaying one of a series of flower colors trending towards yellow and away from the scarlet color of the hummingbird pollination syndrome, and by being visited by hordes of bees rather than hummers as the predominant pollinators. Our plants are northern outliers, with plants like ours on the Arizona Strip connecting to the type locality in the Grand Canyon.

Because there is some intergradation, and because this group is not sufficiently well known, Baker includes these plants with *E. coccineus* in IMF, while placing *E. canyonensis* in synonomy. It is possible that further study will change this.

The theory of its difference is that these plants grow in areas that are hotter and drier, where hummingbirds are not abundant, and therefore are becoming adapted to bees rather than hummers. Flowers adapted to bees are smaller than hummingbird flowers. Bees don't need as much nectar as the larger birds with their high metabolisms, and often seek pollen rather than nectar. Though bees visit the scarlet-colored hummingbird flowers, they prefer yellow flowers. The predominant pigments in the Cactaceae are betalains, the chemistry of which precludes anthocyanins with their blue hues, which bees favor. The scarlet hues of the hummingbird hedgehogs come from flavonoids, and these flavonoids are different pigments not found in most cacti.

The recognition that *E. coccineus* is found in Utah solved a longtime puzzle for me. In May of 1973 I came upon a curious population of hedgehog cacti on the Kolob road. These

plants had a somewhat different color of flower in orangish hues, moving away from the usual pure scarlet, and were attracting swarms of bees. I made specimens of it but did not know what to call it, putting it under the umbrella of *E. triglochidiatus* but stating that it was different and being visited by bees.

At that time, the best and most complete reference for keying out Utah cacti was Benson's 1969 3rd edition of *The Cacti of Arizona;* I also referred to his other 1969 book, *The Native Cacti of California*. Both of these carried *E. coccineus* and *E. canyonensis* in synonomy (along with many other synonyms) but with no descriptions. Another reference was Boissevain and Davidson's 1940 *Colorado Cacti,* which did include *E. coccineus*. But their concept of the species was not the tetraploid, dimorphic entity as it is understood today, on the basis of the type, and their circumscription of it did not fit the environment of my specimen. This is not to dismiss their work; they did well for that time when so much less was known about the Cactaceae.

Baker's annotation of *E. mojavensis* for all the other Utah specimens of sect. *Triglochidiatus* was more puzzling. For one thing, specimens in our East Desert are somewhat different from those in our West Desert. For another, because of all the wildly different treatments of this section in cactus literature though the years, until now, *E. mojavensis*, which is based on a specimen from the Mojave River in California, had not been clearly and consistently differentiated from *E. triglochidiatus*, based on a specimen from Wolf Creek in New Mexico.

Addressing the first issue are two statements, the first from FNA: "That taxon [*mojavensis*] includes curly-spined plants (mainly in California) and straight-spined plants (including most populations in Arizona, Utah, and western Colorado)." And from Baker, "…UPGMA suggests that *E. triglochidiatus* subsp. *mojavensis* [this was written before he had enough data to feel satisfied in recognizing this taxon in specific rank] may be composed of more than one taxonomically definable

Above: True Echinocereus triglochidiatus *from the Sandia Mountains in New Mexico. Photo by Bob Sivinski.*

group, a western group represented by the type and an eastern group, perhaps represented by the basionym *Cereus mojavensis* Engelm. & J. M. Bigelow var. *zuniensis* J. M. Bigelow & Engelm, for which the type locality is in Canyon Diablo, east of Flagstaff, Arizona." To resolve this, an analysis such as that employed by Baker needs to be done.

As to the second issue, is *E. mojavensis* the only sect. *Triglochidiatus* taxon in Utah other than *E. coccineus*? Baker's herbarium visits showed that although *E. triglochidiatus* as now understood occurs near the Four Corners, it has not appeared in herbaria as occurring in Utah. To best differentiate between these three species in the field or in herbarium specimens, Baker uses spine characters. Viewed under 30x magnification, *E. coccineus* has spines round in cross section and mostly smooth-surfaced with little trend toward a papillate surface. *E. mojavensis* also has round spines but they are papillate. And *E. triglochidiatus* has spines that are smooth but angled in cross section, fewer, and stouter. In the field *E. triglochidiatus* is the most noticeably different vegetatively, with a more open and chunky look, and has on average shorter stems, fewer ribs, areoles farther apart, and shorter and fewer spines.

E. coccineus in Utah may be distinguished not only by spine structure, but also by its location in Washington County (as far as is known). *E. mojavensis* also occurs there, but in more mesic locations. If flowering, *E. coccineus* will display smaller flowers with perhaps different colors, and is predominantly visited by bees rather than hummingbirds. Each plant will have only male or only female flowers. Stem and spine measurements overlap with *E. mojavensis* but the ones I've seen seem to be taller and more slender with finer spines on better-separated areoles. This is tentative, however, and spine surface and flower characters are more useful until we know this species in Utah better. So far I've accumulated about 11 locations from various sources, most in or near the south end of Zion, but also extending from Pah Tempe Hot Springs near Hurricane to the Little Creek Mountains.

According to specimens in the major Utah herbaria, *E. mojavensis* is found in all Utah counties except the far northern tier of Box Elder, Weber, Cache, Rich, Morgan, Davis, and Summit.

Baker has annotated the specimens in our three major herbaria, but most of the smaller Utah herbaria have probably not yet caught up with this recent work.

References:

Baker, M.A. 2006 A new florally dimorphic hexaploid, *Echinocereus yavapaiensis* sp. nov. (section *Triglochidiatus*, Cactaceae) from central Arizona *Plant Systematics and Evolution* 258: 63-83

Baker, M.A. 2006 Circumscription of *Echinocereus arizonicus* subsp. *arizonicus*: Phenetic analysis of morphological characters in section *Triglochidiatus* (Cactaceae), Part II *Madroño* 53(4): 388-399

A Comparison of Utah *Echinocereus* Species

By Tony Frates and Dorde Woodruff

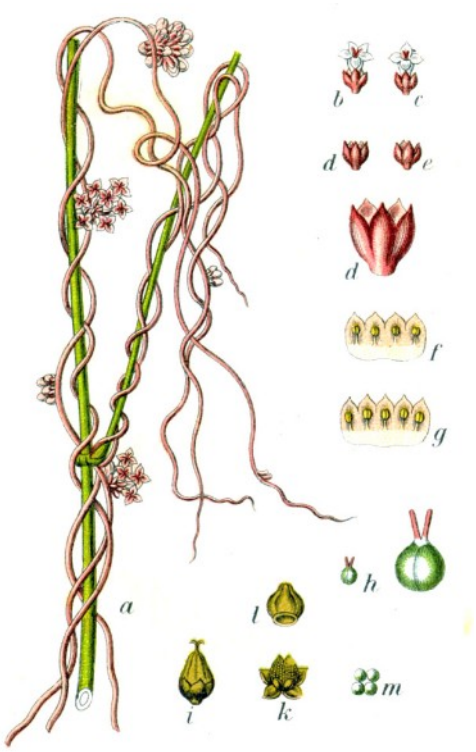
Species	Synonyms and notes	Location in Utah (none limited to UT)	Description
Echinocereus coccineus Scarlet claret cup, Scarlet hedgehog The specific epithet *coccineus*=scarlet is somewhat a misnomer for ours since they are much visited by bees and thus drifting from the scarlet hummingbird-attracting color	A confusing array of synonyms have been used; this taxon was not formerly well understood Utah plants are part of the proposed *E. canyonensis*; more study is needed for acceptance of this as a valid taxon	Only known from eastern Washington County	Stems in closely set clumps; flowers dimorphic, with a slightly constricted "waist"; 7-19 smooth spines per areole, uniform in color though gray in age, round in cross-section; flowers smaller, narrower, < 5 cm long, may be more yellowish than in *E. mojavensis* Visited by bees more than hummingbirds Tetraploid, n=22
Echinocereus engelmannii Engelmann's hedgehog	Vars. *chrysocentrus, variegatus, & purpureus* have been recognized in the past, but differences are inconsistent or insufficiently documented and vars are no longer accepted	A southern Utah, Great Basin, and Colorado Plateau species in Beaver, Garfield, Iron, Kane, Juab, Millard, Tooele, San Juan, and Washington cos.	Stems single to several in open clumps but not mound forming; central spines with contrasting light and dark colors, flat or angled; flowers perfect, pale to dark rose-pink, to 9 cm tall and wide Bee pollinated; easily distinguished from other Utah *Echinocereus* Tetraploid, n=22
Echinocereus mojavensis Claret cup; Hedgehog; Hummingbird hedgehog	Most often known as *E. triglochidiatus* var. *mojavensis,* with a confusing number of other synonyms. Sometimes misspelled as "mohavensis". The specific epithet is unfortunately a misnomer since it is not restricted to the Mohave Desert, but named for the Mojave River. There may be differences between western and eastern plants. The name var. *inermis* has been applied to the spineless form of far east-central Utah, but this taxon is no longer accepted.	The most widespread *Echinocereus* in Utah, occurring in all counties except the northern tier of Box Elder, Cache, Davis, Morgan, Rich, and Summit cos.	Plants in closely set clumps; flowers perfect, scarlet, usually >5 cm long; 5-11 spines per areole, uniform in color though gray in age, mostly round in cross-section, papillate (use 30x lens) Hummingbird pollinated. Diploid, n=11

Dodder Doesn't Dodder Around

By Peter Lesica
(Adapted from *Kelseya*, the newsletter of the Montana Native Plant Society)

Dodders (*Cuscuta* spp.) are surely among the world's most unusual plants. They are parasitic on other flowering plants and lack leaves or any photosynthetic tissues. This is odd enough, but unlike most other parasitic plants, such as broomrapes (*Orobanche* spp.), paintbrushes (*Castilleja* spp.) or even mistletoes (*Arceuthobium* spp.), dodders have no roots. They can be annuals arising from seed each year or perennials arising from overwintering stem segments. Our species have yellow or orange, twining stems. Dodders are closely related to morning glories, but the flowers are inconspicuous though sometimes with intricately ornamented corollas. There are about 150 species of dodder worldwide, most common in subtropical and tropical America. Eleven species are reported for Utah, and based on the small number of herbarium collections and my own experience, most (with the exception of *C. pentagona*) are not common in the state. In Utah they have often been collected parasitizing native and introduced legumes as well as spotted knapweed and other members of the Aster Family.

In some ways, dodder acts more like an animal than a plant! Other parasitic plants, such as broomrape, have seeds that germinate only when they are contacted by host root exudates, but not dodder. Dodder seeds germinate on the surface of the ground and then forage for their host. The stems grow outward while at the same time waving around until they reach a host plant. The juvenile stems can reach up to 6 cm (2.4 inches), but none are able to reach twice that far, and they must find a host within a few days or die trying. The way dodder is able to choose a host is also reminiscent of an insect herbivore or parasite.



Above: 1796 print of Cuscuta europaea *by the painter Jacob Sturm from* Deutschlands Flora in Abbildungen.

Researchers have demonstrated that dodder stems will orient toward a tomato plant or even a vial of tomato extract as long as an odor can be detected. Other studies have shown that dodder can locate a host by the quality of light reflected off the host's leaves and will even preferentially move toward hosts with higher chlorophyll content, in other words, those that are greener, and presumably with more sugars.

As soon as a dodder stem twines around its host it begins to form haustoria, specialized short stems that tap into the host vascular tissue. Flowering plants have two kinds of vascular tissue. Xylem carries water and mineral nutrients from the roots up the stem, and phloem moves energy-rich carbohydrates to the roots or other areas of need. To match this, dodder develops two different extensions from its haustoria: a hand-like form that surrounds the phloem and a straw-like form that pierces the xylem. In this way dodder can obtain everything it needs (water, mineral nutrients and food) from its host.

Most species of dodder can parasitize many different host plants, but studies have shown that dodder grows better on some hosts compared to others. Furthermore several studies have shown that dodder is able to preferentially infect those hosts that provide the most benefit. Colleen Kelly, from Oxford University, demonstrated this and found that the choice is made based on chemicals in the bark that dodder can detect before forming haustoria. Kelly also found that having two different hosts was better than one, although a second independent study failed to confirm this result.

The effects of dodder go beyond just individual host plants. By the end of a growing season a single dodder plant may form thousands of haustorial connections with many different host species and cover an

area the size of a small house. Of course this can have significant effects on the plant community. Since they are somewhat host-specific, dodders can alter community structure by preferentially damaging some species more than others. For example, University of Montana's Ray Callaway and his collaborators found that dodder reduced the dominance of glasswort (*Salicornia*) in favor of sea-lavender (*Limonium*) in California coastal marshes. Dodders also may damage commercial crops such as tomato, pumpkin and alfalfa. Indeed, this is why we know so much about dodder ecology. Dodders' negative impacts also extend beyond simple parasitism. For example, they can be conduits between host plants for viruses, including disease-causing pathogens. Some diseases can spread more quickly through a crop field infested with dodder than one without.

On the positive side, a native Chinese dodder has been used to control bittervine (*Mikania*) a serious invasive weed in China as well as Puerto Rico. The native dodder causes a decline in the invader resulting in greater nutrient availability to native members of the community.

Although it might seem like host plants are defenseless against the wiley dodder, this may not always be the case. Recently researchers have found that some host plants transfer messenger RNA (mRNA) into their dodder parasites. Some of these mRNAs can incapacitate dodder's genetic machinery, thereby reducing its ability to make proteins and grow. This discovery has spawned an interest in genetically engineering crop plants that produce dodder-destroying mRNA. With luck agriculturalists may be able to turn dodder's voracious appetite against it.

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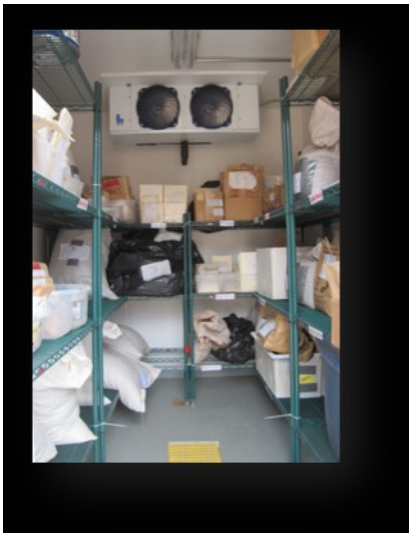
Utah Botanica

Odds and Ends from Utah Botany

Zion Vegetation Program: In Bloom Year-Round!

In 2007, Zion NP received funding to put in seed increase fields at its Native Plant Nursery, with the goal of growing and harvesting large amounts of seed and using that seed for large-scale restoration projects such as fire rehabilitation, annual brome competition, and campground revegetation. Part of this funding included the purchase of a new seed storage cooler, which would be used to store seed from Zion and Cedar Breaks and Pipe Spring National Monuments at a consistent temperature year-round. The Zion Veg Program has long needed a dependable unit for long-term seed storage, and we got it in the form of a 10x12 walk-in refrigerator with lighting, a floor drain, and adjustable temperatures that can be set as low as 35°F (below right).

To celebrate the new cooler and do away with unnecessary "white space," the Veg Program hired fellow plant nerd Shannon Eberhard (below left), an aspiring plant illustrator and a former employee of the Fire Effects Monitoring Team, to paint the cooler with native plant illustrations (above). Shannon did an amazing job, and that means that the Veg employees are lucky enough to look at beautiful, accurate native plant paintings on a daily basis. Right awn!! *-Rebecca Lieberg, Zion Lead Reveg Bio Tech*



Botanist's Bookshelf: Summer Reading Special

By Walter Fertig

Ahh summer … time to unroll the hammock, pour a cool drink, and relax with a good botany book … or two. The following are some recent titles you might consider for your summertime reading pleasure.

Wasatch Wildflowers: A Field Guide, by Steve Hegji, 2010, Cedar Fort, Inc, Springville, UT. 207 pp. While this slim guide does not cover every plant species in northern Utah's Wasatch Range, it does include 200 of the most common or showy wildflowers. Each color photo is accompanied by a brief, often entertaining caption. For example, American bistort (*Polygonum bistortoides*) is described as being "… a bit like a giant Q-tip sticking up above all the other plants." A series of thumbnail symbols is used to organize brief discussions of key flower, leaf, and habitat traits and other information. Hegji is a gifted photographer with a real eye for composition and interesting perspectives. His book is geared to a non-technical audience, but the photos will be appreciated by all plant and nature lovers.

National Wildlife Federation Field Guide to Wildflowers of North America, by David Brandenburg, 2010, Sterling Publishing, New York. 673 pp. Compact but hefty, this field guide has more than 4000 color photos of 2200 native and introduced wildflowers found across North America. The book is organized taxonomically rather than by flower color and shape as in many other popular field guides. Descriptions of species are necessarily brief, and only a few of the more common or showy species in each genus are featured, along with color range maps. An innovative feature is the use of thumbnail images of different flower types arranged by color and shape located at the beginning of the book which helps orient the user to the correct family or genus without resorting to difficult keys. This book covers too wide of a geographic area and too few species to be especially useful for identifying anything but the most showy species, but is an excellent introduction to the overall diversity of genera and species found in North America. It would be an excellent companion to a more formal taxonomic textbook in teaching students about floristic diversity.

Above: Oenothera howardii *by Steve Hegji.*

The Sibley Guide to Trees, by David Allen Sibley, 2009, Alfred A. Knopf, New York. 426 pp. Over the past decade Sibley has created a small publishing empire based on his series of bird guides, but now has branched into trees of North America. Done in much the same style as his original bird field guide, *The Sibley Guide to Trees* covers nearly 600 native and naturalized tree species with watercolor paintings of leaves, flowers, fruits, twigs, bark, and other identifying characteristics. The book has brief descriptions of each species and a detailed range map, as well as essays on families and genera. Unlike many recent tree guides, this book is organized phylogenetically and not by leaf arrangement (opposite vs. alternate) or shape. I noticed some minor errors, such as the range map of Utah juniper omitting most of the Colorado Plateau, but no more than one might expect from an ornithologist writing about botany. The book is probably too large for field use, but would be a valuable reference for keying out specimens at home or for general information.

California Mosses, by Bill and Nancy Malcolm, Jim Shevock, and Dan Norris, 2009, Micro-Optics Press, 430 pp. One of my annual New Year's resolutions is to become more competent identifying mosses and bryophytes. *California Mosses* may just be the book I've been waiting for to help me. The authors have amassed an amazing array of color photos of 600 moss species of California that illustrate growth form, leaf shape, and important cellular details. Many of the photos are quite beautiful and their subjects resemble pieces of stained glass art. Accompanying the brief descriptions are black-and-white drawings of stylized leaves that emphasize diagnostic differences between genera and species. A table at the end of the book compares and contrasts these leaf shapes to help the professional or novice bryologist place their unknown specimen into its proper sequence. Though the book covers California specifically, my bryologist buddy John Spence assures me that most of the species from Utah and western North America are included.

Flora of North America: volumes 7 and 8, by the Flora of North America Editorial Committee, 2009-2010. The Flora of North America (FNA) project was conceived nearly 20 years ago and 16 of the planned 28 volumes have now been published. The ambitious goal of the project is to produce a taxonomic treatment of the entire flora of the North American continent, including bryophytes, ferns, gymnosperms, and flowering plants. Volumes include keys to all native and naturalized species, range maps, brief taxonomic descriptions, and often a line drawing (at least one per genus). The two most recent volumes cover 30 families of flowering plants, including the Saxifragaceae, Primulaceae, Ericaceae, Salicaceae, and Brassicaceae.

Because it covers all of North America, the taxonomic keys in the FNA are often difficult as they must focus on obscure characters to split out so many taxa, or species tend to come out in the key at multiple points. Those interested in keying

out their local species are better served by good state or regional floras which only have to deal with a subset of all the taxa in the FNA. The real value of the FNA comes in its monographic treatment of families and genera. The taxonomic concepts and nomenclature used in the FNA should guide the treatment of species in state and regional floras in the future.

Numerous taxonomic changes have been made in volumes 7 and 8, especially in the Brassicaceae, Capparaceae (now Cleomaceae), and among genera formerly included in the Primulaceae, Pyrolaceae, and Monotropaceae. Such changes can be upsetting to those of us more comfortable with the names we learned in our youth, but are not a bad thing if they represent advances in taxonomic concepts (taxonomy is a science after all, and not just stamp collecting). The accompanying table summarizes the more significant changes that affect species, genus, and family concepts in Utah.

Many of the changes seem reasonable. A lot of morphological and genetic data support merging the mustard genera *Lesquerella* and *Physaria*. Likewise, no one will lose sleep over combining *Cardaria* with *Lepidium*. Other changes may be more controversial, such as splitting *Arabis* into *Boechera* and *Turritis* (though there is good evidence for this), or recognizing new taxa of *Boechera* that are of complex apomictic or hybrid origin.

Personally, I'm more concerned with species treatments that don't seem to match reality in the field. Elimination of all varieties of *Lepidium montanum* with the weak explanation that the dozen or so vars. recognized by Reed Rollins and C.L. Hitchcock intergrade is not an advancement of the science and risks trivialization of numerous distinct and localized endemics (such as vars. *claronense* and *neeseae*). Many new *Draba* species are recognized, including some like *D. santaquinensis* from Utah that are quite localized, but other equally uncommon species seem to have been summarily discarded. Despite the contentions of the authors, the type of *Draba juniperina,* a tall species with long, slender styles of desert areas of southwestern Wyoming and adjacent Colorado and Utah is not "identical" to *D. pectinipila*, a dwarf alpine species with short, stubby styles endemic to alpine limestone fellfields of Beartooth Butte in Wyoming (but not in Montana as reported). Likewise, *Draba calcifuga* is a cryptic but distinct species from Montana and Wyoming that can be readily distinguished from *D. oligosperma* but has been synonymized without comment.

The value of FNA would increase greatly if more emphasis was placed on discussions of taxonomic problems associated with species (like the *Draba*s mentioned above). In the interest of brevity, such discussions are frequently excluded or kept too short to be meaningful. This is unfortunate, because without adequate explanation taxonomic decisions can appear arbitrary or weakly supported. I would also like to see the new volumes return to the original practice of having range maps depict the approximate area inhabited by a species, and not just have one dot per state. This is redundant anyway, given that states and provinces are listed in the text for each species. The best maps in the FNA series were those done for the two grass volumes which had county level distribution. There is no good excuse for excluding such information as county-level distribution maps are now readily available through the work of John Kartesz and the BONAP program.

Plant Endemism and Geoendemic Areas of Utah. By Stanley Welsh and N. Duane Atwood. 2009. Self-published, Orem, UT, 97 pp. Only a handful of states have more species of vascular plants than Utah. The size of the state flora is caused, in part, by the high number of endemic species found mostly or entirely within Utah. Most of these endemics are restricted to unusual geologic substrates, of which Utah is particularly rich. Welsh and Atwood tease apart these patterns in their latest contribution to Utah botany. The book includes a lot of background information on the unique attributes and flora of different geographic areas of the state, as well as a history of botanical exploration of Utah. Welsh is an engaging storyteller and the book is entertaining, even if your passion is not plant geography.

Major Taxonomic Changes in FNA volumes 7 & 8

Brassicaceae (Cruciferae)

Arabis: split into three genera - *Arabis* (*sensu stricto*), *Boechera, & Turritis*

Cardaria: lumped with *Lepidium*

Cusickiella: new genus (formerly included in *Draba*)

Lesquerella: lumped with *Physaria*

Schoenocrambe: lumped with *Sisymbrium* or moved to new Genus *Hesperidanthus*

Sinapis: formerly included in *Brassica*

Cleomaceae (formerly Capparaceae)

Peritoma: new genus for *Cleome lutea* and *C. serrulata*.

Crassulaceae

Rhodiola: formerly included in *Sedum*

Tillaea: lumped with *Crassula*

Ericaceae

Family expanded to include the Monotropaceae and Pyrolaceae.

Ledum transferred to *Rhododendron*

Myrsinaceae

New family for UT flora, includes *Anagallis* and *Lysimachia* (from Primulaceae). Genus *Glaux* transferred to *Lysimachia*

Resedaceae

Oligomeris linifolia—new for UT based on an 1877 Palmer collection from "Southern Utah"

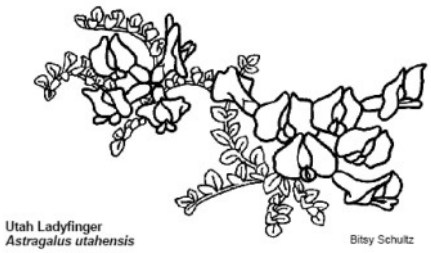
Saxifragaceae

Boykinia: transferred to *Telesonix*

Micranthes: formerly included in *Saxifraga*

Theophrastaceae

New family for UT flora— only includes genus *Samolus* (previously in Primulaceae)



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