



Sego Lily

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Ivesia gordonii

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Nuclear DNA content and ploidy levels of *Ivesia* Torrey and A. Gray (Rosaceae) in Utah

by Israel Borokini

Introduction

Ivesia is one of the many endemic plant genera in the western United States (Ertter 1989). The ancestral taxa in this genus were believed to have originated from the western slopes of the Rocky Mountains and eastern Great Basin Desert, and spread through the prehistorically mesic Basin and Range. Evolutionary events may have resulted in the speciation of many relatively young taxa in or around the Sierra Nevada and other ranges in the western edge of the Great Basin Desert. Consequently, the Sierra Nevada is considered the center of diversity for the *Ivesia*; California houses 28 of the taxa in the genus, including 16 endemic *Ivesia* taxa (Shevock 1996, Ertter and Reveal 2014). Of the 38 extant taxa in *Ivesia*, eight have been reported in Utah, including the endemic *I. utahensis* and *I. shockleyi* var. *ostleri*. The remaining Utah resident *Ivesia* taxa include *Ivesia gordonii* var. *wasatchensis*, *I. gordonii* var. *gordonii*, *I. kingii* var. *kingii*, *I. arizonica* var. *arizonica*, *I. sabulosa*, and *I. setosa*.

Despite the relative endemism of this genus, and the state and federal conservation prioritization on many of *Ivesia* taxa, the genus has suffered from research neglect that could benefit effective management of the species. This study seeks to increase the understanding and provide baseline cytological information on *Ivesia* taxa, upon which further studies can be done.

Journey into this study

My PhD dissertation focused on *Ivesia webberi*, a federally threatened forb restricted to the western Great Basin Desert. One of my research studies involved using microsatellite DNA markers to assess genetic diversity, population structure and rates of gene flow in this species. However, this study was delayed by lack of knowledge on the ploidy of this species amidst the concern on the limited use of microsatellite markers for population genetic studies of polyploids (Liu et al. 2017, Meirmans et al. 2018). *The Flora of North America* (FNA) shows that some of the species in the genus are diploid, with 28 chromosomes, but this baseline information is lacking for the majority of the taxa in the genus, including *I. webberi*. Therefore, I determined to

investigate the ploidy of not only *I. webberi*, but as many accessible taxa in the genus, and provide this vital baseline cytological information for academic posterity.

Determination of ploidy levels

In this study, the ploidy level of *Ivesia* was estimated using flow cytometry, which quantifies the nuclear DNA content (also called, genome size or C-value) from which inference can be made on the ploidy of the sampled taxon. We are all familiar with karyotyping, sadly this skill is gradually being eroded, and seldomly practiced or reported. Genome size, an important cytological functional trait, is the total amount of DNA in an unreplicated haploid nucleus of an organism (Greilhuber et al. 2005). Many experts agree that interspecific variation in genome size is conserved, and thus could be used as a taxonomic marker to resolve classification issues, infer phylogeny and evolutionary events (Leitch et al. 2010, Beaulieu et al. 2010, Broderick et al. 2011). Validation of taxonomic treatments is particularly important in *Ivesia* in which classification was done using plesiomorphic morphological characters (Eriksson et al. 1998, Töpel et al. 2011, Ertter and Reveal 2014). These plesiomorphic characters may have arisen from allopolyploidy, ancient hybridization and gene flow.

Beyond its use in taxonomy and phylogeny, genome size has been observed to be positively correlated with many life history and functional traits in plants and animals. This includes positive correlation with cell size, flower and fruit size, seed size, guard cell and epidermal cell sizes, leaf length and width, and mitotic cell cycle duration (Bennett 1987, Chung et al. 1998, Francis et al. 2008, Hodgson et al. 2010). The relationship of genome size with these functional traits suggest that nuclear DNA content may play a role in plant physiology, geographical distribution and persistence (Knight and Ackerly 2002, Hodgson et al. 2010).

Field sampling and flow cytometric analysis

Between the spring of 2018 and fall of 2019, I collected leaf samples from 31 out of 38 *Ivesia* taxa, including all but one resident taxa in Utah (Figure 1). Despite repeated field sampling efforts, *I. shockleyi* var. *ostleri* could not be located in its reported habitat in the Needle Range and the Wah Wah Mountains, both in Beaver

County. *Ivesia gordonii* var. *wasatchensis* (Figure 2) was collected in the Big Cottonwood Canyon, Mt. Baldy, while *I. utahensis* was collected in the Sugarloaf Mountain, both near the Alta Ski Resort. Sample collections were done selectively in larger populations to reduce impact on the species. Reference vouchers for the sampled taxa were deposited at the University of Nevada, Reno herbarium.

Leaf samples were collected from six individuals in each population and shipped to the Benaroya Research Institute, Seattle, Washington State for flow cytometric analysis. Flow cytometry was conducted following the protocol described in Arumuganathan and Earle (1991). Leaf samples were digested in MgSO₄ buffer, mixed with nuclei of chicken red blood cells (internal reference standard) and stained with propidium iodide (PI). Nuclear DNA content of *Ivesia* samples was estimated from 10,000 counts of stained nuclei from at least three samples per population or species. Since we know the ploidy of some of the *Ivesia* taxa, inferences can be made on the ploidy of the remaining taxa by comparing their genome sizes.

Genome size and ploidy of resident *Ivesia* taxa in Utah

Genome size of the sampled *Ivesia* resident in Utah ranged from 0.97 picograms (pg)/2C to 1.4 pg/2C (Table 1). Overall, the genome size of all 31 sampled *Ivesia* taxa ranged from 0.73 pg/2C in *I. baileyi* var. *beneolens* to 5.57 pg/2C in *I. lycopodioides* var. *megalopetala*. Regardless of their genome size, the *Flora of North America* shows that 14 *Ivesia* taxa, including *Ivesia gordonii* var. *wasatchensis*, *I. baileyi* var. *beneolens* and *I. lycopodioides* var. *megalopetala*, are diploid with 28 chromosomes ($2n = 2x = 28$; Ertter and Reveal 2014). Therefore, it could be inferred that all taxa in *Ivesia* are diploid species.

Genome size and ploidy of *Ivesia* has evolutionary and conservation implications. Plants with smaller genomes tend to persist in harsher environment (Knight et al. 2005), and are believed to be relics of ancestral lineages in taxonomic groups that have persisted over a long period of time (Garnatje et al. 2007). However, the majority of *Ivesia* taxa have low dispersal capacity and many of these taxa are restricted to isolated populations

Table 1. Nuclear DNA content of *Ivesia* taxa resident in Utah, United States. Genome size was estimated using flow cytometry, and expressed in picograms/2C. Data represent mean genome size ± standard deviation, with range in parentheses. Ploidy shows the reported ploidy reference in the *Flora of North America*

Taxa	Sample collection	Genome size	Ploidy
<i>Ivesia arizonica</i> var. <i>arizonica</i>	Rainbow Canyon, tertiary canyon, just north of Chokecherry Canyon, growing on protected west facing rock wall, Lincoln County, NV	0.97±0.02 (0.95-0.99)	unknown
<i>Ivesia gordonii</i> var. <i>wasatchensis</i>	Big Cottonwood Canyon, Mt. Baldy, near Lupine Trail, Salt Lake County, UT	1.0±0.00 (1.0)	2n = 28
<i>Ivesia kingii</i> var. <i>kingii</i>	Alkaline salt flat near Fish Lake Valley hot well, Silver Peak range, near Dyer, Esmeralda County, NV	1.4±0.03 (1.35-1.45)	unknown
<i>Ivesia sabulosa</i>	Egan range, ~0.6 miles by air south of Highway 50 intersection, just east of Ruth road, White Pine County, NV	0.84±0.04 (0.83-0.85)	unknown
<i>Ivesia setosa</i>	Egan range, ~0.5 miles by air south of Highway 50 intersection, just east of Ruth road, White Pine County, NV	0.99±0.02 (0.96-1.01)	unknown
<i>Ivesia utahensis</i>	Saddle below and west of Sugarloaf Mountain, Alta ski resort, Salt Lake County, UT	1.03±0.05 (0.97-1.07)	unknown

in mountain and edaphic islands across western United States; this raises the concern of possible reduced gene flow due to geographical isolation. Based on the population genetic theory, small and isolated plant populations may experience genetic drift and inbreeding which can result in loss of genetic diversity, inbreeding depression and loss of fitness (Neaves et al. 2015). The ability of a species to persist through changing environmental conditions is strongly linked with genetic variability (Hopley and Byrne 2019). Studies have shown that diploid species are particularly more susceptible to inbreeding depression associated with reduced gene flow (Lowry and Lester 2006, Pandit 2006). Therefore, it is not enough to protect the habitats of endemic *Ivesia* species, but an assessment of their genetic diversity and the rates of gene flow is important for genetic and demographic implications.

A complete analysis of the intra- and interspecific genome size variations in *Ivesia* and the findings are being prepared for peer-reviewed publication.

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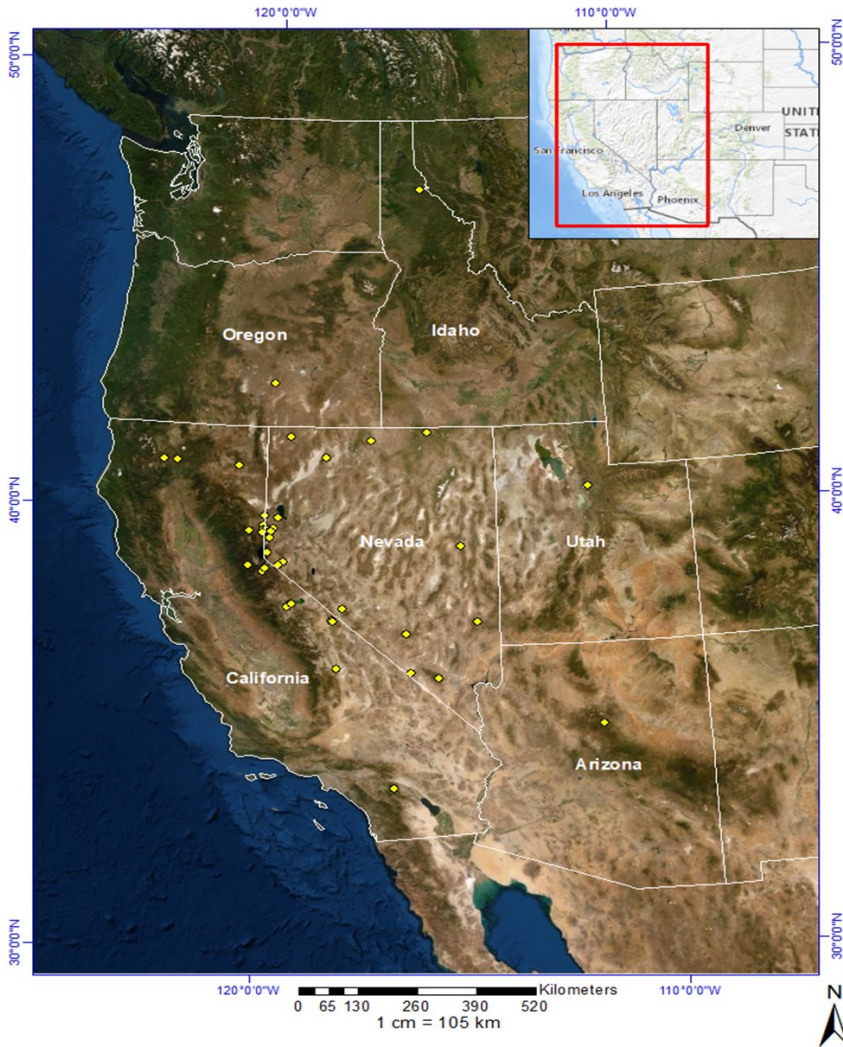


Figure 1. Locations of samples collected for all *Ivesia* taxa used in this study. Sample locations are illustrated in yellow point



Ivesia photos by Israel Borokini.

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Sylvia and the Giant Juniper.

Utah Native Plant Society

Virtual Annual Meeting

Thursday, November 12, 7:00 pm

Join us for our first ever virtual (e-meeting) Annual Meeting. Because of the ongoing Covid-19 pandemic, this year we will have to forgo the New World Potluck (feel free to prepare something tasty for yourself at home). There will be a brief business meeting followed by the election to the board of directors to UNPS. Then Bill Gray will give a presentation on *Utah's Giant Juniper Forest*, 'newly discovered' in the West Desert. Photo by Bill Gray.

Details on how to attend the meeting will follow later in an email from UNPS, it will be either by Google Meet or Zoom and should be easy for all to join. If you need to update your email contact information, get in touch with Tony Stireman, the UNPS membership chair, at tstireman@gmail.com.

Anyone who wishes to make new nominations to the board of directors may do so by emailing UNPS President Kipp Lee at kipphlee@gmail.com.

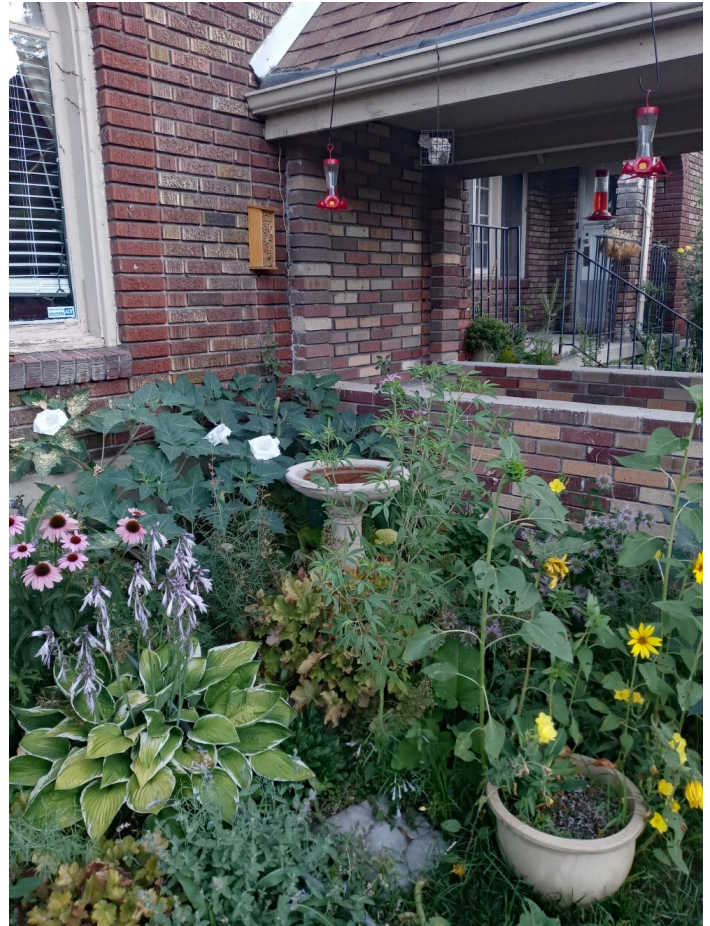
Creating Urban Habitats for Wildlife

by Kipp Lee

One of the biggest threats to both wildlife and plants in addition to climate change is the loss of habitat. As the population continues to exponentially grow along the Wasatch Front and other parts of the state, more and more land is converted for human use. High-density housing is going up everywhere and less green space is being included with these developments. Xeriscaping has been translated to mean “zero-scaping” and some have resorted to use gravel and bark in their yards and parking strips with no vegetation at all. As a result, we are losing biodiversity and green space to help support the many species that inhabit or migrate through our region. Based on studies by biologists and entomologists, most of the commonly sold trees, shrubs, and plants offered by big chain nurseries are not utilized by our local wildlife or pollinators. This is why the use of locally native plants in landscapes is extremely important. Not only are they beautiful, they have context and don't need to be on life support requiring tons of water and fertilizers to survive in our arid climate. And they support an abundance of mammals, birds, butterflies, bees, moths, and other wildlife! Because plants are the base of all food chains, establishing a landscape or even small garden with a diversity of native plants can benefit urban wildlife.

Unfortunately, the use of native plants in landscapes was primarily promoted as only a means to save water. But this seems to be an issue that is not heavily promoted or enforced in Utah. Saving water is important, but protecting biodiversity is equally important. One of the most basic ways we can support biodiversity is to start by creating suitable habitats in our own homes. This can entail entire yards or a small section, large planters, parking strips, or even something like a window box. I live in a duplex and have created an 8 foot by 3 foot wildlife garden in front of my living room window. I included a birdbath, a small ceramic pond for ground dwelling species, hummingbird feeders, bird feeders, suet feeders, and a bee house. I have planted locally native shrubs and flowers which include golden currant, serviceberry, agastache, evening primroses, penstemons, bee balm, epipactis, geraniums, helianthus, datura, and two milkweed species.

In a matter of a few months, the small garden has attracted and supported four squirrels, two quail families, three dove species, several hummingbirds, American goldfinch, chickadees, a few finch species, several native



bee species, butterflies and moths, and various ground dwelling insects. I have also seen the occasional Cooper's hawk hanging out. The quails have made two nests in the garden and successfully hatched a couple of clutches of bumblebee sized chicks. I deliberately planted the garden in front of my living room window to provide much entertainment throughout the year. It also has been a source of both entertainment and frustration for my two German Maine coon cats who make clicking and meowing sounds when the birds or squirrels visit and torment them.

I typically choose native plants, trees, and shrubs that are not only aesthetically pleasing, but also provide food, shelter, and a place for wildlife to reproduce and raise their young. The more diverse you can be in your plant selection, the greater the chances of attracting and supporting a greater diversity of wildlife. If you have space, I recommend devoting a section of your yard if not the entire yard to a native landscape. It is important



Commercially available bee houses attract a variety of native bees and should be installed with an eastern exposure to sun.



Flowers of xeric *Purshia stansburiana* are an inch in diameter and produced over a long season with supplemental watering.

to remember to also include a water source, bird boxes, feeders, bat houses, and bee houses. I have included a list of species which are both aesthetically pleasing and also support wildlife. It is by no means comprehensive but does include plants that can often be found in specialized nurseries.

Trees and Evergreens:

Chokecherries (*Prunus virginiana*) produce a display of flowers that support pollinators in mid-spring. Their fruits begin to ripen in July and provide food for both birds and mammals. They grow rapidly providing a place for birds to nest and raise their young. They do tend to sucker so some pruning may be needed. Once established this tree is very durable.

Gambel's oak (*Quercus gambelii*) is another important tree throughout Utah that provides food to birds and mammals in early autumn. They can grow as shrubby trees or be pruned to grow as medium-sized single trunk trees. They put on leaves in late spring but drop them rather late in the fall. Their acorns are an important food source to squirrels, birds, and numerous rodent species.

White fir (*Abies concolor*) is an attractive evergreen of the foothills and mountains that has bluish-green needles which are extremely fragrant. The tree can grow fairly large and is conical in shape. The cones are an excellent source of food for both birds and mammals.

Pinyon pine (*Pinus edulis* and *P. monophylla*) are easy to grow and attractive conifers for the landscape that are common throughout Utah. They are small to medium in size and have long needles. They support jays, other birds, and mammals with their edible nuts which are produced in the autumn. Because they are evergreen they also provide some protection to wildlife in winter.

Shrubs and bushes:

Cliffrose (*Purshia mexicana* and *P. stansburiana*) are members of the rose family which produces abundant white, cream, or yellowish flowers in late spring which attract numerous pollinators. The flowers are fragrant and the bushes are extremely xeric.

Apache plume (*Fallugia paradoxa*) is a xeric shrub producing white flowers that benefit pollinators throughout the growing season. They can grow 4-5 feet tall and wide.

Elderberry (*Sambucus glauca*) is a tall shrub that produces cane-like branches. They produce racemes of white flowers in spring and numerous tiny blue berries that support an array of wildlife. The berries are also edible and great for jams or wine.

Golden currant (*Ribes aureum*) is another beautiful shrub that has edible fruits. The yellow clove-scented flowers adorn the branches in early spring and the juicy tart fruits appear in early summer and last until autumn. Needless to say, this bush supports numerous species of pollinators, birds, and mammals. Plus the berries are great for jams and sorbets.

Thimbleberry (*Rubus parviflorus*) grows all over the mountains along the Wasatch Front. They produce white flowers in late spring and red sweet berries in summer. They are related to raspberries and are enjoyed by numerous species. The berries are edible and can be eaten fresh or made into jams.

Serviceberry (*Amelanchier utahensis*) is a great shrub in the landscape. The bush is covered in fragrant white flowers in spring and produces blue apple-like berries in the summer which are enjoyed by birds. The berries are edible but rather dry.



The greater the diversity of flowering species and overlapping flower times, the greater the benefit to native bees like this *Bombus* sp. (bumblebee) and *Agapostemon* sp. (metallic sweat bee) and so many others as well as their competitor, the honeybee.

Fernbush (*Chamaebatiaria millefolium*) is a beautiful native shrub that brightens the garden with white clusters of lilac-like flowers from mid-summer to autumn. The leaves are fern-like and the bush is evergreen, providing cover for wildlife.

Flowers:

Milkweeds (*Asclepias asperula, speciosa, incarnata, cryptoceras, and tuberosa*). These plants are an important food source for monarch caterpillars and butterflies which rely on them for most of their life cycle. Their flowers come in combinations of pink, white, yellow, orange, and purple and most are extremely xeric. *A. incarnata* is a wetlands dwelling species and requires wetter conditions.

Penstemons (*Penstemon cyananthus, platyphyllus, eatonii, palmerii, platyphyllus, strictus, whipplei*). These wildflowers are some of the most striking and produce stalks of colorful, snapdragon-like flowers in shades of blues, purples, pinks, and reds. They bloom for a few weeks in spring and early summer and quickly go to seed. *Penstemon palmeri* can grow 4-5 feet tall and the pink flowers are large and extremely fragrant, attracting bumblebees.

Penstemons grow throughout Utah from the deserts to alpine peaks.

Geraniums (*Geranium viscosissimum and G. richardsonii*). The two geranium species grow sympatrically and one is white flowered, the other pink flowered. They grow along moist areas such as streams or shady canyon bottoms in the middle elevation range of the Wasatch Front. They do very well in shady gardens and can grow 3 feet in diameter. They bloom all season.

Mules ear (*Wyethia amplexicaulis* and *W. sagittata*) are great foothill species that are xeric and bloom in mid-spring. The medium-sized sunflowers go to seed in mid-summer providing food for birds and rodents.

Firechalice (*Zauschneria latifolia*) is a low spreading ground cover plant with long red trumpet-like flowers that attract hummingbirds.

Western or mountain pennyroyal (*Monardella odoratissima*), a small aromatic member of the mint family, has light purple flowers and grows in dry rocky areas of the high mountains.

Evening primroses (*Oenothera caespitosa, elata, pallida*) the beautiful white flowered plants grow along road cuts, sandy areas, and xeric conditions. They attract moths and other pollinators. The taller yellow flowered *Oenothera elata* grows along streams and wet areas. It is a biennial that grows well in the garden and spreads quickly.

Hummingbird mint (*Agastache urticifolia*), the fragrant white flowered member of the mint family, grows in the mountains throughout Utah.

Sunflowers (*Helianthus annuus*) are a great annual that grow from one to several feet tall producing large yellow flowers. The seeds are an excellent food source for birds.

Showy goldeneye (*Heliomeris multiflora*) is a branching plant 1-3 feet tall and wide that produces numerous yellow flowers from mid summer to autumn. Goldfinches are attracted to the seeds that are produced.

Beeplant (*Cleome lutea and C. serrulata*), yellow and pink flowered bee plants are annual members of the legume family and grow in disturbed areas, roadsides,

and open areas throughout Utah. They bloom throughout summer and *C. serrulata* can grow 4-5 feet tall.

Wild strawberry (*Fragaria vesca*) is an excellent groundcover that grows in shadow mountain areas. The flowers are white and the small red berries are edible and a great food source for wildlife.

Buckwheats (*Eriogonum umbellatum, ovalifolium, and brevicaulis*) are extremely xeric native plants producing compound umbels of sulfur, yellow, and white flowers during late spring to early summer.

Desert Four O'Clock (*Mirabilis multiflora*) is a low mounding perennial plant that can spread out to over 6 feet when mature. The flowers are magenta pink and bloom all summer. The plant grows from a large tap root and dies back at first frost.

Columbine (*Aquilegia coerulea, canadensis, and scopulorum*). *A. coerulea* and *scopulorum* have purple and white flowers and *A. canadensis* has orange and yellow flowers. They are great for cool shady areas with higher moisture.

Datura (*Datura wrightii*). This member of the Solanaceae family grows up to 5 feet in diameter and produces large white trumpet shaped flowers that open in the evening and close in the morning. These require little water once they are established.

Asteraceae (erigerons, fleabanes, daisies) are numerous species that grow from the deserts to foothills and come

in yellow, pink, blue, or purple. They grow in all the different habitats of Utah.

Clematis (*Clematis occidentalis, C. ligusticifolia*) are two species that grow in the Wasatch Front. The Western clematis has purple flowers and grows in shady locations. The yellow flowered clematis grows very large, often covering trees along canyon bottoms and streams.

Globemallow (*Sphaeralcea ambigua, grossulariifolia, coccinea*), these are orange flowered members of the mallow family that bloom all season and are very xeric (although additional water keeps them blooming longer).

Maple mallow (*Iliamna rivularis*) is a tall pink flowered member of the mallow family that grows in the mountains in more shady and wet areas. As the name implies, the leaves are similar to maple tree leaves in shape.

As I mentioned earlier, this list is only a fraction of the native species that can benefit wildlife in our urban environment. You can grow them from seed, purchase them online, or find them in a few select nurseries throughout Utah. There is nothing more rewarding than watching your garden grow and to see the various types of insects, birds, mammals, reptiles, and amphibians that may randomly appear and utilize your urban oasis. We all definitely need to dedicate more space to the other inhabitants of our region.



Asclepias tuberosa

My Garden Journey

by Cameron Carlson

My name is Cameron, I am a new member of the UNPS, and live in the southwestern reaches of the state, in Washington. I would like to share some of my story of what brought me here to connect with you all, and I wanted to express that I am excited to meet you, and read and hear of your stories, perspectives, experiences, and passions.

I moved here in 2014 to attend Dixie State University where I studied Earth Science and graduated with my Bachelor of Science in 2018. Since moving to Southern Utah, my interest and focus on environmental sustainability, nature, and outdoor recreation has drastically increased. Furthering my understanding and connection with nature (and our impact on it), studying the Earth in this beautiful area, and becoming a homeowner has opened the door to the practical application of native ecology and botany in my life.

This area, as many of you may know, is unique in its convergence of three major ecological areas: the Mojave Desert, the Colorado Plateau, and the Great Basin. I live in or just beyond a seemingly natural floodplain of the Virgin River, which has been used as agricultural land by locals for many decades. I also recently learned that the riparian habitat just beyond my neighborhood subdivision is periodically home to the endangered Southwestern willow flycatcher, a good reminder that we share this home with many animal and plant species, and how we landscape around our homes can have a direct impact on the local ecosystem.

I purchased my home in December 2016, and at the time the landscaping was sadly similar to the average suburban home in our area: abundant lawn, surrounded by basic desert tolerant gravel garden plantings containing mostly exotic plants from our big box nursery. My home landscape lacked biodiversity and creativity, and was high maintenance, resource intensive, and wasted space. As I started adjusting to life as a homeowner, I started to get more familiar with my yard and considered ways I could improve it. I simply wanted to save water, time, energy, and wanted to plant appropriate plants for the area.

My first summer living here, daily high temperatures were around 100-110°F+ and my household used 32 thousand gallons of water in one month! According to my bill, my water consumption was (sadly) average for the area, however I was still shocked by the outrageous

water usage. I realized then that the grass definitely had to go, and so that next spring I simply didn't turn on the sprinkler irrigation and the desert sun cooked it to a crisp. Ha! Following this, I started chipping away at different projects around my yard, playing with ideas, and exploring options for my new garden. This time also served me well as I began more careful observation of my site.



Last year March (2019), my backyard flooded from a combination of factors: weeks of heavy rains, a hardpan of clay under my shallow topsoil, poor sloping/drainage, lack of vegetation (old lawn), and close proximity to river (historical riparian floodplain and probable high groundwater table). Reactively, I purchased a pump and made a makeshift sump to pump out the hundreds of gallons of water out to the street. This event informed and inspired the next steps of my garden project, including the understanding that I should proactively design my landscape for our changing climate and not rely on traditional forms of pumping and draining water away as many of my neighbors have resorted to; I have observed their projects or listened to my neighbors' stories of bringing out pumps each time it rains, laying new drainage pipes, or digging serious sumps in their yard to rid themselves of the water.

I know that we live in a time of anthropogenic global climate change. In the desert, this change so far seems to manifest itself in unseasonable weather and the typical arid climate extremes in greater frequency and intensity: flood events, drought, extreme heat, and cold snaps. My observations from only the last year range from record rains in late winter/early spring (I believe we received nearly 12 inches by the end of March, where our *annual* average is around 7-8 inches), near freezing temperatures in late October (a month early), and the



longest dry spell in recorded history (155 days) to be broken by record rains in November. All of these events transpired in 2019.

I wanted to make something beautiful and resilient to all these changes. This was a multifaceted situation, and with the size of the project I was going to be taking on, my approach needed to be creative and deliberative. Among my search for new information and inspiration, I found this lovely book called *The American Meadow Garden* by John Greenlee on my first trip to the local library, and also attended a local workshop about rain-water harvesting where I was introduced to the idea of rain gardens and the work of Brad Lancaster of Tucson, Arizona. This was it! I decided I would plant a drought tolerant rain garden in the desert to capture rain during our flood events, and create meadows as a sustainable alternative to lawn areas.

I began crafting and excavating that summer. With the help of some friends, we laid out the rough outlines of what would become two connected oval/kidney shaped rain gardens, flanked by two wildflower meadows. After scraping away the topsoil, I ended up needing to use a pick axe to be able to break through the very hard, compact clay layers at the base of my future rain garden. I eventually was able to haul away most of the chunky

clay that I had unearthed, and fill in these newly constructed basins with a blend of existing topsoil and clay dirt, and some locally obtained compost. Alongside this, I amended the meadow areas with this compost, and also began removing some of my front lawn to eventually replace with native xeriscape.

Throughout this time, I learned all about the benefits of planting native, which is the proper way to plant/seed both rain gardens and meadows. I was sooo excited to know that it was finally time to search, purchase, and plant natives. These plants are deep rooted and drought tolerant, invite beneficial pollinators, bugs, and animals, are accustomed to the climate and soil, and in the case of rain gardens, tolerate occasional flooding or "wet feet." I encountered serious hurdles finding which plants would be best for a rain garden in my area, as the closest I could find were Rocky Mountain or Sonoran Desert plant lists. I did, however, persist in my search and online research. From a combination of purchasing seeds and plants online, scouring local nurseries, and even obtaining seeds from a friend, I had options for my garden. So between last fall and this spring, I planted about 10 trees, dozens and dozens of shrubs and forbs, and dozens of grasses and grass plugs. I have additionally spread seed for native grasses and wildflowers.



Now, over this time I have become more observant, increased plant biodiversity in my landscape, made my garden more enjoyable, and I am now spending more time outside. These may factor into the increase in the following observations, yet my garden feels more alive than ever before! Since near completion this spring/summer, I have seen more hummingbirds, lizards, bees, songbirds, grasshoppers, ladybugs, and praying mantises. I've heard more crickets and cicadas. I've also seen new bugs around my yard such as caterpillars, leafhopper bugs, types of spiders, and milkweed bugs. I've watched new birds visit such as lesser goldfinches, prairie falcons, orioles, blackbirds, ravens, and more!

My garden now hums to the sunshine of the day. At night, I enjoy passive cooling as cool air pools and emanates from the meadows and rain garden. My property is now recognized as a certified wildlife habitat by the National Wildlife Federation.

In the end, I replaced an estimated 2000 square feet of lawn in my backyard, and about 400 square feet of lawn in the front. I now have beautiful garden paths of flagstone and playground wood chip mulch, two thriving native meadows, one of which is an ephemeral wet meadow (connected to rain garden), a native xeriscaped front yard, and a native rain garden (the two connected

earthen water catchment basins) that additionally harvest rain from nearby patios and downspouts. A few noteworthy plant surprises in the garden that I did not plant are cottonwood sprouts (*Populus*), a quailbush sprout (*Atriplex lentiformis*), and what appears to be coyote/sandbar willow sprouts (*Salix exigua*) too. As far as irrigation goes, I have low flow rotary sprinkler heads for my meadows, drip for my front xeriscape, and drip for my rain garden. I now only use a portion of the water I once did for all the grass, and will have even lower water use in a year or two when many of the plants are much more established.

I have a newfound passion for native plants, particularly for their characteristics of hardiness, resilience, adaptability, and ability to thrive so quickly after planting. Additionally, I love the "sense of place" that native plants provide and how they help us connect with the land we live on. I have really enjoyed embracing the creative flow, outlet, and expression of myself into the garden and land, am thrilled to restore and beautify the area, and rejuvenate the soil and its life-giving force. I am very grateful for this organization and am excited to now be a part of it, especially to share this passion with many like-minded folks. Thank you for all you do too. :)

New Native (or regionally native) Plants:

Asclepias speciosa (showy milkweed)

Asclepias tuberosa (orange milkweed/butterfly weed)

Aster tanacetifolius (Tahoka aster)

Atriplex lentiformis (big saltbush/quailbush)

Baileya multiradiata (desert marigold)

Bouteloua curtipendula (sideoats grama grass)

Bouteloua dactyloides (buffalo grass)

Bouteloua gracilis (blue grama grass)

Chamaebatiaria millefolium (desert sweet/fernbush)

Chilopsis linearis (desert willow)

Clarkia unguiculata (farewell to spring)

Coreopsis tinctoria (golden coreopsis)

Encelia farinosa (brittlebush)

Ephedra viridis (Mormon tea)

Epilobium canum (California fuchsia)

Ericameria laricifolia (turpentine bush/larchleaf goldenweed)

Eriogonum fasciculatum (Eastern Mojave buckwheat)

Eschscholzia californica (California poppy)

Eschscholzia mexicana (Mexican gold poppy)

Utah Native Plant Society

Fallugia paradoxa (Apache plume)
Fraxinus anomala (single leaf ash)
Gaillardia pulchella (Indian blanketflower)
Gilia tricolor (bird's eyes)
Gutierrezia sarothrae (broom snakeweed)
Larrea tridentata (creosote bush)
Layia platyglossa (tidy tips)
Linum perenne lewisii (blue flax)
Lupinus arizonicus (Arizona lupine)
Lupinus succulentus (arroyo lupine)
Mentzelia lindleyi (blazing star)
Nemophila maculata (five spot)
Oenothera pallida (white evening primrose)

Oenothera speciosa (showy pink evening primrose)
Panicum virgatum (switchgrass)
Phacelia campanularia (California bluebell)
Prosopis glandulosa (honey mesquite)
Ratibida columnaris (Mexican hat)
Rhus trilobata (skunkbush sumac/squawbush)
Ribes aureum (golden currant)
Rudbeckia hirta (black-eyed Susan)
Sphaeralcea ambigua (desert globemallow)
Thymophylla pentachaeta (eleven-needle prickly leaf)
Yucca baccata (banana yucca)
Zinnia grandiflora (prairie zinnia)



William A. Weber

1918-2020

by Leila Schultz

Bill (William A.) Weber died in March of this year. Born in 1918, he lived to enjoy his 100th and 101st birthdays, and he entered a Boulder marathon in 2019 – using a walker, but proudly winning the prize as the oldest competitor. He was born in New York City on November 16th, two days short of the same birthday shared by Asa Gray, Art Holmgren, and Noel Holmgren. Those of us in Utah know him as the author of the popular and user-friendly Colorado floras – in spite of increasing use of unfamiliar plant names.

He became the major professor for my master's degree in what was then the University of Colorado's department of "Environmental, Population, and Organismic Biology" – abbreviated "EPO" Biology for the sake of brevity. I say "became" because I started work with John Marr as a student in ecology. But when Dr. Marr saw my determination to name all the "unknowns" we graduate students gathered from study plots, he suggested I talk with Bill Weber about a job in the herbarium. First year graduate students at CU could not receive stipends at the time, and work study was my best hope of finding employment--which John Marr knew I sorely needed. The herbarium was in the Museum of Natural History, where Bill Weber held a professorship after leaving the Biology Department (largely due to conflicts over the importance of building a research herbarium). Dedicated to the task and an inveterate scholar, Bill built the herbarium from a scrappy set of specimens left by ecologist Francis Ramaley then expanded by Joseph Ewan. When Ewan left the University, he left a core botanical collection as well as a library of floras and monographic works.

Bill liked to say that his goal in writing floras was to make keys easy enough for an intelligent ten year old to use – and only to use characteristics that could be seen with a 10-power hand lens. He also limited the number of species in the flora – always a good way to simplify the identification process – by dividing the Colorado flora into "East Slope" and "West Slope." As it turns out, this makes ecological sense as well since the high mountains (58 peaks over 14,000 ft high) create a natural climatic and ecological barrier.

When I started working in the herbarium, he was more involved with moss and lichen taxonomy than vascular plants. But maintaining a "tight ship" in terms of herbar-



The author* and "Herr Professor Dr. Weber"***at a Missouri Botanical Garden Symposium in 2006. Photo from Dennis W. Woodland.

ium operation was always a priority and he kept several of us running during the day. Loan requests and exchanges were promptly processed and new collections hardly had time to gather dust before they were integrated in the collection. Always with a hand lens around his neck, he checked identifications as they came in and worked to help ecologists who were climbing high peaks to do phytosociological studies. Beatrice Willard and Vera Komarkova were among the scientists doing pioneering studies during my tenure in Colorado. Pat Nelson was finishing a random-access key to the mosses of Colorado, Miriam Colson was working on the systematics of *Carex*, Jerry Arp was working with cacti, and it only seemed natural that someone should be working on a simplified key to vascular plants. That became my master's work: creating a computer-generated polyclave to the genera of Colorado plants. The end product consisted of the old-time punch cards with multiple holes – each card consisting of a plant characteristic with hole positions representing genera. It was a "peek-a-boo" system where you superimposed character cards until you narrowed the generic choices to a manageable few. In coding genera for characteristics, I soon learned how inadequate most floras were in giving you details for species attributes. I needed to examine every species in order to create uniform codes.

Bill's interest in the evolution of the Rocky Mountain flora and similarities with the Himalayan Mountains led to a number of seminal papers in biogeography. I think that is part of why he became so passionate about the study of mosses and lichens. Here were organisms that could disperse as fragments, and their survival would depend entirely on their ability to establish in that site. They are, in other words, an indicator of habitat conditions. He spoke often about the evolutionary significance

of a primarily haploid organism (i.e. mosses without sporophytes) that could survive long periods of drying. Specimens of moss, long stored in herbarium cases, will begin growing again if wetted. And, because they are haploid, they do not have the genetic complement allowing for greater ecological amplitude. If rarely producing sporophytes, the potential for evolutionary change is limited. Circumboreal floras were always a fascination to him, witnessed by the bryological and lichenological floras he produced in Australia and the Galapagos.

Many people knew Bill to be cantankerous. If someone came to the herbarium to visit, they would be turned away if he or she could not explain why they came or what they were studying. In the herbarium work room, he proudly posted an aphorism stating “if you don’t have anything to do, don’t do it here.” A colleague in Colorado recently told me he met people who liked to say “yes, I met Bill Weber (long pause) once.” But his long-term friendships with colleagues like Askell Löve, Joseph Ewan, John Marr, William Ricketts, Dana Bailey, Ron Wittman, Beatrice Willard, Peter Raven, and old birding buddy Ernst Mayr, are testament to his wide ranging interests and respect for scholarship.

Bill was known as a taxonomic “splitter,” using names unheard of in most North American floras, but often found in early floras produced mainly by botanists from Europe. For instance, have you heard of the families “Alsinaceae, Ceratophyllaceae?” – or genera *Adenolinum* and *Mesynium* for what we know as flax? When he started calling all the sagebrush in Colorado *Seriphidium*, I drew the line, telling him the Asian *Seriphidia* are a separate evolutionary lineage from North American *Artemisia*, and use of the name obfuscates the relationships. In reviewing one of his papers for a botanical journal, I sent it back to him and told him he needed to provide explanation for his name changes. Even though the article was ultimately rejected, we remained friends. Social isolation, of course, may be part of the explanation, and because I was working in Utah, we could talk about floristic similarities and differences without being competitors. He was highly critical of anyone working

with the Colorado flora, but perhaps that is as it should be. He considered Colorado his domain and woe be to the person who tried to challenge his authority. But he was always willing to help anyone who was serious about field work and systematic research, and his identifications were, for the most part, unassailable.

In his tenth decade, Bill worked with his daughter Linna Weber Müller-Wille and grandson Ragnar on a retrospective of his life and career in botany.** He was able to revisit colleagues and friends through written recollections and story-telling. In 2015, the University of Colorado Library honored him as a “lasting legacy” with an exhibit now housed in their archives. In my last visit with him, he told me he believed his most important contribution might have been in preserving the legacy of T.D.A. Cockerell by publishing “*The American Cockerell, A Naturalist’s Life, 1866-1948.*” That was an interesting remark given his legacy of multiple floras, book chapters, journal publications, awards, and his immense number of collections. Twenty-eight species and three genera have been named for him, including flowering plants, lichens, and mosses from Tasmania, New Guinea, Australia, Argentina, South Africa, and North America. The day before he died, friend and co-author Ron Wittmann visited. Ron told me he had planned a brief stay, but Bill said “please stay longer,” talking far into the afternoon. When Ron returned the next day, loaded with the books Bill said he wanted to share with staff at the nursing home, he learned Bill had passed away in his sleep. Curious, engaged, and publishing papers to the day he died: what better ending to a life well-lived?

*Research Professor Emerita, Quinney College of Natural Resources, and former Curator of the Intermountain Herbarium, Utah State University, Logan, UT 84322.

**For recent pre- and posthumous publications, see: Weber Müller-Wille, Linna, and Ragnar Müller-Wille, eds. 2020. *Acta Botanica Weberi* ISSN 2561-9357, and personal website <http://www.williamaweber.com>.

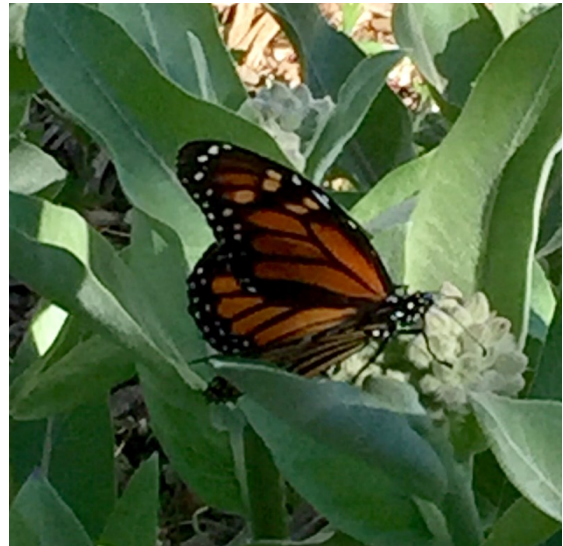
New UNPS Lifetime Members

Amber Rasmussen, Craig Wallentine, Scott Hynek & Tyler Wilson

BLM Employee Helps Monarchs Take Flight

Story & photos Adrienne Pilmanis,
edited by Kari Boyd-Peake, BLM UTSO
Reprinted from BLM Utah's Facebook account

BLM ecologist Adrienne Pilmanis normally works at the BLM State Office in downtown Salt Lake City, but has been teleworking from home since mid-March. The teleworking schedule that Adrienne maintained was very routine with her, her computer and her important research, until she made an exciting discovery...in her yard!



The first recorded monarch butterfly sighting in Utah for 2020.



Showy milkweed planted along the sidewalk in Pilmanis' yard.

Adrienne first planted milkweed in her front yard in 2016 after hearing about the critical crash in western monarch populations. "People had noticed a huge decline in monarch sightings in Utah over the years, and they really didn't know whether Utah monarchs wintered in Mexico or California." She decided to plant some native milkweed species and now has four species ("Showy - *Asclepias speciosa*, "Mexican whorled" - *A. fascicularis*, "antelope horn" - *A. asperula*, "butterfly" - *A. tuberosa*) growing in her yard.

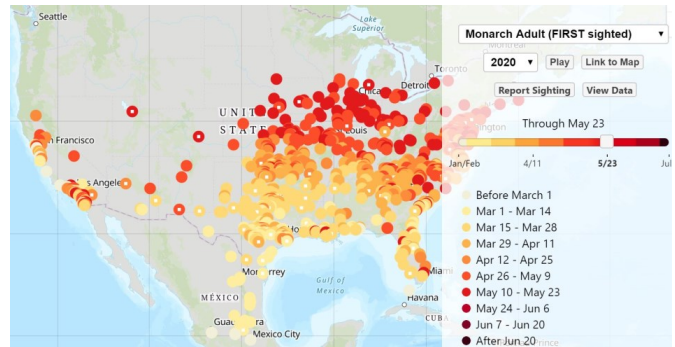
On May 15, Adrienne took a break and strolled into her yard. She noticed a large orange butterfly flitting around her milkweed plants. "It was too large to be a painted lady so I ran to grab my camera hoping to return and find a monarch butterfly. It was!" explained Adrienne.

Adrienne logged the first confirmed 2020 monarch sighting in Utah on the Journey North Citizen Science website. Generally, monarchs aren't noticed in Utah until June. That weekend and in days after, social media posts

hailed more monarch and egg sightings in Utah, causing much excitement among local monarch fans (Monarchs of the Wasatch Front facebook group).

Soon after her exciting discovery, Adrienne and local monarch enthusiast and educator Rachel Taylor, Southwestern Monarch Study research associate, searched the milkweed patch and found 40 eggs!

Many eggs had been laid on very small showy milkweed sprouts, others on upper leaf surfaces and on flower buds of larger plants, in addition to the typical under-leaf surfaces.



Journey North Monarch tracker showing first adult sighting in Utah for 2020

"She really loaded you up!" Rachel commented. Since only a small percent of monarch eggs survive naturally due to predation and damage, Rachel and Adrienne collected the eggs and shared them to local foster families to raise in protected settings to adulthood.

Considering the odds and the drastically low western monarch population reports, Adrienne and Rachel thought it was important to give these offspring the best



Tiny monarch eggs on showy milkweed sprouts.



One pupa in chrysalis, morphing into a beautiful butterfly.



Just before hatching, monarch eggs turn black (the caterpillar's head about to emerge).



Adrienne's freshly eclosed male Monarch taking time to prepare its wings for flight.



Adrienne's caterpillars (2nd or 3rd and 5th instars) growing up in mesh cage.



Adrienne's butterflies have been released back to the wild. She'll watch to see if they breed in her yard again!

fighting chance possible. Adrienne kept a few to raise in a mesh cage outdoors on her porch.

Even when grown in a protected setting, there will be eggs that do not hatch, larvae that do not manage to pupate (change from caterpillars into a chrysalis) or pupae that do not eclose (come out of a chrysalis as a fully fledged butterfly).

Adrienne's caterpillars grew large and chunky in her protective mesh cage, specially designed for raising butterflies. After 20 days, two caterpillars metamorphosed into pupae (the chrysalis stage of a butterfly life cycle) and began the magical transformation from caterpillar to butterfly.

"I lost one chrysalis when a windstorm tipped the cage over even though it was weighted down, but on the 14th

day two butterflies emerged, a male and a female," explained Adrienne.

Social media posts soon shared the news that other protected eggs had made it to adult freedom as well! On June 21 Adrienne's two new adult monarch butterflies eclosed (came out of their chrysalises). They rested for nearly a day to let their wings fully expand, then flew out of the cage and into the world to take their chances.

"I saw mine nectaring in and out of my backyard on the 22nd and am hoping for more sightings and eggs. Such a breathtaking sight, to see those beautiful and amazing

creatures finally on the wing!” exclaimed Adrienne. These new monarchs are likely a second generation from those which wintered in Mexico or California. They have time to reproduce another generation, which in turn will breed the generation that migrates away for the winter.

Update 7-2-2020 for Utah Native Plant Society Newsletter:

Adrienne’s female monarch stuck close to her birth yard. “She loves my *A. fascicularis*! I’ve seen her nearly every day nectaring almost exclusively on those plants.” The female visited neighborhood yards, too, but kept faithful to Adrienne’s. “She does her tour of the yard a few times a day, checking out where young showy milkweed sprouts are popping up.” Adrienne searched for eggs every day, hoping her male or another was somewhere nearby so her female could have the up to 16 hour-long overnight “date” necessary for monarchs to mate.

Eggs found June 30th! “I’m so relieved!! I was getting worried I hadn’t kept enough eggs here to ensure matings, but then her flight behavior changed and she was clearly visiting leaves and laying eggs in addition to nectaring.” It was eight days post-eclose when the first eggs appeared. According to online sources, females can mate from 3-8 days after eclosing.

For this generation (two), Adrienne will only collect eggs to raise if they appear in danger of trampling or other hazard (e.g. those laid on sprouts along the sidewalk, or

off of older stems thinned from the milkweed patches). I have noticed ~30 eggs already on showy milkweed and a few on whorled milkweed flower buds. It will be interesting to watch how many caterpillars are evident and how many pupae and adults make it. If all goes well, we may see Gen 3 adults in about 6 weeks.

Monarchs are being considered for listing by the US Fish & Wildlife Agency under the Endangered Species Act; a decision is due in December 2020. Information on the process and conservation measures can be found here: <https://www.fws.gov/savethemonarch/SSA.html>. If you are interested in learning what you can do to support monarchs visit Monarch Joint Venture, Journey North, The Xerces Society, Southwestern Monarch Study, or Monarch Conservation in Utah. Please note: captive rearing is not considered an effective conservation strategy, and would likely require a permit from FWS if the monarch is listed.

Adrienne is BLM’s Colorado Plateau Native Plant Program (CPNPP) Coordinator. CPNPP is one of BLM’s Ecoregional Native Plant Programs working to bring more and better native plant materials into use in seeding and planting projects on public lands. In 2016 the CPNPP & partners received a Monarch Butterfly & Pollinator Conservation Fund grant from the National Fish & Wildlife Foundation to work in Utah, Colorado and Arizona to collect milkweed and other pollinator-friendly plant seed, create pollinator gardens, and move seed and seedlings into restoration projects.

Andrey Zharkikh Photo



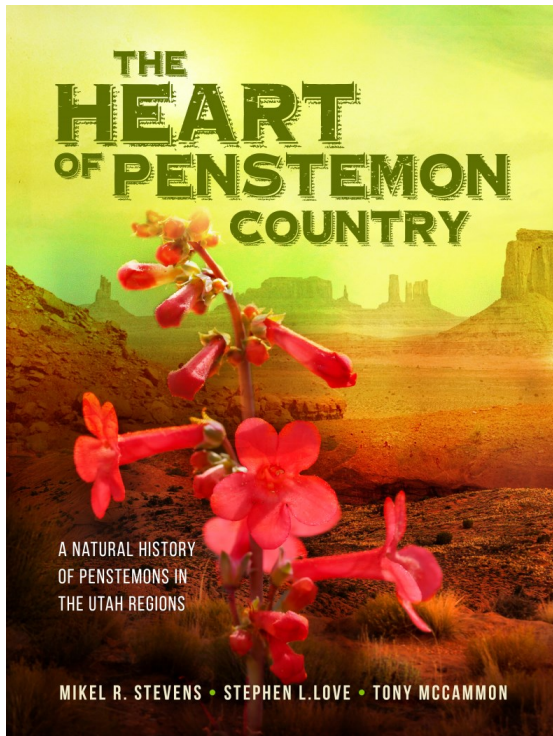
Castilleja parvula on Delano Peak. It is endemic to southern Utah and I was happy to catch it in full bloom.

Hot off the press!

The Heart of Penstemon Country: A Natural History of Penstemons in the Utah Regions

by Mikel R. Stevens, Stephen L. Love and Tony McCammon

The long-awaited natural history of penstemons in Utah has just been published and made available to the public. Those who are interested in this limited edition publication should contact Mike Stevens by email at mikel_stevens@byu.edu.



A description of the book by the authors:

“The genus of plants designated *Penstemon* consists of over 280 unique and beautiful species of plants native to western North America. Seventy-six of these species can be found within the state of Utah. This comprehensive and unique natural history of Utah penstemons (including many species found in surrounding states) provides exhaustive information on their discovery, scientific documentation, geographical distribution, habitat, between species comparisons, morphological characteristics, historical ethnobotanical uses, methods of garden cultivation, and their breeding for urban landscapes. Attractive photographs enhance textual descriptions. A species key, descriptions of species morphology, and comparisons between look-alike species will increase aptitude of professionals and amateurs alike in identifying these plants in their habitat. This book is a

must for lovers of penstemons, anyone interested in natural history of plants in the west, and those with specific interest in incorporating penstemons into urban landscapes.”

From the back cover:

“What do you get when three horticulturalists combine expertise and direct it towards a single plant genus? In this case, a fascinating volume detailing the natural history of the stunning wildflowers we know as penstemons. More specifically, the 76 species of penstemons found in the mountains, deserts, and canyon lands of Utah - the probable center of origin for this complex array of intriguing plants. Penstemon truly is Utah’s wildflower. Within these pages you will find the most detailed and comprehensive information ever compiled for this group of Utah’s floristic treasures. This book provides information on the discovery of each species, historical ethnobotanical uses, information on range and habitat, detailed descriptions of foliage and flowers, and methods you can use to grow each species in your own garden. Take this book along on your next hike and use it to identify and learn about each and every penstemon you encounter.”

“*The Heart of Penstemon Country: A Natural History of Penstemons in the Utah Region* is a visual treasure, packed full of interesting information about species of *Penstemon*. Utah is the geographic epicenter for the diversity of this large genus, which is native to North America. The combination of taxonomic information and history, beautiful photographs, range maps, cultivar lists, conservation statuses, and ethnobotany will make this book a must have for people interested in the flora of the intermountain region.”

Dr. Andrea D. Wolfe, Professor Department of Evolution, Ecology, and Organismal Biology
The Ohio State University

“In the hot deserts of southern Utah, surrounded by dry, infertile soil and withered plants, it’s not hard to find a penstemon growing out from a rocky slope in full bloom without any signs of stress. Awe and wonder over such an anomaly have sparked decades of research of this genus across North America and Europe. This book combines these efforts into the most detailed and comprehensive Penstemon reference ever written from the perspective of the genus’ epicenter. It is a treasure trove to plant breeders and penstemon aficionados, who will pull this resource from the shelf again and again.”

Dr. Shaun Broderick, Assistant Research & Extension Professor of Ornamental Horticulture
Mississippi State University Extension

Sample pages can be viewed here:
https://www.unps.org/miscpdf/Stevens_angustifolius_sample.pdf

Your Membership

Your membership is vital to the Utah Native Plant Society. It is important that your information is correct and up to date for notifications and the delivery of The Sego Lily newsletter.

Any questions about your membership, Contact Tony Stireman, tstireman@gmail.com.

Cooler Weather is coming... It is time to consider another issue of the Utah Native Plant Society *Sego Lily* which relies mostly upon articles from the society's membership. Please submit articles of your native plant stories and photos from hikes and field trips, conservation activities... whatever might be informative and interesting to fellow members.

The *Sego Lily* editors can use most any text format for articles (PDF is often difficult). Photos are always best submitted in original resolution and as individual files separate from text. You can indicate desired positioning within a document. We are looking forward to hearing from you. For submissions and/or questions: newsletter@unps.org or cathy.king@gmail.com.



Utah Native Plant Society

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Salt Lake City, UT, 84152-0041.

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Webmaster: unps@unps.org

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Southwestern/Bearclaw Poppy:

Utah Valley: Robert Fitts

Website: For late-breaking news, the UNPS store (posters, etc.), the *Sego Lily* archives, Chapter events, sources of native plants, the digital Utah Rare Plant Field Guide at unps.org.

Webmaster inquiries at unps@unps.org

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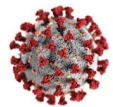
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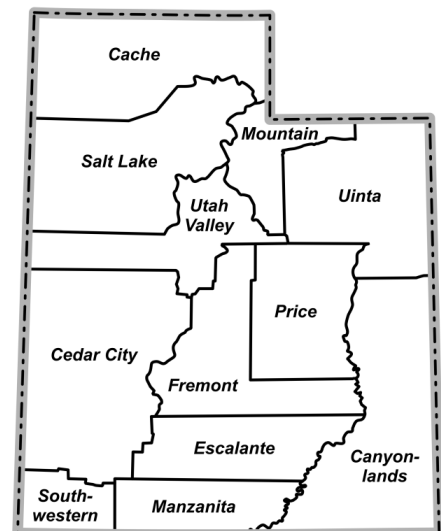
Submit articles to Cathy King:
cathy.king@gmail.com

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