Sego Lily
Newsletter of the Utah Native Plant Society

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Bristlecone pine "flowers" are, of course, really just staminate (reddish-yellow) and immature pistillate (purple) cones. Although flower-like in appearance, the cones of Pinus longaeva *do not have true petals or sepals and the ovules (unfertilized immature seeds) within the pistillate cone occur on the surface of woody cone scales, rather than embedded within a protective ovary. Even at a young age, the "bristles" of the cone are evident. Photo by Douglas N. Reynolds. For more on Utah's oldest inhabitants, see the story on page 4.*

Volunteers Across the Nation to Track Climate Clues in Spring Flowers

Starting February 15, 2008, citizen-scientist volunteers will be able to help track climate change by observing and recording the timing of flowers and foliage. Project BudBurst, operated by the University Corporation for Atmospheric Research (UCAR) and a team of partners including the US Geological Survey's USA National Phenology Network (USA-NPN), allows U.S. students, gardeners, and other citizens to enter their observations into an online database that, over time, will give researchers a more detailed picture of global climate change. The project will operate year-round so that early and late blooming species in different parts of the country can be monitored throughout their life cycles. Project BudBurst (http://www.budburst.org) builds on a pilot program carried out last spring, when a thousand participants recorded the timing of the leafing and flowering of hundreds of plant species in 26 states.

"Climate change may be affecting our backyards and communities in ways that we don't even notice," says project [continued on page 11]

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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 Garvin (356-5108), 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). News items, articles, photos, and illustrations from members are always welcome. The deadline for the May 2008 *Sego Lily* is 15 April 2008 (tax day!).

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Chapter News

Manzanita (Kane County): On Saturday, March 8th, the Kanab chapter will host its second annual Plant Propagation workshop. Becca Leiberg of Zion National Park will provide training on planting techniques and offer gardening tips. Seed from a variety of native wildflowers, shrubs, and grasses will be provided. The workshop will take place at the Best Friends greenhouse from 10 AM-noon. Pre-registration is required as space is limited. There will be a fee of $10 for UNPS members and $15 for non-members. Contact walt@kanab.net for more information.

Our March meeting will be held on Wednesday, March 12th and feature Roger Hoverman, retired US Forest Service fire ecologist and fuels specialist with the Kanab-based Wild Mountain Fire and Forestry company. Roger will discuss landscaping practices homeowners can use to reduce the risk of wild fire.

Bala Chaudhary of Northern Arizona University will speak on Thursday, April 3 on plant-soil relationships in a talk entitled "Is the fate of native plants determined belowground".—*W. Fertig*

Salt Lake: Dr Fred Montague who is the student advisor and a professor in the Biology Department at the University of Utah gave a talk in January on the affects of the human population growth on world climate and ecology. This is a time in our planet's history when it is crucial to raise questions such as "Are we already too late?" and "Do our individual efforts make a real difference to the global picture, or just make us feel good?" Fred discussed the flaws in "sustainable growth" and the need for alternative energy and the importance of "buying local".

On Wednesday February 5th, Dr Bill Gray gave a very informative presentation on his mapping efforts this past summer of *Angelica wheeleri* and Wasatch Fitweed. New populations of both species were discovered in the surrounding canyons along the Salt Lake Valley. Bill discussed how difficult it was to reach some of these populations and how he mapped the plants with the use of GPS, a watch, and databases that he created.

Wednesday March 5th, 7:00pm -9:00pm (REI): Dr Leila Shultz will do a presentation on "Tracking Utah's Rare Plants". Dr Shultz is a professor at Utah State University where she works in the Department of Natural Resources. She has held many important positions in plant research, including heading the Geographical Information Systems Center for the Flora of North America project.

Thursday March 6th, 7:30pm: Maggie Wolf, Horticulture agent

for the Utah State University SL. Co. Extension will be at the Weber County Library (2464 Jefferson Avenue in Ogden). Learn methods to responsibly landscape your own home and become knowledgeable of what thrives in Utah's climatic extremes. With this knowledge, become a better steward of our natural environment.

Sunday March 23rd: Stansbury Island Trip (dependent upon the weather). We will meet at the trailhead on Stansbury Island and hike along the hills in search of several early blooming species including Anderson's Buttercup (*Ranunculus andersonii*) and Yellowbells (*Fritillaria pudica*). Carpools will be arranged and more specific information will follow.

Wednesday April 2nd, 7:00pm: Jack Brown of the Utah Bureau of Land Management will discuss the Great Basin Restoration Initiative, an ambitious project being carried out by the BLM in several Western States. The goal of this project is to rehabilitate the land after many years of abuse, fires, overgrazing, etc.

Friday April 25-Sunday April 27-Beaver Dam Mountains: We will be camping in the Cedar Pocket Campground in the Virgin River Gorge. A road from our campground will take us into the Utah portion of the Beaver Dam Wilderness Area where three floristic provinces meet. The plant species are unique and very limited in our state. We especially invite members from other chapters to join us in this event. Please contact Kipp Lee (kipp_lee@ comcast.net) or Bill Gray (cyberflora @xmission.com) if you would like to participate.—*Kipp Lee*

Southern (Washington Co.)
The Southern Utah Chapter had another very successful propagation workshop on February 2. All 18 of the 11 who were enrolled showed up. (No, that's not a typo!) Less successful was our scheduled Feb. 4 meeting, which had to be canceled because of the high snowfall. Carolyn Shelton's talk on "Sex in the Garden" is being rescheduled for May 5th. Our March 3rd meeting will feature Dr. Doug Reynolds, retired professor of botany and ecology. He will present "Going Native: Utah Plants for Utah Landscapes". In addition to showing beautiful slides of recommended native plants adapted to our environment, Doug will present a case study of how he landscaped his Cedar City area cabin with native plants.

We are having a native plant sale Saturday, April 12, from 9 AM to 1 PM at the Bit & Spur Restaurant meadow in Springdale, featuring Great Basin Natives and Wildland Nursery. April will also feature the annual Earth Day celebration. —*Margaret Malm & Barbara Farnsworth*

Bulletin Board

Mojave Botanical Illustration Workshops: Plein-air artists, educators, and students alike will benefit from this unique opportunity to make a visual journal of the diverse desert plant life of Joshua Tree National Park. Desert blooms vary from year to year, but there is always something fascinating to discover and record. Donald Davidson—illustrator, educator, and artist– will teach drawing and compositional skills geared to assist participants in enhancing their rendering of botanical forms. The class will start indoors focusing on hand-eye coordination, comprehensive line drawing, contours, volume, perspective, and interpretation of form and function. The class is open to all skill levels—come with your enthusiasm and desire to learn!

Botanical Drawing: A Visual Journal. Class # 329.
Date/Time: Sunday, March 16, 10 AM-4 PM
Cost: $50 ($40 for Joshua Tree National Park Association members)
Meet at: Oasis Visitor Center, Joshua Tree National Park, CA
Instructor: Donald Davidson
Hike level: easy.
Information/registration: call 760-367-5535

The Desert Studies Center of the University of California-San Bernardino is offering a second botanical illustration course with Donald Davidson on the weekend of Friday April 4-Sunday, April 6. For information, contact Carol Galvin at 909-537-3910.

Donald Davidson has spent many years traveling through the west's national parks creating watercolor portraits of native plants. See samples of his work at: www.nps.gov/plants/cw/ watercolor/index.htm).

Wet winter in southern Utah = Spring Wildflowers: It has been an atypically cool, snowy and rainy winter in southern Utah, which bodes well for spring annuals. Keep watching the weather (hopefully it won't heat up too fast) and make your spring wildflower-watching plans accordingly! (Above, *Rafinesquia neomexicana* by W. Fertig)

Request for UNPS Survey Volunteers: Mary O'Brien of the Grand Canyon Trust has asked whether UNPS could provide some volunteers for help with plant surveys in central/southern Utah. Volunteers would need to have good plant identification skills, particularly on the first of the events.

July 10-12 Tushar Mountains near Beaver, in collaboration with the US Forest Service and others. Volunteers will help to resurvey transects that are being monitored for the effects of grazing.

July 25-27 Two surveys. First, of an exclosure near Teasdale, to compare grazed and ungrazed areas. Second, a high elevation wetland area near Fish Lake, that may never have been thoroughly surveyed before.

If you are interested in learning more, please contact Bill Gray (801-532-3486; cyberflora @xmission.com)

Utah's Oldest Inhabitants

By Douglas N. Reynolds

One of the most fascinating native tree species in Utah is the Great Basin bristlecone pine (*Pinus longaeva*). This species was recognized as distinct and split out from *Pinus aristata* by D. K. Bailey in 1970 based on morphological characteristics and geographical distribution. It differs from *Pinus aristata*, the Rocky Mountain bristlecone pine, in having two resin ducts along the entire length of its needles. There are also differences in growth form and chemical composition of the foliage. The specific epithet *longaeva* signifies that individuals of Great Basin bristlecone pine can live much longer (by several thousand years) than individuals of the Rocky Mountain bristlecone or the related Foxtail pine (*Pinus balfouriana*).

The two bristlecone pine species have separate ranges with no overlap. Rocky Mountain bristlecone pine occurs east of the Green – Colorado River drainage in New Mexico and Colorado and gets no closer than 160 miles to populations of the Great Basin bristlecone pine. The Great Basin bristlecone is found only in California, Nevada, and Utah where it occurs from the Confusion Range of Millard County, north to the Uinta Mountains of Summit, Wasatch, and Duchesne counties, south to the Pine Valley Mountains of Washington County and east to the Aquarius and Wasatch Plateaus.

An excellent resource on bristlecone pines, especially the Great Basin bristlecone, is the recently published *The Bristlecone Book* by Ronald Lanner, emeritus professor of Utah State University. This is the source of much of the information in this article.

The fame of the Great Basin bristlecone comes from the extreme age and picturesque appearance of some individuals seen on high mountain ridges. Until recently, the oldest living tree was thought to be Methuselah, of California's White Mountains, who will turn 4500 years old in 2009. Another still living tree, was cored years ago but whose rings were only recently counted, may be as old as 4806 years. The oldest tree ever found was 4862 years old when it was unfortunately cut down in 1964 at Great Basin National Park. Dead trees have also been found that were over 5000 years old at the time of their death.

Above: Utah's big tree bristlecone pine, from the rim of Cedar Breaks National Monument. Photo by Douglas N. Reynolds.

Interestingly, these extreme ages for bristlecones have engendered much concern amongst creationists who want to believe that the earth is only a few thousand years old. They have claimed that bristlecones put on more than one growth ring a year and, therefore, are not nearly so old as they appear. Legitimate scientific investigation, however, has shown that producing more than one ring a year is rare; rather, it is much more common for no ring to be formed at all in a poor year making bristlecones (and therefore, the earth) probably even older than indicated by the number of rings. This has left Creationists to claim that the earth must have been created with mature bristlecones with many rings already in place on mountain ridges.

Why do individuals of this species live so long? It seems counterintuitive that the earth's oldest organisms live in some of its harshest habitats in poor soils on cold, dry, high-elevation ridges. The answer appears to be a combination of both the species' biological characteristics and its environment. As Ronald Lanner points out, the simple answer may be that its enemies do less well in its extreme habitat than it does. Where light is available in more favorable environments, such as along flood plains, Great Basin bristlecone pines have an upright, straight trunk reaching as high as 60 feet. But in these situations, the trees don't come close to achieving the great ages that they do on high, arid ridges. While not optimal for growth, harsh environments allow bristlecones to escape competition, fire (rare in cold sites with little other vegetation to burn), attacks by insect pests and fungi, and disease that normally kill other trees species at younger ages.

Great Basin bristlecone pines have five needles per bundle like other members of the white pine group but they are very long-lived and continue to photosynthesize, some for more than 35 – 40 years, giving the tree great metabolic efficiency without having to spend limited resources replacing needles. Trees also have a sectored construction with roots supplying only the portion of the stem and branches immediately above themselves. If roots on one side of the tree die then so do the branches above them. This explains the appearance of some of the oldest specimens where most of the trunk is dead, twisted and eroded with only a thin strip of live bark feeding a few upper branches. Unlike any other pines only the two bristlecones and the Foxtail pine produce new branches from buds within their needle fascicles throughout their lives. This allows trees to produce new branches and foliage over many centuries to replace those that die.

Studies by Kristina Connor and Ronald Lanner found no significant differences in pollen or seed viability or vascular cambial activity between bristlecones a few hundred years old and those that were several thousand. They concluded that bristlecones do not intrinsically senesce as the years go by but that something has to kill them. Very often it is the erosion of soil away from their roots that kills them or allows winds to topple and uproot them.

Unlike many other high elevation pines (such as Whitebark and Limber), which have large, wingless seeds primarily dispersed by birds, bristlecone seeds are small and winged, adaptations for wind dispersal. But based on the high percentage of multi-stemmed clumps observed at Cedar Breaks and surrounding areas, Lanner has proposed that birds like Clark's Nutcracker may collect and cache the seeds on high, open ridges. Seeds in caches forgotten by the birds may later germinate and, as the seedlings get bigger, their stems may grow together to form a multi-stemmed clump. More recent studies have found no genetic differences between stems within a clump, however, suggesting that multi-stemmed clumps may also originate from a single, damaged original stem.

Above: Great Basin bristlecone pines at the Twisted Forest, north of Cedar Breaks National Monument in Dixie National Forest. Photo by Douglas N. Reynolds.

Great Basin bristlecone pine's longevity is the source of important information for other scientific fields. The widths of its rings are correlated with temperature and moisture and give us a climatic record going back almost 10,000 years since ring patterns of still-living trees can be overlapped with those of long dead trees. This long chronology has also been used to calibrate carbon-14 dating procedures that can be used to date artifacts of ancient human cultures. A study at the Twisted Forest north of Cedar Breaks National Monument also used bristlecone pines to estimate erosion rates of the red soils that make up the Breaks. By coring a tree, counting its rings, and then measuring how deep its root system had been exposed by erosion, A. J. Eardley and William Viavant estimated that about two feet of soil erodes every 1000 years on some slopes.

Some of the best places to see the Great Basin bristlecone in southern Utah are along the Spectra Point Trail at Cedar Breaks National Monument. Here resides the recently certified "Utah Big Tree", the biggest of its species in the state (see photo). It is 252 inches in circumference at breast height and 32 feet tall with a crown spread of 32 feet. Despite its size, this tree is nowhere near the record for age, being "only" about 1600 years old. At the nearby "Twisted Forest" in the Ashdown Gorge Wilderness of the Dixie National Forest there is a spectacular forest of bristlecones, some over 2400 years in age. Great Basin bristlecones can also be seen along the Fairyland and Bristlecone Loop trails at Bryce Canyon National Park where the oldest, near Yovimpa Point, is an estimated 1600 years in age.

In the last few years there has been a heated competition amongst botanists to find the oldest living organism. Clonal individuals like Creosote bush or Aspen that spread vegetatively, continually putting up new stems, have ages estimated over 10,000 years. But none of the stems we see today are more than decades old. The large trunk of a Great Basin bristlecone pine, however, contains cells that, although now dead, were born more than 4000 years ago, making this bristlecone the oldest non-clonal organism on earth.

Medicinal Qualities of Utah Prickly Pears (*Opuntia* Species)

By Dorde Woodruff

Many of our Utah native plants have medicinal qualities. They may have been used (or still are) by Native Americans, or may be in current use by herbalists. The Prickly pears (*Opuntia* species) are among these.

The same species used as food are the easiest to use for medicine, basically the fleshy-fruited species *O. macrorhiza* (Tuberous-rooted prickly pear) and *O. phaeacantha* (Brownspined prickly pear).

In Washington County gardens there's also the vigorous and prolific cultivar *O. linguiformis*, Cow's tongue prickly pear. The shrub *O. chlorotica* (Clockface or Pancake prickly pear) does occur in limited areas there, but the fruits I've seen are smaller than in other local species, and may dry early ("often mummify" is how *Flora of North America* puts it). The fleshy-fruited prickly pear picture in that area is quite complicated. Different authorities split up *O. phaeacantha* into other taxa. Comparative study is needed.

Even if you're not looking for fruits, as a class the pads of fleshy-fruited taxa are usually less spiny than most of the dry-fruited taxa, so they're easier to handle. Not only do they have fewer spines, but also their areoles (the spine-bearing organs) are farther apart.

However, some *O. polyacantha* (Plains pricklypear), for instance, are almost spineless (though still having glochids). Whatever is accessible and easiest to handle can be used.

As a vegetable, the pads of *Opuntia* species are a great example of food as medicine. Their ample mucilages make them problematic in palatability to some people, but that can be mitigated by culinary practices. Mucilages being soluble fiber (a kind of complex carbohydrate) slow down metabolism of food so that the glucose excesses of our civilized diet, which are the root of so much bad health, don't occur.

A suggested dose for type 2 diabetics is 4 ounces of the juiced pad (nopal) per day. This is quite a lot of green glop, but much used in Mexico, where nopales are tender, cheap, and plentiful, both by diabetics and for weight management. Lesser amounts are always beneficial as part of a healthy diet. Here's one way to ingest cactus that is tasty, a favorite in Mexico:

GREEN DRINK

1 thin slice raw pineapple, chunked
1 whole orange, pared, seeded, cut up
1/3 large nopal, about 2½ x 3½", prepared, sliced
½ stalk celery, strings removed
1 xoconostle*, prepared, optional
leaves and tips of four sprigs parsley
juice or water to thin, if needed

Blend and drink. Use daily. Alternatives are grapefruit, papaya chunks, or other fruit. If you don't include too much nopal it won't be gloppy. Adjust to suit. Pureed, they can be frozen in ice cube trays for a later time.

Cactus mucilages also reduce total cholesterol and bad cholesterol, and consequently are cardio-protective. Dehydrated nopal is available commercially for these uses and others, as is tincture of the pads.

Medicinal uses of *Opuntia* were important to the prehispanic peoples of Mexico, and recorded by the Spanish. Seeds of *Opuntia* were thought to combat flu. The root was used as liver medicine, for ulcers, and for skin diseases. A bit of nopal was chewed and held at the site for toothache. Nopal was used for diarrhea and intestinal infections; soluble fiber normalizes digestion, so will work either for excess or deficiency, diarrhea or constipation. Other uses were for kidney medicine, to stop fevers, or for cuts.

*Xoconostles, green-colored *Opuntia* fruits that are sour not sweet, are often sold at Latino markets. Other prickly pear fruit can be used.

Raw or roasted pads were used as poultices for mitigating pain and curing inflammation. This would still suffice for wilderness medicine. Just cut the pad in half and apply it to the wound. You probably would want to trim or singe off spines and glochids first, but being away without medicines is good motivation to use what is at hand. Juiced pads can be used to make healing salves.

In North America *Opuntia* was not as important a horticultural plant as in Mexico, though archeologists think Native Americans encouraged it, at least, and took productive taxa with them when they moved. As compiled in Daniel Moerman's Native American Ethnobotany database (at http://herb.umd.umich.edu/), they used Opuntias mostly as a wound herb, for cuts, burns, boils, sores, and also for earaches. A few tribes reported use as a diuretic, anti-arthritic, laxative, or for diarrhea. Both North American and Mexican natives used cactus spines as implements, sometimes in medicine, e.g., to lance boils.

These ancient uses are validated by science. For example, a Tunisian study found that extract of Indian Fig pads protected against liver damage in mice. Italian and Mexican teams studied the protective effects of the mucilages against ulcers in rats. Another Italian study validated the antiinflammatory effect of Indian Fig extract against arthritis. An Italian group used extracts from Indian Fig to benefit wounds on rats. A Korean group found that extracts of *O. humifusa* (Eastern prickly pear, the Eastern and Central U.S. equivalent to our *O. macrorhiza*) showed potent anti-oxidative and anti-inflammatory activity. Another Korean study determined that an extract of Indian Fig had neuro-protective action in mouse cells.

Many studies show anti-oxidant and anti-inflammatory effects of the fruits; they were found to be anti-ulcer, neuro-protective, cardio-protective, and hepato-protective. They are also high in taurine, a non-essential amino acid that is never-

theless beneficial to older animals including humans, and scarce from plant sources.

Human trials are expensive; some of these actions are validated in humans, but many studies are on animals or in vitro. Much scientific study of medicinal uses of cacti is recent. Much of the research on *Opuntia* was done in Mexico, and also around the Mediterranean, both areas where the large *O. ficus-indica* (Indian Fig) is a common crop.

Although most studies are done with Indian Fig, there is no reason to think that similar results wouldn't be attained commonly with our species. All *Opuntias* have mucilages, all have betalains—the distinctive pigments of the order Caryophyllales—all the flowers have flavonoids, and so forth.

It is accepted in herbal medicine that O*puntia* plants are diuretic in their various parts, although Native American records aren't strong on this use of *Opuntia*. However, new research shows that flowers are especially effective because their flavonoids are especially anti-inflammatory, and are also analgesic. Dried flowers in capsules are also effective for BPH (Benign Prostate Hypertrophy).

Flowers of chollas (sometimes segregated as the genus *Cylindropuntia*), are thought to be equally effective. *O. whipplei* (Whipple's cholla) is usually tall but there are some dwarf forms. It's native only to the far southerly parts of our East and West deserts, but will grow enthusiastically in Salt Lake gardens. Two southwestern species, *O. acanthocarpa* (Buckhorn cholla) with skinny joints, and *O. echinocarpa* (Silver or Golden cholla according to the color phase of its spines) with shorter, fatter joints, get into the Virgin Valley, but are not hardy in Salt Lake.

Capsules of dried, powdered *Opuntia* flowers are sold by the Springville, Utah, company Nature's Way. They obtain *O. ficus-indica* flowers from India. An Israeli company gets them from fruit plantations in that country. In Sicily with its large Indian Fig plantations, the tradition of *Opuntia* flowers in a decoction as a urinary system herb is strong, simmering the herb in water rather than infusing it after the water is taken off the heat.

Above: After anthesis, Opuntia *flowers, valuable for their anti-inflammatory activity, wither, dry, then fall off of developing fruit.* O. polyacantha*, Water Hollow, Central Utah. Photo by Dorde Woodruff.*

Opuntia flowers begin to wilt after blooming, then fall off the top of the fruit. Dried fallen flowers are collected from cactus fruit plantations for the commercial medicine. They could also be collected before totally dry and dried further.

It's surprising how much a small plot of *Opuntia* can produce, even the low-growing *O. macrorhiza*, given good drainage, plenty of sun, weeded, fertilized, and watered every week or so in the warm growing season. While not on the scale of a diabetic who needs 4 ounces of juice a day, it will produce pads for juicing, salves, poultices, or for drying for powder, and will fruit well. A small garden plot may be a little skimpy for the purpose of collecting spent flowers for herbal use, but a nice, non-consumptive way to obtain a pleasant herbal medicine while traveling around the state is find a huge field of overgrazed desert thick with flowering cactus plants. The "marked antioxidant activity" of the Israeli study suggests a broad range of health benefits of *Opuntia* flowers.

Botanic Verses

By Bill Gray

Roses are red??

White is the Rose,

Yellow the Violet.

Blue is the Pimpernel,

Rather than sciolet.

I can't imagine anything sillier!

How about a pink Scarlet Gilia?

(With apologies to our black-and-white subscribers.)

Above: Dog Rose, Rosa canina*; Goosefoot Violet,* Viola purpurea*; Scarlet Pimpernel,* Anagallis arvensis*; Scarlet Gilia,* Ipomopsis aggregata. *Photos by Bill Gray*

Color is such an immediate presence for most of us that we have a hard time keeping it in perspective. In botany as in human affairs it is a quick and obvious tag, often useful but easily abused. It can mislead as well as it can guide.

Naming is one of our ways of trying to find order in a complex world. But not all names function the same way. Just because a plant was named after a color (or *vice-versa* with rose and violet) doesn't mean that we captured the essence of where it fits in the evolutionary tree. And that is a high priority for botanists trying to assign plants to family, genus, species, etc.

Flower colors are produced when enzymes convert simple chemicals into more complex ones (pigments) that absorb visible light unevenly. Within our eyes other pigments, obtained from carotene in our diet, capture the remaining light and our brain interprets the resulting signals as color. The ability to make those enzymes, hence those pigments, hence those colors is encoded in the plant's genes. It was one of the attributes that Mendel used to discover the laws of heredity.

Variation is of the essence in the natural world. It is continually produced by mutation and rearrangement of genes, and continually winnowed by the harsh realities of surviving in a competitive environment. How much variation does it take to convince a taxonomist that some group needs to be split? It depends very much on the taxonomist and on the group of organisms, and there is no one measure that fits all.

But what about DNA – isn't that an objective guide? It is for some jobs, not others. It's without peer for deducing history, but simple logic shows that a single number such as percent difference in DNA won't work for assigning names. Suppose we set a value of 1% as the criterion for deciding if we have separate species. Start with a pair of plants that differ by 1.1% - clearly two species. Now add a third that differs from each of the others by say 0.6%. By our definition it must be the same species as <u>both</u> of the two different original ones! So the definition doesn't work. Similar logic affects more rounded definitions of species based on breeding (biological species concept). Some widespread plants and animals vary geographically and local subgroups can be recognized: closely adjacent groups usually interbreed. In extreme cases two ends of an array meet and the newly adjacent parts of the continuum cannot interbreed. Illustrations of such *'ring species'* can be found at http://en.wikipedia.org/wiki/Ring_species.

Another confounding factor for plants is that their breeding systems are much more flexible than those of animals. It is relatively common for plants to have multiple copies (not just two) of each chromosome. Those with multiple copies, produced in a single step, can have very different physical appearances and immediate loss of the ability to breed with other members of the original species – they become isolated genetically.

Likewise, plants such as dandelions often dispense with the necessity of having two parents. Self-breeding drastically limits the amount of genetic variation in the descendants, and can give rise to many very distinct subpopulations. These usually remain fertile with other such groups, however.

What sense does it make to have such odd systems? A single dandelion seed may alight far from its nearest neighbour and be inaccessible to cross-pollination by insects. By using its own pollen to fertilize itself it still produces a wide variety of combinations, a few of which are likely to be well suited to local conditions. The single seed has thus established a microcosm of the broader variation within the species.

Scientists have only scratched the surface of the extraordinary range of variation within a species, much of it significant in adapting plants to their localized niches.

Where on the spectrum do our examples fit?

Roses have been selected over thousands of years by humans for form, color and fragrance (I write on Valentine's day). White is by far the commonest color variation in nature because it is the default – inactive enzymes, no pigment.

Violets are clearly separated into many species, distinguished by many different sets of criteria. Yellows, reds, blues, violets, almost blacks are some of the commonest colors (think pansies).

Pimpernels Sometimes two striking color forms clearly coexist within a single species, as shown by the fact that the variants interbreed but the offspring still show the one-or-the-other character. An example is gray and white forms or *morphs* of several bird species. It's not that simple with the pimpernels. Rather than all being lumped together as *Anagallis arvensis* the blue ones are variously considered as a separate subspecies (*A. arvensis* ssp. *foemina*) or even a different species (*A. foemina*).

Scarlet Gilias are even more complex. They are not all-or-none, but scarlet to almost white. Color differences are correlated with geography, with elevation, with pollination, and with other differences in flower structure. Pink forms occurring in Utah and elsewhere were sometimes considered separate species, then opinion favored calling them all *Ipomopsis aggregata* var. *macrosiphon*. More recently the pink plants in Arizona-New Mexico have been elevated to *I. macrosiphon* while those in Utah and other western states have been elevated to *I. tenuituba*.

There is not necessarily one **right answer** as to how they should be named, but how plants are classified may carry very important implications.

Last Chance Townsendia is a yellow-flowered member of the genus *Townsendia*, a quite uncommon color for the genus. That much is agreed. It occurs only in a narrow segment of Utah, and arguments can be made for its being classified as a separate very rare species (*T. aprica*), included within a rare variety of a second species (*T. jonesii* var. *lutea*) or as resulting from hybridisation between the latter and a third very common species (*T. incana*). In either of the first two scenarios the plant could merit Federal protection (provided other criteria are also met), while the third would be unlikely to warrant protection. Making the proper taxonomic decision is a complex matter of analyzing genetic variation, pollination biology, soils and other factors.

Expect to look for more than a single criterion being used whenever species and varieties are separated. One very good, though somewhat loaded, definition of a species is "whatever a competent taxonomist says it is". Expect equally diverse opinions on what constitutes a competent taxonomist!

Noteworthy Discoveries

New Species of Camissonia and Erigeron in Utah: Indefatigable field botanists Duane Atwood and Stan Welsh of Brigham Young University added two more new species to the state's flora in the latest issue of the botanical journal *Rhodora*, published in December, 2007. The first is a new species in the evening-primrose family (Onagraceae) named *Camissonia bolanderi* in honor of long-time Utah state BLM botanist Ron Bolander. *Camissonia bolanderi* is apparently a narrow endemic of the San Rafael Desert in Emery County, Utah, where it occurs in saltbush/Mormon tea communities on outcrops of the Moenkopi Formation. The new species is characterized by small, 4-petaled, yellow flowers (each less than 2 mm long), and mostly simple leaves borne along the lower portions of the stem, but not in a basal rosette. It might be confused with *C. walkeri* in flower size and general appearance, but that species has a well-developed basal rosette and leaves that are almost always divided into numerous pinnately compound segments. Bolander's camissonia resembles another new *Camissonia* (*C. dominguez-escalantorum*) described by Atwood in the same article. The latter species is known from the Harrisburg limestone on the Arizona Strip and might be sought on the Utah-Arizona border south of St. George (several other narrow endemics have recently been discovered on this formation).

The second new taxon is *Erigeron katiae*, known only from Rich County in northern Utah. The species name commemorates Katie Moon, a BYU graduate student studying the flora of Rich County and adjacent Wyoming and co-collector of the type specimen. Katie's fleabane resembles *E. nematophyllus* but has larger and more ample stem leaves and a less prominent basal rosette. The new species also resembles *E. wilkenii*, a narrow endemic of Dinosaur National Monument in NW Colorado which has taller, less tufted (but also leafy) stems. *Erigeron katiae* is just the latest addition to a group of 18 locally endemic fleabanes described from Utah, making the state a center of speciation for this group.—*Walter Fertig*

Reference: Atwood, N.D. and S.L. Welsh. 2007. New taxa of *Camissonia* (Onagraceae); *Erigeron, Hymenoxys,* and *Tetradymia* (Compositae); *Lepidium* and *Physaria* (Cruciferae) from Arizona, New Mexico, and Utah. Rhodora 109:395-414.

Utah Plant Families: The Caper Family

By Walter Fertig

The Caper family (Capparaceae) suffers from something of an identity crisis in the west. Worldwide, the family numbers about 700 species and is especially abundant in dry, tropical areas of Africa. Only six to seven species (depending on one's taxonomic view) in four genera manage to make it to Utah. These species are often mistaken for mustards (Brassicaceae) when in flower or legumes (Fabaceae) when in fruit. Worst of all, the very name of the family is somewhat demeaning. The word *Capparis* (the genus for which the name of the family is based) is derived from the Latin term for goat (Capra), in reference to the foul odors often associated with both organisms.

Despite the bad rap, the Caper family can claim its share of successes. The capers of commerce are derived from the flower buds of *Capparis spinosa* and related species. Capers are typically picked by hand in the morning, just before they would open to unfurl their flowers. Once picked, capers are sun-dried and then pickled in vinegar brine. Noted Colorado botanist (and amateur gourmet?) William Weber considers capers "essential to the preparation of the German meatball dish 'Konigsberger klops'". Many capers are also grown as ornamentals, including Spider-flower (*Capparis spinosa*), and species in the genera *Gynandropsis* and *Polanisia*.

Members of the caper family can be recognized by their four-petaled, slightly irregular (zygomorphic) flowers, stalked ovaries, and capsular fruits. The family is closely related to the mustards but differs in technical features of the fruit. All of the Utah species of Capparaceae have palmately compound leaves and pod-like fruits that superficially resemble those typical of the pea family. Unlike legumes, Capparaceae fruits are composed of two fused carpels divided by a partition and are borne on a jointed stalk called a gynophore.

Above: Palmer's cleomella (or for those unafraid of latin, Cleomella palmeriana*), is a low-growing member of the Caper family that superficially resembles the common Yellow beeplant. In addition to its smaller stature, Cleomella differs in its boxy rather than bean-like fruits and its preference for barren clay soils, as here on the Tropic Shale near Lake Powell on Glen Canyon NRA. Photo by W. Fertig.*

Recent molecular genetic studies suggest that the caper family really consists of two distinct evolutionary lines that ought to be split into separate families. Under this system, the true capers and their relatives (about 450 species) would remain in the Capparaceae, while the western North American species and their allies would form a new family, the Cleomaceae. This would necessitate changing the common name of the family to the Cleome, or Spider-flower family.

The most common members of the caper family (in the broad sense) in Utah belong to the genus *Cleome*, better known as the beeplants, stinking clovers, or spiderflowers. All of these common names aptly describe our two representatives: the pink or purple flowered Rocky Mountain beeplant (*Cleome serrulata*) and Yellow beeplant (*Cleome lutea*). *Cleome* flowers have 6 stamens that extend far beyond the petals, much like the legs emanating from a spider's body. Each flower produces a large quantity of nectar, making the blooms popular with bees and bee-keepers. The flowers and foliage are strongly scented (some would say malodorous), perhaps to attract pollinators or repel grazers. The Hopi used boiled Rocky Mountain beeplant leaves to make a black paint for decorating pottery and baskets. Both species are common in Utah, especially along sandy roadsides or on disturbed soils.

Palmer's cleomella (*Cleomella palmeriana*) and other members of the genus *Cleomella* resemble stunted forms of *Cleome lutea* (the latin name *Cleomella* translates loosely as 'tiny cleome'). It can be recognized by its somewhat box-like or triangular shaped fruits, low stature, and preference for barren clay and shale soils. During wet springs, Palmer's cleomella is one of four or five annual forbs that can convert the barren gray moonscapes of the Tropic Shale into fields of bright yellow and gold.

Clammy weed (*Polanisia dodecandra*) earns its name from its sticky-hairy leaves and stems which feel cool (or clammy) to the touch. These sticky glands also

give the plant its characteristic foul smell. Clammy weed is moderately common in salt desert shrub communities or on coarse sandy soils near reservoirs. The flowers are white or cream-colored with pink or purple stamens of various lengths. Its fruit is an erect, glandular-hairy capsule on a slender stalk.

Jackass-clover (*Wislizenia refracta*) is the rarest member of the caper family in Utah. It is known from a single collection in San Juan County at the northern tip of its range (it is more widespread through Texas, New Mexico, Arizona, California, and Mexico). This species resembles *Cleome lutea* in flower color and growth form, but has an unusual fruit, consisting of two spreading, pouch-like pods and an elongate style. The arrangement resembles a pair of spectacles.

The tongue-twisting name *Wislizenia* commemorates Frederick Adolph Wislizenus, a German physician and amateur botanist active in the mid-1800s. Although not well-known today, Wislizenus attained some notoriety for his 1839 book "A journey to the Rocky Mountains" about his western adventures and for being captured as a purported spy in Mexico (during the Mexican-American war) during his self-financed botanical expedition of the southwest. At war's end, Wislizenus returned to his home in St. Louis with a trove of important botanical collections. Perhaps the strangest twist in the Wislizenus saga, however, is that his name is also given to the mustard *Dithyrea wislizenii,* which is also characterized by spectacle-shaped fruits. Coincidence? The truth behind this botanical mystery may never be known.

Volunteers Across the Nation to Track Climate Clues in Spring Flowers

[Continued from page 1] coordinator Sandra Henderson of UCAR's Office of Education and Outreach. "Project BudBurst is designed to help both adults and children understand the changing relationship among climate, seasons, and plants, while giving the participants the tools to communicate their observations to others. Based on the success of last year's pilot program, this project is capturing the public's imagination in a way we never expected."

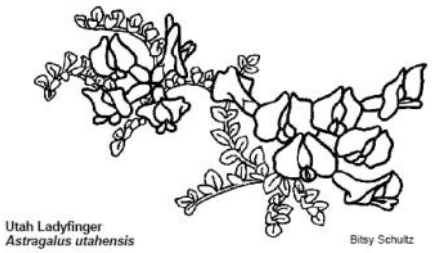
Phenology is the study of periodic plant and animal life cycle events and how these are influenced by seasonal and inter-annual variations in climate, says Dr. Jake Weltzin, executive director of USA-NPN, a citizen-science partnership between the US Geological Survey, National Science Foundation, University of Arizona, and the US Fish and Wildlife Service. Examples of phenological events include the timing of leafing and flowering, agricultural crop stages, insect emergence, and animal migration.

"By observing these cycles through time, researchers can better understand and predict global climate change, wildfire risk, invasive species, and the spread of infectious diseases," said Weltzin. "In the long-term— and with enough data—such information can help us better understand, mitigate, and adapt to ongoing and future climate change."

Above: Phlox austromontana *var.* austromontana *was in full flower (well, one plant was) on January 1 2007 on a south-facing slope in the Vermilion Cliffs outside of Kanab. Photo (of a different plant in April 2007) by W. Fertig.*

As described on the Project BudBurst webpage, each participant selects one or more plants to observe. Participants begin checking their plants at least a week before the average date of budburst—the point when the buds have opened and leaves are visible. After budburst, participants continue to observe the tree or flower for later events, such as the first leaf, first flower, and eventually, seed dispersal. When participants submit their records online, they can view maps of these phenological events across the entire United States.

Partners in Project BudBurst include the Chicago Botanic Garden, Plant Conservation Alliance, and universities of Arizona, California-Santa Barbara, Wisconsin-Milwaukee, and Wisconsin-Madison. Funding comes from the Bureau of Land Management, National Fish and Wildlife Foundation, National Science Foundation, and Windows to the Universe.— *Jake Weltzin, David Hosansky, Catherine Puckett,* and *Rachel Drummond*



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