

Aquilegia

Newsletter of the Colorado Native Plant Society

Volume 43 No. 3 Annual Conference/Summer 2019

2019 Annual Conference Grand Junction, Colorado



The Ever-Changing Landscape

Dear Readers,

Please note that this issue of *Aquilegia* is the Summer issue and the Annual Conference issue. This combined publication features information sure to spark your interest in the September Annual Conference in Grand Junction—mark your calendars and register soon!—as well as regular features, quarterly columns, research and reports, and notice of field seminar opportunities and workshops.

Because this publication is quarterly, we can't possibly include all chapter activities, workshops, and other events in a timely manner. Please make a habit to check the CoNPS website at <https://conps.org/mfm-event-list/#!event-list> to see the latest event schedule. The society and individual chapters are always adding interesting events to the calendar.

Also note that *Aquilegia* will now be available as a full-color printed publication. This means you can see all the wonderful photographs in their natural beauty. See page 16 for details. The new print version is available for a subscription fee.

Finally, thanks to the volunteers who help get this publication ready for distribution, especially the proofreaders—we can never have too many eyes.

Enjoy!

Mary Menz
managing editor

Kelly Ambler
associate/design editor

P.S. Do you have ideas for future issues? Let us know!

Botanicum absurdum by Rob Pudim

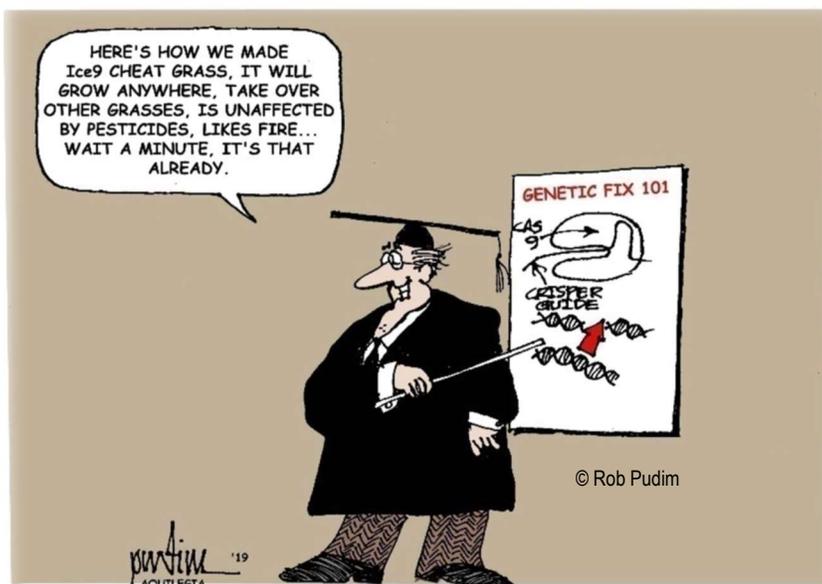


PHOTO CREDITS: Front Cover AND Back Cover: Dominguez Escalante Canyon Fall 2018 and Spring 2019. © Jim Pisarowicz

Corrections to Spring 2019 Issue

Charles Maurer's name was misspelled in the caption under a photo on page 24.

The word "false" was left out of the common name for cliff fendler-bush (*Fendlera rupicola*) on page 17. A common name for this plant is false mock orange. Mock orange—without the word False—is a common name for *Philadelphus microphyllus*, as in littleleaf mock orange.

Aquilegia: Newsletter of the Colorado Native Plant Society

Dedicated to furthering the knowledge, appreciation, and conservation of native plants and habitats of Colorado through education, stewardship, and advocacy

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AQUILEGIA: Newsletter of the Colorado Native Plant Society
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Aquilegia is the newsletter of the Colorado Native Plant Society. Members receive at least four regular issues per year (Spring, Summer, Fall, Winter). At times, issues may be combined. All contributions are subject to editing for brevity, grammar, and consistency, with final approval of substantive changes by the author. Articles from Aquilegia may be used by other native plant societies or non-profit groups, if fully cited to the author and attributed to Aquilegia.
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16TH Annual Colorado Rare Plant Symposium “Globally Imperiled Plants of SW Colorado”

Friday, September 27

8:30 AM to 4:30 PM

Registration is \$10 per person online <https://conps.org> or at the door. The Symposium will be held in the Classroom Office Building of CSU's Western Colorado Campus in Grand Junction.

This symposium is held each fall in conjunction with the Colorado Native Plant Society's (CoNPS) annual meeting. Hosted by the Colorado Natural Heritage Program (CNHP), the symposium addresses current status and conservation needs of rare plants in Colorado.

This year, the focus is on the globally imperiled plants of southwest Colorado. This includes several species of *Astragalus*, *Eriogonum*, *Physaria*, and *Townsendia*, and others such as *Lupinus crassus* and *Lomatium concinnum*. Colorado's federally listed plant species will also be discussed. The afternoon session will provide an opportunity to participate in the 2019 Floristic Quality Assessment (FQA) revision that is being coordinated by CNHP. For the 2019 revision, a panel of 30 experts will be evaluating the remaining 20% of the Colorado flora (about 800 species) that have not been assigned an FQA value. The first meeting to review the assigned values will be at the Colorado Rare Plant Symposium on Friday, September 27, 2019. A full agenda will be available on the CoNPS website by September 1.

CNHP tracks the location and condition of over 500 globally and/or state imperiled plants. Tracking and monitoring efforts guide effective management and protection of those species and thereby prevent extinctions or statewide extirpations of Colorado's native plant species.

CNHP conducts field surveys for rare native plants; designs and implements monitoring studies; produces models, best management practices, and conservation strategies; and develops detailed maps for rare plants as well as noxious weeds. The CNHP team has active members on the Colorado Rare Plant Technical Committee, the Colorado Weed Advisory Committee, the Colorado Native Plant Society, and NatureServe. Colorado Natural Heritage Program staff works closely with botanists and land managers across Colorado to develop the state's most comprehensive and accurate dataset of Colorado's rare flora.

Annual presentations and species-specific meeting notes are available on the CNHP website for 2004-2018. View or download copies of past presentations at:

<https://cnhp.colostate.edu/projects/colorado-rare-plant-symposia/>. View the Colorado rare plant guide here:

<https://cnhp.colostate.edu/library/field-guides/>

Contact Jill Handwerk for more information at (970)491-5857 or jill.handwerk@colostate.edu 📧



Astragalus naturitensis. © Bernadette Kuhn



Lupinus crassus. © Peggy Lyon



Townsendia glabella. © Jill Handwerk

43RD Annual CoNPS Conference “The Ever-Changing Landscape”

Saturday, September 28
8:00 AM to 5:00 PM

Time	Description	Speaker
8:00	Attendee check-in/registration	
9:00	Welcome	
9:10	Using Genetic Data to Conserve Colorado Hookless Cactus (<i>Sclerocactus glaucus</i>)	Dr. Mit McGlaughlin
10:00	Phenology and How Wildflowers and Pollinators Respond to Changes in Climate	Dr. David Inouye
10:45	Break Snacks, Bookstore, Photo Contest, Silent Auction	
11:05	Colorado’s Native Bees	Abi Saeed
11:50	Society News and Presentation of 2019 CoNPS Life-Time Achievement Award	
12:10	Lunch	
1:10	Colorado’s Amazing Female Naturalists	David Anderson
1:55	Dominant Plant Species of the Western Slope	Dr. Stephen Stern
2:40	Break	
3:00	Ute Ethnobotany	Sally Crum
3:45	Fire-wise Landscaping	Susan Carter
4:30	Society Notes	
4:45	Pay for Silent Auction items and Bookstore purchases	

The Conference will be held at the Colorado State University Western Colorado Campus. Address and maps are on page 10 of this issue.

Friday Night Mixer and Film

5:00-6:30 PM, immediately following the Rare Plant Symposium at the Classroom Office Building
“The Story of the Bitterroot” by Steve Slocomb (who will be on-site to answer questions!)

Finger foods and non-alcoholic beverage service will be provided.

No charge for rare plant symposium or conference attendees.

This movie is a heartfelt look at a most unusual plant and its relationship to Native American culture. The bitterroot forms the lynchpin of the Salish Indian culture. Part 1, "In the Beginning," tells the legend of how it came to be, along with elder's stories of gathering the plant when they were young. The film features interviews with spiritual leaders from the Confederated Salish and Kootenai Tribes of Montana. The plant grows throughout the Rockies.

Steve Slocomb has 34 years of extensive experience in motion picture (35mm, 65mm), video, and 3D and visual FX. He has provided expert cinematography to most of the major television networks, and has clients worldwide. Some of his clients include Oprah Winfrey, America's Most Wanted, Good Morning America, and many others. He also produces and directs his own independent films. He lives in the Bitterroot Valley of Montana.

Saturday Breaks

There will be snacks and beverages at the morning and afternoon breaks. During the breaks, attendees are encouraged to visit the CoNPS on-site Bookstore, vote for favorite Photo Contest entries, and bid on awesome Silent Auction items!

Saturday Lunch

Lunch is provided in the cost of the conference. For lunch options, see the registration form on page 12.

Speakers and Presentations

(arranged alphabetically by speaker's last name)



David Anderson 1:10 PM to 1:55 PM “Colorado’s Amazing Female Naturalists”

The story of natural history discovery is often told as a narrative dominated by white men—this presentation is not that story. In this presentation, David celebrates the lives, discoveries, and accomplishments of Colorado’s female natural historians, both the famous and less famous, and both the dearly departed and extant. These stories are part of the weft of CoNPS, and we can all feel proud to be a part of them. Colorado’s diverse flora, fauna, geology, and range of habitats has made our state a key destination for natural historians, and many of the key concepts in ecological science were developed here. But Colorado is also remarkable because female natural historians have been leaders in the exploration and understanding of our natural history. These women have persevered in a field dominated by men, overcoming gender barriers and social attitudes that have excluded women. These women are heroes and great examples for the next generation of natural historians.

David Anderson is the director of the Colorado Natural Heritage Program. Dave has served on the CoNPS board and was CoNPS vice president long ago. He is a botanist who doesn’t get out in the field enough; but when he does, it tends to be with amazing botanists who teach him a lot, and with enthusiastic friends and kids who love loupes and plant hairs.



Susan Carter 3:45 PM to 4:30 PM “Fire-wise Landscaping”

Defensible space around your home does not have to mean moonscape. This talk will focus on how to make the first thirty feet of your defensible space—referred to as “Zone 1”—into a beautiful, people-friendly space that invites pollinators and birds to a space filled with native plants.

Susan Carter is a horticulture and natural resources agent for Colorado State University Extension, Tri-Rivers Area.

She is a Native Plant Master® and teaches the course for CSU Extension. Her office is in Grand Junction. Susan has always loved plants and has been working with them since eighth grade, leading to acquiring two related college degrees.



Sally Crum 3:00 PM to 3:45 PM “Ute Ethnobotany”

For 23 years, Sally Crum worked as an archaeologist and tribal liaison for the US Forest Service on the Grand Mesa, Uncompahgre, and Gunnison National Forest. She met Clifford Duncan, Northern Ute elder, and Betsy Chappoose, director of cultural rights and protection for the Ute Tribe, and showed them various archaeological sites on the Forest that might have been of Ute origin. Through the years, Betsy and Clifford discussed relationships of these sites with the natural resources surrounding them, particularly the plants used for food, tools, and even shelter. They worked together and obtained several grants to bring Ute elders and students to the Forest to observe and collect plants that the elders identified as being utilized by their ancestors.

In her presentation, Sally describes these projects that include a cooperative venture leading to the development of the Ute Learning Garden near the Grand Junction Fairgrounds. Ute students from the reservations helped plant indigenous shrubs and trees for the garden, which also boasts two wickiups, hearths, and a tipi. Volunteer docents and interpretive signs describe how Utes (and earlier cultures) annually traveled specific routes in the region following ripening berries, roots and nuts, and the animals who ate them, to the upper elevations where summers were spent in the cool forests hunting and gathering until autumn brought them down to the pinyon-juniper woodlands to gather pinyon nuts to help survive the severe winters in the valleys below.

Sally Crum has lived in the Southwest and western Colorado for more than 40 years and she’ll never leave. She’s been an interpretive ranger at several National Parks, a contract archaeologist for several firms, a cultural resource specialist for the Navajo Nation, and an archaeologist and tribal liaison for the US Forest Service. While working with the Ute Tribes, Sally was involved in several projects ►

◀ *emphasizing indigenous plant use on the forests. She's written several books to make history and prehistory come alive for the public, especially children. These include Race to the Moonrise—An Ancient Journey, Race to the River—The Ancient Journey Continues, The Night the Stars Fell—the 1833 Meteor Shower, and People of the Red Earth, American Indians of Colorado.*



David Inouye, PhD
 10:00 AM to 10:45 AM
“Phenology and How Wildflowers and Pollinators Respond to Changes in Climate”

David has studied the variation in abundance and phenology (timing) of flowering by about 120 species of wildflowers at the Rocky Mountain Biological Laboratory since 1973, and the demography of three species. He has worked with bumble bees and hummingbirds as pollinators. The results of these long-term projects have provided insights into how the wildflowers and pollinators are responding to the changing climate, and about what environmental factors are most important. For example, this year's mast flowering event of *Frasera speciosa* (the monument plant or green gentian) is a response to summer precipitation four years ago. He will talk about this and other aspects of his research.

Dr. David Inouye is professor emeritus in the department of biology at the University of Maryland, and a principal investigator at the Rocky Mountain Biological Laboratory. He has worked at RMBL for 49 years, and continues his long-term research on the variation in phenology and abundance of flowering by about 120 species of wildflowers, a project initiated in 1973. He also conducts work on pollination, bumble bees, and hummingbirds. He splits his time between RMBL and a home near Paonia, Colorado.



Mit McGlaughlin, PhD
 9:10 AM to 10:00 AM
“Using Genetic Data to Conserve Colorado Hookless Cactus (*Sclerocactus glaucus*)”

Although most plants are identified based on outward morphological appearance, morphology can be misleading in species with limited morphological features or if they have a tendency to change based on variable environmental conditions. For many species, genetic data provides

an important tool that is independent of morphology to understand species boundaries, evolutionary history, and management needs. In this work, he has examined the Colorado hookless cactus (*Sclerocactus glaucus*), an iconic Colorado species that is threatened with extinction.

Historically, *S. glaucus* has been described based on the presence of unhooked central spines, but his work has documented that this trait varies within and among populations and that it is not indicative of species. Genetic diversity also varies among *S. glaucus* populations, indicating that some regions should be given conservation priority. This talk will address what genetic data is, how it is being used to conserve *S. glaucus*, and how genetic data can enhance our understanding of Colorado's native flora.

Dr. Mit McGlaughlin is director of the school of biological sciences and is curator of the herbarium at the University of Northern Colorado. He earned his PhD from Rancho Santa Ana Botanic Garden examining speciation and conservation in the Hawaiian silversword alliance (a group of approximately 30 plant species endemic to Hawaii). At UNC he teaches courses related to botany, conservation biology, evolution, and molecular ecology, at both the undergraduate and graduate level. Mit's research is focused on using genetic data to enhance plant conservation and management and to better understand how new species of plants form. Over the past 20 years he has worked with endangered plants in California, Colorado, Hawaii, Oregon, Utah, and Wyoming for the Bureau of Land Management, National Park Service, US Army, US Navy, US Forest Service, and the Nature Conservancy.



Abi Saeed
 11:05 AM to 11:50 AM
“Colorado's Native Bees”

Pollinators are vital to our ecosystems and our economy—providing valuable services including the pollination of economically-important crops, in addition to maintaining plant biodiversity. Bees are the most important pollinators of all, primarily due to their anatomy and behavior.

Colorado is home to 947 species of bees, most of which are native to the state. Colorado's common native bee families include pollinators such as bumble bees, mason and leafcutter bees, sweat bees, mining bees, and more. Topics in this presentation will focus on native bees, creating pollinator habitat, native plants that encourage landscape pollinators, ►

◀ and landscape management practice to minimize detrimental impacts on all pollinators.

Abi Saeed received a master's degree in entomology from the University of Kentucky, where she conducted research on solitary bees and orchard pollination. Following graduate school, Abi worked as a research technician and pollinator specialist at a turf and landscape entomology lab at the University of Kentucky, where she led the lab in pollinator identification and assisted in designing research experiments to evaluate the impacts of pesticides on ornamental pollinators.

Abi works in the Garfield County Extension Office (based in Rifle), where she is an agriculture, horticulture, and natural resources extension agent and master gardener coordinator for CSU. Abi has a passion for pollinator education and science communication, and has written on, spoken about, and conducted media interviews regarding pollinator conservation at several local, regional, and national forums.



Stephen Stern, PhD
 1:55 PM to 2:40 PM
“Dominant Plant Species of the Western Slope”

The Western Slope of Colorado encompasses a broad array of habitats. From saltgrass flats in the valleys at 4,600' to fens on the Grand Mesa at 10,500', there is an incredible diversity of habitats, each with unique stresses and opportunities for plants. This talk will discuss the dominant species of ecosystems on the Western Slope, species that are unique to western Colorado, and comparisons between the Front Range and Western Slope.

Dr. Stephen Stern received his undergraduate degree from the University of North Carolina-Asheville and his PhD from the University of Utah. He has been on the faculty of Colorado Mesa University since 2011. He has taught many subjects within the field of biology, including introductory biology, principles of plant biology, plant systematics, taxonomy of grasses, plant identification, tropical field biology, and various research and internship classes. Stephen is also curator of the Walter Almond Kelley herbarium at CMU. ☺

Sunday Field Trips

September 29

Free for conference attendees. Sign up for your preferred field trip during registration. Meet-up locations and specific times will be announced at the conference. Attendees should bring water, hat, sunscreen, snacks, and appropriate layered clothing. Participants may want to bring cameras, notepads, and pencils, etc.

Location	Leader
A Tour of the Ute Learning Garden	Susan Carter and Jan Klahn
Tour of Two Cactus Gardens	Lois Davidson
Late Bloomers on the Grand Mesa	Charlie Maurer and Mary Menz
Plant Photography <i>in situ</i>	Jim Pisarowicz
Western Slope Grasses and Other Species	Stephen Stern



A Tour of the Ute Learning Garden
Trip leaders: Susan Carter and Jan Klahn

The Ute Learning Garden in Grand Junction is an ethnobotany teaching garden. The plants in the garden are all native and were used by the Northern Utes in the Grand Valley.

This garden is arranged by life zones and can also be used as a teaching tool for native plants and changes in elevation. The Ute people often visit as this is their homelands. The garden was started in the early 2000s and is continually growing and improving.



Susan Carter is the horticulture and natural resource agent for CSU Extension Tri-River Area. Susan is a Native Plant Master® and teaches the course for CSU. Soon after she started with CSU Extension, she met with the Bureau of Land Management and the Uinta-Ouray Utes (Northern Utes). She discovered the importance of the gardens and how they teach the Ute history and the uses of the plants for fiber, edibles, and medicinals, as well as provide examples of cultural living structures. Jan Klahn is a CSU Master Gardener and has gone through training by the BLM and CSU Extension to be a docent for the gardens.

Mary is an award-winning writer and enthusiastic native plant lover. She co-teaches the NPM® class with Charlie on the Grand Mesa. Mary and business partner Jim Pisarowicz recently published Common Wildflowers of the San Juan Mountains, available in the CoNPS bookstore.



Cactus Gardens Tour
Trip leader: Lois Davidson

The tour of the cactus and succulent demonstration gardens at the CSU Extension office and at the Western

Colorado Botanic Gardens includes native and naturalized plants. The garden at the Extension office is being rejuvenated and includes a crevice garden installation in progress.

Lois Davidson has been involved with xeric cactus and succulent gardens for over 30 years both in the Grand Valley and Texas. She is a CO Native Plant Master® and a Colorado Master Gardener.



Late Bloomers on the Grand Mesa
Trip leaders: Charlie Maurer and Mary Menz

Both lovers of the subalpine forest and alpine tundra plant communities, Charlie and Mary look forward to sharing the delightful plants of the Grand Mesa. Late and bountiful snowmelt should provide a good selection of late blooming plants in the area. They teach a section of the Tri-River Extension office's Native Plant Master® class.



Charlie is a retired agronomist and a generous patron and supporter of Flora of Colorado and the CSU Herbarium. He is also a CO Native Plant Master®. His NPM students love his extensive anecdotal knowledge of Grand Mesa species, as well as his great sense of humor.



Plant Photography in situ
Trip leader: Jim Pisarowicz

Participants will examine photographic techniques for shooting wildflowers *in situ*. The basics of photography, often modified when shooting wildflowers, will be demonstrated including specialized macro-photographic equipment. Participants should bring their cameras for hands on experience. We will be gathering at the Colorado National Monument visitor center parking lot.

Jim Pisarowicz is a photographer and naturalist living in Montrose, Colorado. He specializes in photographing native plants of Colorado and the West and enjoys documenting the full life cycle of native species, from the flowering stage to their dormant winter foliage. He has shot thousands of native species to date, amassing a photographic library of over 200,000 images. Jim and Mary Menz are the authors of the recent Common Wildflowers of the San Juan Mountains. Photo by Tom Zeiner, Escalante Canyon.



Western Slope Grasses and Other Species
Trip leader: Stephen Stern

Dr. Stern will select sites around Grand Junction just prior to the conference weekend to ensure the best selection of Western Slope grasses and other species to view. Participants should expect short walks (½ to 1 mile) at two to three different field sites. Species lists will be provided but participants should feel free to bring a flora, hand lens, camera, etc., as well as water and food.

Stephen Stern, PhD, has been faculty at Colorado Mesa University since 2011. At CMU, Stephen teaches plant identification and grass taxonomy courses utilizing field sites around Grand Junction. ☯

Lodging and Restaurants

Lodging

Coming in from out of town? A block of rooms at two local hotels are reserved for conference attendees. Make reservations early: twenty rooms at each hotel are available at the special conference rates. Rates are good the evenings of September 27 and 28 only. Both hotels are within blocks of each other near the airport and conveniently located near I-70. Both have special group rates for conference attendees.

Grand Vista Hotel
(970) 241-8411
2790 Crossroads Blvd
Grand Junction, CO 81506

The group code for Grand Vista is 3842 (Colorado Native Plant Society/CONPS). The room rate is \$89. Reservation cutoff date is September 13. After that the rooms will be released into the general inventory.

Courtyard by Marriott
(970) 263-4414
765 Horizon Dr
Grand Junction, CO 81506

The group code for the Courtyard by Marriot is CONPS. Reservation cutoff date is August 27. The room rate is \$125.

Camping options are also available. Check out the Grand Junction website at <https://www.visitgrandjunction.com/campsites-near-grand-junction>

Dining in Grand Junction

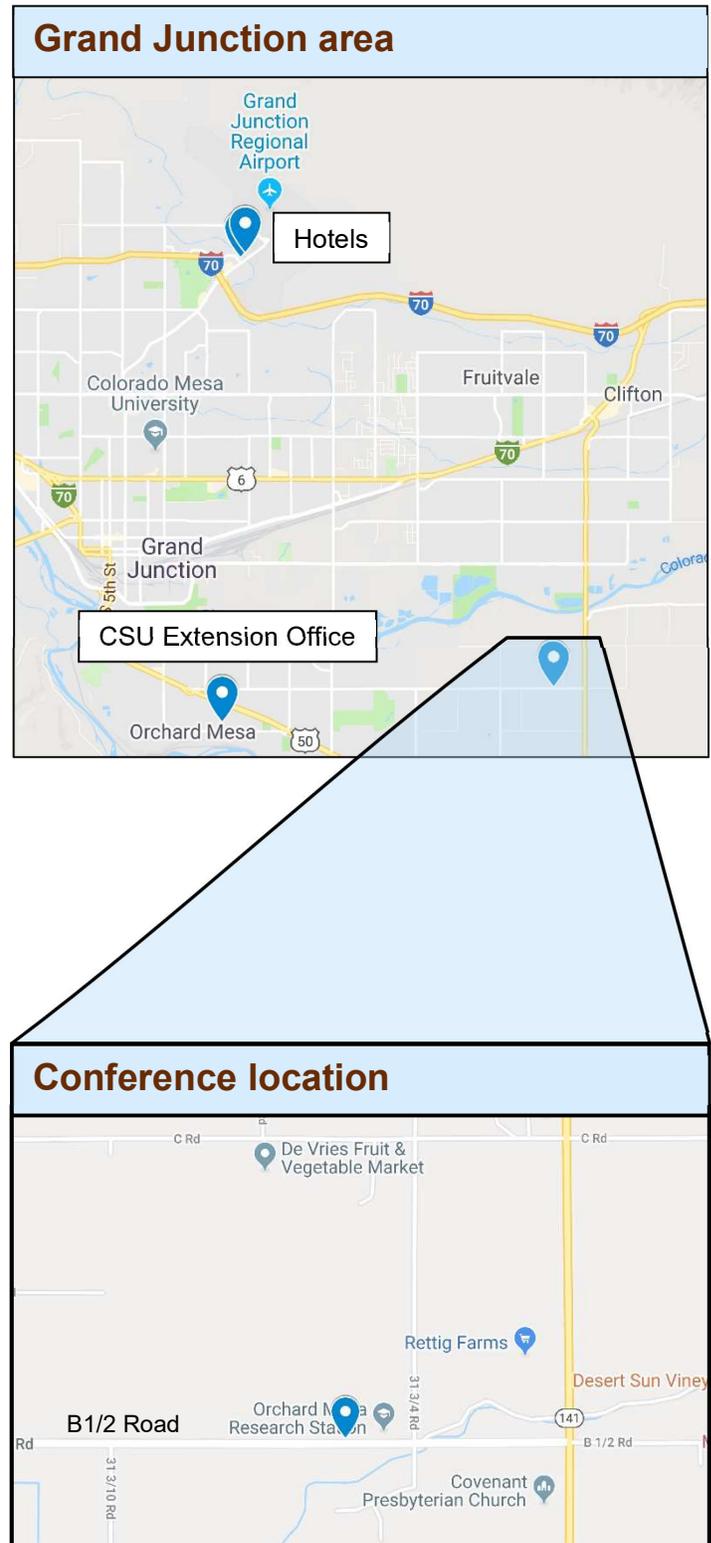
Grand Junction has a vibrant downtown area that offers a diverse selection of restaurants and local street art. Large groups might consider making reservations for Friday or Saturday evening dining. Dining options also are located near the hotels.

Conference Location

Colorado State University
Western Colorado Campus.
Classroom Office Building (COB)
3168 B 1/2 Road
Grand Junction CO 81503

Field Trips

Meetup sites for Sunday field trips will be announced at the conference. The Ute Ethnobotany Garden Tour is at the CSU Extension office located at 2775 US-50, Grand Junction, CO 81503.



Annual Silent Auction Benefits CoNPS Activities

At the Annual Conference there will be opportunities to bid on many special items. Proceeds support the Colorado Native Plant Society's wide-ranging projects including education, conservation, native plant gardening, and botanical and horticultural publications, and activities.

Denise Wilson and the silent auction committee seek your donations for this event.

Denise encourages members to purchase items and donate them to the Colorado Native Plant Society's Annual Conference silent auction. Many smaller items will be grouped together in a gift basket.

Denise suggests donations might include—

- Sample of a member artist's painting, photography, or other work;
- Framed artwork that has outlived your enjoyment;
- Greeting cards, stationary, markers, pens, stickers, and so on;
- Tee shirts, hats, gloves, raingear, gaiters, UPF clothing, technical fabric clothing;
- Water bottles;
- Lightly used backpacks, items to fill a backpack, other outdoor gear;
- An unopened bottle of wine or liquor;

- Garden tools, art, statuary, wind chimes in "like new" condition;
- Gift cards;
- Any unused gift you've received and would like to find a home for; and
- Money that the committee can use to make a great gift basket.

If you or your business are interested in donating an item for the silent auction, please contact Denise at deniseclairewilson@gmail.com. Likewise, if you'd like to volunteer to help with the Silent Auction, contact Denise.

Special Door Prize!

Bring some dollar bills with you to the Saturday conference. For every one dollar in cash added to the donation box, the attendee donor will receive a door prize ticket. A \$5 donation will receive six door prize tickets. The winner of the door prize will receive half of the total money collected!

Annual Photo Contest—Call for Entries

Have you taken some spectacular photos of native plants this summer or in years past? If so, consider entering the CoNPS annual photo contest. Photos may only be submitted electronically with a completed entry form.

Entries can be made in any of five categories including:

- Colorado Native Plant **Landscapes**
- Colorado Native **Plants**
- **Artistic** (of Colorado Native Plants or Native Plant Landscaping);
- Colorado Native Plants & **Wildlife** (including insects/pollinator); and
- Native Plant **Gardens** (new category).

Contest rules and agreements are posted on the CoNPS website. The deadline for entries is September 15. Photos will be displayed and judged by conference attendees. Winners will be announced September 28.

Entries must be a single work of original material taken by the contest entrant. No more than one photo per category may be submitted by a photographer. Photos may be from previous years (for example, you may submit a photo that you took in 2013). A \$50 prize will be awarded to the first-place winner of each category.

Contest is open to CoNPS members only. Please see the CoNPS website for entry forms, <https://www.conps.org>

Questions? Contact jim.pisarowicz@gmail.com

Registration

Registration is available online at <http://conps.org>. Please log in if you are a CoNPS member, then proceed to the Calendar of Events to register. If registering by mail, please complete the following registration form for each person attending and submit by September 7. **Attendance is limited; there may be a waiting list.**

Mail registration form and payment to: CoNPS, c/o Linda Smith, 4057 Cottonwood Dr., Loveland, CO 80538

Name (first, last) _____

Phone _____ **Email** _____

Mailing address _____

The registration fees include attendance to the Annual Conference on Saturday, September 28, a box lunch from a local deli, and the Sunday field trip of your choice. There is no price reduction when opting out of the box lunch. A separate fee is charged for attending the Rare Plant Symposium.

Member registration*

The 16 TH Annual Rare Plant Symposium @ \$10	\$ _____
The 43 ND Annual Conference @ \$45 (\$55 after September 9)	\$ _____
Field trip of your choice (included in cost)	_____ 0
Total enclosed	\$ _____

Non-member registration* Consider becoming a member! See page 14

The 16 TH Annual Rare Plant Symposium @ \$10	\$ _____
The 43 ND Annual Conference @ \$55 (\$65 after September 9)	\$ _____
Field trip of your choice (included in cost)	_____ 0
Total enclosed	\$ _____

* Student discount is \$10 off. A limited number of scholarships are available. See CoNPS.org for details.

Lunch options: Meals served with side and dessert options.

Choose one:

- Ham and brie (sliced apple, fruit preserves, toasted almonds, mixed greens)
- Turkey (bacon, tomato, avocado, cheddar cheese, roasted garlic mayo, mixed greens, **nut-free**)
- Chicken pesto (grilled chicken breast, mixed greens, sliced tomato, red onion, cucumber, fresh herb pesto, mayo, **dairy-free**)
- Super veggie (herb pesto, tomato, red onion, avocado, sunflower seeds, roasted beets, cucumber, kale, mixed greens, **vegan**)

Choose one side: Chips Tabbouleh Beet salad

Choose one dessert: Cookie Fruit

Check here if you need gluten-free wrap and dessert!

Field Trip Options

Please indicate first and second choices for Sunday Field Trips (included in registration), assigned on first come, first served basis.

_____ Cactus Gardens Tour _____ Western Slope Grasses _____ Photography *in situ*
 _____ Ute Ethnobiology Garden Tour _____ Late Bloomers on Grand Mesa

Please check if you would like to be contacted about carpooling to Grand Junction. If checked, your phone/email information will be provided to others interested in carpooling.

Featured Story

Autumn Foliage Colors in Colorado

By David Lee

When the topic of autumn foliage color comes up, the spectacular color displays of the deciduous forests of New England and the Blue Ridge Mountains in the south come to mind. Although Colorado only displays flashes of this color in its urban landscapes, it does produce autumn colors in a much broader ecological palette. Below, learn how and why autumn colors are produced in Colorado's plant communities.



Figure 1. Autumn foliage color in Colorado, clockwise from top left. Aspen from near Cumbres Pass, Conejos County; Cottonwood Pass, Chaffee County; Treasure Falls, near Wolf Creek Pass, Mineral County; and oak woodland north of Durango, La Plata County

Autumn Colors in Colorado Vegetation

In contrast to the eastern US, where color is produced in broadleaf deciduous forests throughout the region, color is seen commonly in Colorado among several widely distributed types of vegetation.

Trembling Aspen Forests: Trembling aspens (*Populus tremuloides*) appear as broad stands from the foothills to the montane in a variety of ecological circumstances. During the autumn these stands turn a brilliant yellow, along with flashes of orange and even bright red. These can be the most spectacular displays of autumn color in Colorado (Figure 1).

Tundra: Many, many species in this vegetation turn red for a brief period before dying back in later autumn. Thus, there is a time when the tundra turns from green to red, and then brown. In Colorado, these colors can dominate mountain vistas, as on high passes or the Trail Ridge Road at Rocky Mountain

National Park. At the right time, this color rivals the beauty of the aspen forests.

Oak Woodlands: Occur on the lower slopes of southern Colorado where the predominant species is the Gambel's oak (*Quercus gambelii*). The colors produced by this widespread tree range from yellow to brown to red, but it can produce brick-red colors on thousands of acres where the species dominates, as in southwest Colorado.

Moist Broadleaf Forests: Broadleaf trees grow in the foothills and lower montane, in wet valleys on north-facing slopes. In autumn, they turn to yellows and reds, giving an esthetic show reminiscent of deciduous forests in the East. Cottonwoods (such as *Populus angustifolia*) also turn a darker golden color along the edges of streams descending from the mountains.

Autumn colors also appear in open woodlands, where clumps of three-leaf sumac (*Rhus trilobata*) and wild rose (*Rosa woodsii*) add color to the landscape.

How Color Is Produced in Leaves

A water colorist paints on paper. The watercolor pigments are dissolved in water and applied to the paper by brush. The paper is almost always thick and completely white. The white of the paper is due to the reflectance of all wavelengths of visible light (all colors) by the cellulose fibers that comprise the paper. Leaves are similar to thick watercolor paper in several ways. First, both consist primarily of cellulose fibers. Secondly, color is produced by pigments embedded in the paper fibers or leaf cells. Thirdly, color is ►

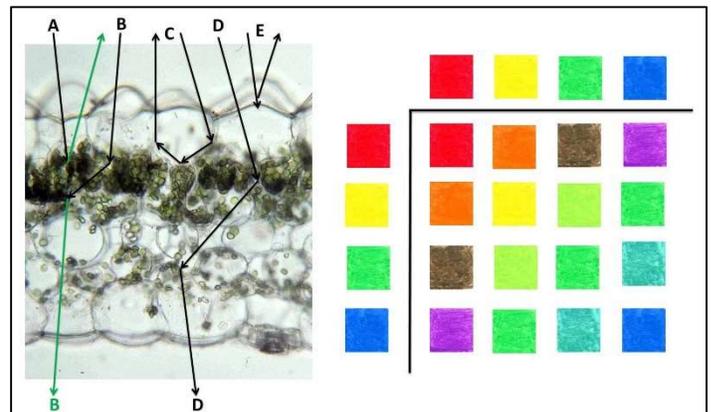


Figure 2. Leaf optics and color. Left, light paths scattered by air spaces in leaf; right, primary colors plus green subtractively interact to produce color combinations.

◀ promoted by the complex scattering of light through, and reflected from, the paper or leaf (Figure 2).

Watercolor pigments produce color subtractively by absorbing all the wavelengths except those that are scattered by the paper fibers and are reflected back out of the surface. It is different than the additive color produced by your cell phone screen. As almost everyone knows, or will remember from using crayons or pastels, the primary subtractive colors are red, yellow, and blue. Combining yellow and blue produces green; red and yellow produces orange; and so on (Figure 3).

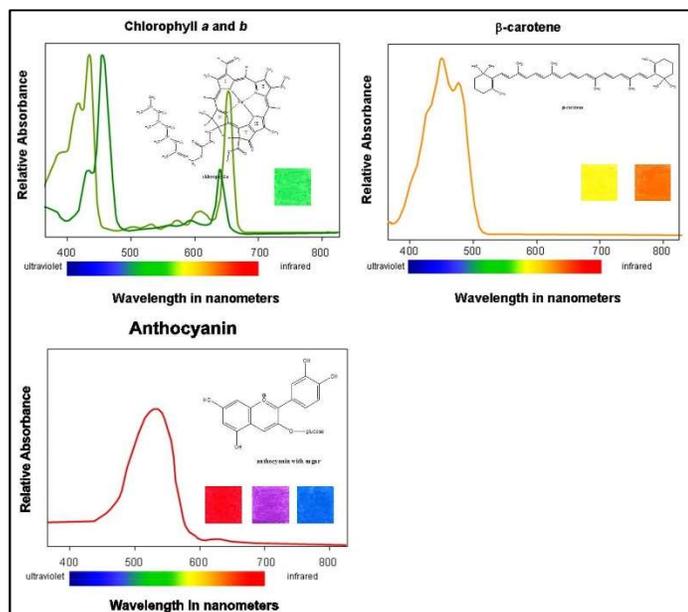


Figure 3. The palette of plant colors in leaves: chlorophylls, xanthophylls and anthocyanins. Each description shows the absorption of the spectrum of visible light (regions not absorbed contribute to the color), and the molecular structure of a typical pigment within each class is given. The colors within the visible spectrum are shown, as well as the colors produced by each pigment type.

Plant Colors and Pigments

Plant pigments subtractively combine to produce the different colors in leaves at different times of the year. Plants produce three main pigment types in leaves, the chlorophylls, the carotenoids (also called xanthophylls), and the anthocyanins (Figure 3 displays the structure, bands of reflectance, and color produced by each pigment).

Green is obviously produced by the two chlorophyll pigments: a and b. Chlorophylls are complex nitrogen-containing molecules. They are synthesized in specialized organelles in photosynthetic cells, chloroplasts. Chlorophylls are water-repelling molecules and are sequestered along with special proteins in lipid-containing membranes in the

chloroplasts. Chlorophylls absorb light in the blue and red bands of visible radiation. The color green is produced because the green wavelengths are not absorbed and can reflect from the leaf.

In leaves, yellow-orange colors are produced by a class of pigments—or compounds produced by the same metabolic pathway—the carotenoids. These are water-repelling molecules and are produced in specialized plastids in cells. Some flowers produce bright yellow and orange colors from the carotenoids that are synthesized and stored in special plastids, the chromoplasts. Carrots do, too. Carotenoids are produced in abundance in the chloroplasts of leaves, helping to protect the photosynthetic machinery from intense sunlight. They do this in two ways. β-carotene blocks sunlight directly, and xanthophylls interconvert in an energy-absorbing cycle. This pathway was discovered by two botanists at the University of Colorado: Barbara Demmig-Adams and William Adams III.

During leaf senescence, chlorophyll is broken down (more about that later), and the carotenoid pigments remain in the chloroplasts, turning the leaves to yellow.

The pinks and reds of leaves are produced by a third class of molecules, the anthocyanins. The most common such pigment in leaves is the same as that producing the pinks and reds of roses and apples. Anthocyanins are produced in the cytoplasm of cells, and they are then stored in the central vacuole of plant cells, as in flower petals. Since those vacuoles occupy most of the cell volume, intense colors are often produced.

Anthocyanins may be transiently produced during leaf development, producing pinkish hues in some foliage early in spring. In many plants, anthocyanins are produced during the autumn, resulting in those spectacular shows of red color. Anthocyanins are produced during the senescence of leaves in the autumn, when about half of the chlorophyll has degraded.

If both anthocyanins and chlorophylls are produced, the result should be brown, and such bronze or brownish leaves may be seen early and late, like the chocolate leaves of the juneberry or the occasionally bronze autumn leaves in the ash.

In autumn leaves of the trembling aspen turn yellow and a few turn orange or red. In the reddish trees, leaves vary in color, and often colors vary within the surface of one leaf (Figure 4). When dissected, a transverse section (about 1/64 of an inch thick) reveals the combinations of pigments that produce the colors. Lots of chlorophyll produces green. Lots of anthocyanin and no other pigments produces a red leaf (or orange with some carotenoids included). ▶

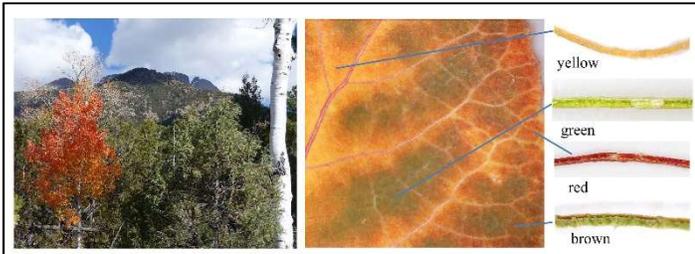


Figure 4. Variation in autumn color produced by a single leaf of a red trembling aspen. Individual sections correspond to the color areas of the leaf: green, yellow, red, and brown. These sections are about 1/64" thick.

◀ Combining red and green produces a brown leaf; yellow (carotenoids) makes yellow leaves.

Many of the autumn leaf colors of individual species are familiar to us, seen in different communities (Figure 5). The brilliant red leaves (but that color varies a lot) contrast with the black berries of chokecherry (*Prunus virginiana*). The bright red foliage of the low dwarf blue berry (*Vaccinium cespitosum*) contrasts strongly with the conifer overstory. The light-yellow autumn leaves of the mountain maple (*Acer glabrum*) contrasts nicely with their red petioles. The darker yellow-orange crowns of cottonwoods contrast with the earlier lighter yellows of the aspens. The prominent bright red leaves of the sticky geranium (*Geranium viscosissimum*) appear in many environments, always easy to identify. The autumn foliage of the waxflower (*Jamesia americana*) is bright red and, in this case, trending towards violet.

The Functions of Leaf Color

Leaf colors are attractive to us, and it is natural to consider that the colors produced by pigments in leaves serve biological functions. We are conditioned to think this because of the functions of color by fruits and flowers, attracting pollinators and dispersers. Our ideas about the biological function of color were inspired by the studies of 19th century naturalists in tropical rainforests. They discovered that brightly colored animals often advertise their toxicity, to deter being eaten. The coral snake comes to mind. Other animals have evolved similar colors, to avoid predation even though they are not toxic. Color has also evolved as a strategy to avoid being seen, as green insects living on plants (that may also help them be more effective hunters, like the green praying mantis). This begs the question: Do warning (aposematism) or camouflage functions occur in leaves?

On the other hand, color produced by red and yellow pigments may only be a by-product of some other function of the molecule. What may be important for the plant is that potentially harmful wavelengths of

light are absorbed by the molecules, and the reflected light (the color) results from that absorbance. However, pigments may have other biological properties not related to color production at all. Many pigments are strong anti-oxidants. When reactive oxygen species (ROS) are produced within cells and tissues, they attack membranes and are harmful (and promote aging). Anthocyanin and carotenoid pigments both have antioxidant capacities. The anthocyanin that makes most autumn leaves red is cyanidin-3-glucoside (the pigment molecule attached to a glucose sugar). It is a well-known antioxidant, and it is sold in health food stores as C3G, to help keep us young.

The difficulty of explaining the function of color in autumn leaves, whether a physiological or a biological one, is that autumn leaves are nearing the end of their life spans. Their color comes just before they fall to the ground and decompose. It makes no sense for an elaborate protection mechanism to be turned on just before the death of the leaves. This seems particularly true for red leaves, where plants go to some expense to produce new pigments in the autumn. However, if the color improves the function of the tree the following spring, then such a mechanism could make sense. Two such hypotheses have been raised during the past two decades.

First, William Hamilton, a British evolutionary biologist known for his earlier work on sexual selection, proposed that the brilliant autumn color could serve as a warning (an honest signal) that such leaves contain poisons or low food value, to repel insects that might visit the leaves and lay their eggs for feeding the next spring. The advantage of the brilliant colors would then be to prevent a buildup of insects (and ▶



Figure 5. Examples of autumn coloration, clockwise from top left. Chokecherry (*Prunus virginiana*), Valley View Hot Springs, Saguache County; dwarf blueberry (*Vaccinium cespitosum*), above St. Elie, Chaffee County; mountain maple (*Acer glabrum*), North Crestone Creek, Saguache County; waxflower (*Jamesia americana*), Penitente Canyon, Saguache County; sticky geranium (*Geranium viscosissimum*) Cottonwood Creek, Crestone, Saguache County; red roots, North Crestone Creek, Saguache County.

◀ Hamilton was thinking particularly of aphids) that could damage the trees and reduce the production of seeds the following year, thus reducing the fitness of such trees.

A second hypothesis, of physiological function, was first proposed by William Hoch, now at Montana State University. He advocated that red leaf color could protect the leaves from damage by high light during sunny and cold autumn days when leaves would be particularly vulnerable. Too much light could damage the leaves by directly damaging chloroplasts and by disrupting the process of chlorophyll breakdown to produce intermediate compounds that could further damage the leaves. When leaves change color in the autumn, chlorophyll is being carefully broken down, and its by-products are pumped into the cell vacuoles where they can do no harm. Simultaneously, the proteins—enzymes and molecules to which the pigments attach on the chloroplast membranes—are being disassembled into their amino acid building blocks. Those amino acids are then translocated via leaf veins, down the petioles and into the branches and trunks of the trees. They are stored for the winter and then released for tree and leaf growth the following spring. Anthocyanins (red leaf color) protect the leaves during this resorption process, and such leaves would end up with less nitrogen (more going into the parent tree) than those without.

These physiological and biological hypotheses are not mutually exclusive; however, neither are supported by very much evidence, and research continues—but at a slow pace. Simca Lev-Yadun and collaborators have shown that spring red leaf color is more common in forests of Japan, Finland, and Israel than autumn color, that the color of a tree in the spring was not predictive of its color in the autumn, and that the brilliance of red autumn color in North American forests compared to the yellows of European forests is a consequence of the species compositions of the different forests. Some trees, like oaks and maples, produce more reds, and beeches and birches produce more yellows.

There is much to learn about autumn coloration, particularly in Colorado plants. What about color production during springtime? Or the short-term color changes in alpine tundra? Many plant species, primarily perennials, change color in autumn. Then there is the question of color production in aspens, mostly yellow but occasionally orange and brilliant red (Figure 4). Do the same trees turn red every autumn, or do individual trees turn different colors in different years?

Another autumn color phenomenon is the reddening of roots in forested stream margins, probably aspen or

streamside willows. These roots turn a brilliant red as the stream temperatures drop and roots are exposed to more direct sunlight (Figure 5). Perhaps this is a form of protection similar to that in red leaves.

Autumn color is the botanical equivalent to the “charismatic megafauna” (like tigers and elephants) that arouse such interest among animal lovers—which is just about everyone, since we, too, are animals. Colorado has a different autumn color palette, just as beautiful as those eastern forests—but perhaps less appreciated and less understood.

Dr. David Lee lives on the edge of the San Luis Valley in Crestone. He is an emeritus professor at Florida International University in Miami. He continues an interest in leaf color dating back to research in the tropics in the 1970s and in temperate regions 1997-2012. Contact David at leed@fiu.edu. His book, Nature's Fabric. Leaves in Science and Culture (Chicago: University of Chicago Press, 2017), is a good summary of color change research and is the source of Figures 2 and 3. 🌀

Aquilegia Now Available as a Full-Color Print Publication

The CoNPS board of directors has been evaluating the publication costs of *Aquilegia*. Most members receive their *Aquilegia* newsletters electronically via PDF, thereby reducing their carbon footprint by filing it on their desktops instead of on a bookshelf. A handful of readers, however, have been receiving a black & white printed copy.

The board recently concluded that it is unfair for members who receive only the electronic edition to subsidize the costs of printing and mailing hard copies. Now, members who choose to receive a printed copy of *Aquilegia* must pay an additional annual \$20 subscription fee in addition to the annual membership fee.

The new printed editions will be in full color and members can opt for the subscription when they renew their membership. Members who currently receive print editions will continue to receive them until their current membership expires. The full-color, hyperlink-enabled PDF version of *Aquilegia* will continue to be free to all members.

Members who do not have internet access or are experiencing financial hardship can apply for a CoNPS scholarship to cover subscription costs. Contact Cecily Mui at chmui@hotmail.com for more information. This measure will allow CoNPS to continue to keep its membership dues at the current rates.

Botany Basics

Plants and Pollinators

by Lenore Mitchell

“The earth laughs in flowers”
- Ralph Waldo Emerson

While we all enjoy flowers, and Emerson’s quote is exquisitely joyful, the actual reason flowers go to the considerable effort of producing fabulous colors and amazingly complex form is, alas, not primarily for human enjoyment. A plant flowers as a means of reproduction. The more primitive class Ferns (originating circa 350 MYA) produce neither flowers nor seeds, but rather reproduce asexually by spores. Gymnosperms bear naked seeds (not true flowers) protected by cones and originated circa 250 MYA. Angiosperms produce covered seeds and originated 100-150 MYA. While both Gymnosperms and Angiosperms reproduce sexually with stamen and pistils, all Gymnosperms are wind-pollinated, while only a few Angiosperms such as Poaceae (grass family) and certain others are wind-pollinated. Angiosperms account for approximately 80% of plants now, and most require pollinators to transfer pollen from the stamen (male) to the ovary in the pistil (female).

Research into the origin of a flower is ongoing; however, according to researchers at University of Florida, “the flower is one of the key innovations of evolution, responsible for a massive burst of evolution that has resulted in as many as 400,000 angiosperm species.” Paleobotanists believe that Angiosperm flowers evolved from Gymnosperm cones. Pollinators evolved along with Angiosperms.

How Flowers Attract Pollinators



Cercocarpus montanus.
© Lenore Mitchell

Nectar Rewards

Pollinators are attracted by colorful petals, scents, and particular flower forms. Once a flower attracts a pollinator, most provide a reward in the form of nectar which is produced way inside the flower, generally next to the ovaries so that the pollinator must reach deep inside, brushing past the anthers and pollen for



Aconitum columbianum.
© Lenore Mitchell

a sip of sweet liquid. Some petals have “nectar guides” to direct pollinators into the flower.

Flower Forms

Plant families share some common elements of form. The rose family, for instance, has perfect flowers (having both stamen and pistil), with many stamens as a defining feature. Most rose flowers also have five petals, although

some such as *Cercocarpus montanus* (mountain mahogany shrub) have no petals at all. For complex form, consider *Aconitum columbianum* (monkshood; Ranunculaceae family) which has five petals convoluted into a beautiful but intricate shape. Imagine the evolution from simple flower to the many wondrous shapes we see!

Flower Color

Petal color is produced to attract pollinators and is a reflection of light from plant pigments in plant cytoplasm and plastids (plant cells) made up of chlorophylls, carotenoids, flavanols and betalains.

- Chlorophyll causes green;
- Carotenoids create yellow, orange, pink;
- Flavanols create yellow, red, blue, purple; and
- Betalains create red, violet, yellow, blue.

Anthocyanins are basic color ingredients which, depending on plant pH, result in red, purple, or blue. They combine with sugar compounds for fall leaf colors. They can also be manipulated by biotechnologists to change flower colors.

Factors which may change flower color in different conditions or locations include temperature (cool = more vivid colors), plant stress (drought and/or insect attack), or too much or too little nutrition.

Most flowers don’t actually change color, but perception changes and varies with people. Generally, men tend to see primary colors (green and blue) while women see more color distinctions (turquoise and chartreuse) due to genetic eye anatomy. Pollen color, although most often yellow, can vary from red to brown. ►

◀ Pollinators

Pollinators include bees, butterflies, flower flies, birds, bats, beetles, and wasps. Insects, in particular, have compound eye structures that perceive color differently, since they often see UV wavelengths we don't see. For example, a flower we see as white or yellow may appear light blue to a pollinator.



Bombus sp. on Lupinus sp. (lupine).
© Lenore Mitchell

Bees (*Hymenoptera*)

There are about 4000 native species in the US, and 946 native bee species in CO. They have double pair wings; hairy bodies, and pollen adheres to legs or abdomen. Eyes are large, but smaller than flies. Antennae are longer than flies

- Honeybees are social, non-native bees originally from Europe, and they form large hives;

- Bumblebees (*Bombus*

sp.) are semi-social natives (16 Colorado species) with underground colonies; and

- Other native bees include mason, carpenter, digger, and leafcutter bees to name a few. Most are solitary, and vary greatly in size.

Butterflies (*Lepidoptera*) of Colorado include 12 swallowtails, 1 Parnassian, 100 brushfooted, 14 whites, 17 sulphurs, 28 winged skippers, and 47 grass skippers. The brushfooted painted lady is the most common, seen April to October. Skippers are smaller with heavier bodies. Butterflies have long antennae with swollen tips and slender hairless bodies. Moths, which are also of the *Lepidoptera* family, have thicker antennae which never have swollen tips, and usually have a more stout and hairy body. Colorado moths



Painted lady butterfly on Aster lateriflorus (lady in black aster). © Lenore Mitchell



Sphinx moth on Agastache sp.
© Lenore Mitchell

include 70 species of tiger or tussock moths, 17 silk moths, and approximately 31 hornworm or sphinx moths.

Flower Flies (*Diptera*) include about 200 Colorado species. They resemble bees or wasps but don't sting. They may also buzz as part of their disguise and are often orange or yellow & black. They have one single pair of wings and mostly smooth bodies with large eyes on the tops of their heads. Their antennae are thick and stubby. The syrphid fly is one of the most common species of flower flies.



Flower fly on Anemone blanda (Grecian windflower). © Lenore Mitchell

Hummingbirds, those amazing acrobats of summer, are pollinators. The most common hummingbird in Colorado is the broad-tailed, but others include the rufous, calliope, and black-chinned.

Bats are mostly nocturnal and guided by sonar. While very beneficial insect eaters, most bats of Colorado are not pollinators.

Beetles in Colorado number 406 species, and only a few feed on pollen. They are not efficient pollinators. Adult lady beetles and green lacewings feed on nectar and pollen; their larvae eat aphids.

Wasps are minor pollinators and yellowjackets and hornets aren't pollinators at all, but rather are insect ▶



Beetles on *Saxifraga bronchialis*.
© Kelly Ambler

◀ predators (carnivores). They lack body hair and have shiny bodies.

All pollinators need food in the form of nectar (sugars and amino acids), pollen (protein), and fermenting fruit, as well as a water source and shelter in the form of leaf piles, logs, brush piles, and more. Butterflies also use mud to obtain minerals.

Flower Characteristics Attract Specific Pollinators

Bees are mostly generalists and will visit many different flowers but tend to stay with one species at a time. Bumblebees specialize in tubular flowers like penstemons or flowers with large landing platforms. They carry pollen on hairy legs and abdomen sacs.



Yellow swallowtail butterfly on *Penstemon* sp.
© Lenore Mitchell

They see blue, white, yellow, and UV nectar guides, or colors humans don't see. They have a good sense of smell and prefer fresh, pleasant fragrances. Butterflies are mostly generalists who prefer the large landing platforms of Asteraceae; or narrow tubular flowers or spurs for their long proboscises. They prefer bright yellows, reds, and purples; and use nectar guides on flower petals. They have olfactory receptors on their antennae and feet. Some moths specialize in nocturnal blossoms. Most hover and use a long proboscis inserted into the flower at a 90-degree angle. They prefer tubular flowers. Because nocturnal fliers don't see very well, they prefer white blooms. Diurnal fliers prefer pale, dull red, purple, and pink blooms. Moths are attracted to strong sweet fragrances that are emitted at night.

Flower flies are generalists and visit many different flowers by hovering or landing on them. Visual cues for flower flies include dull to dark brown or purple and flecked patch colors. They are attracted to putrid smells like Jacob's ladder.

Hummingbirds have long beaks, long tongues, and the ability to hover for long periods over narrow, funnel-like cups and tubes of flowers. They can perch, prefer scarlet, red, orange, or white flowers, and find them with their excellent vision. Most birds have no sense of smell.

Beetles provide minimal pollination, but are generalists and prefer larger flowers that are dull white or green.

The next time you observe a beautiful flower, consider the effort made by the plant to attract pollinators. Settle down next to it for a while to really study the flower while watching pollinator activity.

For more information about pollinators, check out these resources:

www.xerces.org dedicated to insect conservation.

www.extension.colostate.edu for fact sheets on bees and butterflies, etc.

www.nativebeewatch.wordpress.com for local citizen science project through CSU Extension Service.

www.butterfliesandmoths.org

www.gardenswithwings.com

www.butterflies.org/gardensnature for citizen science butterfly monitoring.

Lenore Mitchell is an avid amateur who has taught Native Plant Master® courses through CSU Extension's Jeffco office for more than twelve years and has presented courses for Osher Lifelong Learning Institute (OLLI) at Denver University, and other programs. She says teaching is a great way to keep learning. She's also the current Metro-Denver chapter president. ☺

A Case for Preserving A River's Natural Character

By Maggie Gaddis

From the eastern Colorado border to the Continental Divide and then sloping out to the west, a 10,000 foot elevation change exists. The ecological diversity that results is a lifetime of opportunity for us all.

Here, six major river basins originate. As a stream descends from the high country, it becomes larger and slower. It becomes less rocky and sedimentation increases. Toxins and pollutants accumulate in rivers as they flow through urban centers and near industrial and military waste. And the biggest problem of all: As rivers flow, we take from them the water itself. We use it for agriculture, landscaping, recreation, domestic, municipal, and industrial purposes. The Colorado River doesn't even flow to the ocean anymore. What was once a broad fertile floodplain, the Colorado River delta is a mudflat with persistent environmental issues.

In the headwaters of the great rivers that connect us, the slope of the landscape changes dramatically from the snow-covered peaks to alpine wetlands. The reduced slope in wetland basins accumulates water and reduces its velocity.

The *Salicaceae* family of plants includes cottonwoods and willows that are facultative phreatophytes whose roots need to be in the water table. They characterize the riparian ecosystem at all elevations in Colorado. The most notable feature of the changing riparian ecosystem is the family of *Populus* species.



Quandary peak from Blue River, CO, the headwaters of the Blue River and a tributary of the Colorado River. © Maggie Gaddis

In the high elevation, alpine willows (*Salix spp.*) predominate and—as with all alpine plants—they are short in stature and no trees are present. As we descend into the subalpine and montane environments, aspen (*Populus deltoides*) occupy the riparian life zone and the interspaces between evergreen species. Of interesting note, but probably not news to any *Aquilegia* readers, *Populus* organisms are thought to be the largest organisms on the planet. We can see this on our hillsides in the fall when groves of aspens change to different hues of yellow, orange, and pink. All of the trees changing to the same fall color are connected by their rhizomatous root systems.



Populus deltoides on Kenosha Pass in September.
© Maggie Gaddis

Moving down the mountain into the foothills, we find *Populus angustifolia*, the narrowleaf cottonwood. The leaves of this species are long and narrow; they are often confused with *Salix amygdaloides* (peach leaf willow). *P. angustifolia* is a lesser known cousin of the higher elevation *P. tremuloides* and the lower elevation *P. deltoides*. Lewis and Clark described *P. angustifolia* along the South Platte River east of Denver (5,380 ft) but historic photos also show it as high as Georgetown, Colorado (8,500 ft).

Then as we reach the lowest flanks of Colorado, we get into *P. deltoides* (plains cottonwood) country. The only tree species native to the Colorado plains, *P. deltoides* are majestic stalwarts of an earlier time when rivers flooded. Our western riparian plants are struggling because most require overbank flooding for germination. The cottonwood seed only germinates when flood waters recede over a several-week period (Shafroth, 1995). Since most western rivers are controlled with dams and diversions, overbank flooding no longer occurs with any frequency. As a result, we have an aging native riparian forest that is

“River’s Character...” *continued on page 31* ▶

Involving the Senses: The Allure of the Chocolate Flower

By Jim Borland

When asked what the flowers of this plant smell like, most will respond “like chocolate,” but a significant number will as likely respond “vanilla.” Both are right, since chocolate is often processed with vanilla.

Chocolate flower (*Berlandiera lyrata*) is popular in the southwestern Great Plains where it is native, but is only slowly gaining celebrity status elsewhere. It is also known as greeneyes, due to its resemblance to same when petals fall, and lyreleaf, in reference to the shape of the leaves. The generic, scientific name *Berlandiera* commemorates Dean Louis Berlandier (1805-1851), a Swiss botanist who collected plants in Texas and New Mexico from 1827 to 1830.

Chocolate flower is usually an erect perennial arising from an evergreen rosette of leaves with several to many, usually branched, stems up to 47 inches tall.

Flowers are showy, with yellow petals with rather unusual red veins beneath, about 3/4 inch across and with a reddish or maroon disk. The chocolate aroma is most noticeable in the morning when the whole garden smells like spilled Hershey’s syrup. Even the flower’s stamens are said to taste like cocoa.

Bloom is prolonged with suitable moisture from April to October. Only the ray flowers produce viable seeds and these manifest quickly and continuously throughout the season. Seed viability is maintained for only a year or two, according to growers, but no special treatment is necessary to germinate the seeds. Growth in the pot and in the landscape is quick with many plants blooming the first year.

While they may not be known for aggressive self-sowing tendencies, a severe hailstorm in Denver one year hammered enough fallen seed into the ground to produce a profusion of seedlings weeks later.

Dry, open limestone sites, mesas, hills and roadsides are the natural habitat of chocolate flower in extreme southwestern Kansas, southern Colorado, southward to Mexico and west to Arizona. At elevations of 4,000 to 7,000 feet, this area experiences 14 to 24 inches of precipitation but evaporates three to four times that much moisture annually. Cold hardy to a wide area, it can be grown from cold hardiness zones 8b (20 to 15°F) to at least 5a (-15 to -20°F) or 4b (-20 to -25°F).

Native soils are usually gravelly or filled with limestone chips, stones or rocks, but clay soils have also proven productive. A fleshy taproot helps conserve moisture.

Grow it in full or part sun tucked beside a boulder or next to a pathway where the full effect of the flower’s aroma can be appreciated during almost continuous bloom. It has been noted that chocolate flower can be grown without soil amendments or supplemental water. Others might also mimic these conditions since the plant gets leggy if watered

excessively and has a tendency to rot in overly moist soils.

Try using the flower heads as seasoning, as is reported by American Indians, and let me know the result.

Jim has been fooling around with native plants for more than 40 years in private, commercial and public venues. His home garden contains thousands of native plants, most grown from seed at home and now not supplementally watered for 20 years. Jim has written hundreds of articles, given talks too numerous to count, and continues to grow and plant the two or three native plants not yet in his garden. ☺



Chocolate flower (*Berlandiera lyrata*).
© Jim Pisarowicz

Increase Seeding Success with Local Native Seed

By Erica Cooper

Native seed collection is essential for restoration success. While some native species are available in the commercial trade, many have been developed over the years in an agricultural setting and have been selected for desirable traits. These products may be the same genus and species as your restoration site but may have been initially collected (and grown out agriculturally) in areas with very different climatic conditions than your reference site.

Consider blue grama (*Bouteloua gracilis*) as an example, which grows all over the western and mid-western United States. If you buy blue grama seed collected and grown in Texas, will it succeed here in Colorado? Restoration practitioners can increase their seeding success by using the most local seed sources available. These local native seeds are adapted to our soils, climate, and conditions.

Not all desirable species are available in the commercial seed trade, nor are they always affordable. The seed trade has developed over the years to be heavy in grasses. The species available are meant for initial germination for erosion control and to out-compete weeds. These characteristics are desirable for any restoration project, but a forward-thinking practitioner might also be interested in planning for habitat quality, including species that may not germinate right away but can fill in later. Another consideration is to plant species that benefit wildlife: two examples include forbs as a food source for pollinators and shrubs as nesting material and habitat for birds. Unfortunately, many of these species are simply unavailable in the seed trade or are prohibitively expensive.

This is where hand-collecting comes in. By using ethical harvesting methods ([found on the CoNPS website](#)), land managers are able to use machinery or volunteers to harvest native seeds in local areas for use in future restoration projects. Planning a seed collection event takes time and attention. First, a species list must be developed. A species list may include purchased species, stock material, and locally-collected native seed. Good candidates for locally-collected seed include species that—

- Produce seed regularly and abundantly;
- Have a high seed fill rate;
- Hold their seed well;

- Are unavailable or prohibitively expensive in the seed trade; and
- Are available in collectable amounts and at accessible sites.

Also, when using large groups of volunteers to help collect seed, a collection community should have ample parking, be in a safe, weed-free area, and be without look-alike species that may confuse collectors.

Seed development must be followed carefully, which can be a time-consuming step in the seed collection process. A target area with a desired species in abundance might look amazing when in flower, but seed development depends on a number of factors including water availability, soil conditions, insect infestations, existing fungus or rust, and more. Care must be taken to check the seed in all stages of development to ensure healthy seed development and to plan for a specified collection date. Ideal collection is during the hard dough phase, when the seed is no longer milky or sappy when broken open. In some cases, seeds must be studied under a dissecting scope to determine the proper development stage and what percentage of seeds are empty or undeveloped (known as the fill rate).

Wildlands Restoration Volunteers (WRV) specializes in planning and executing these types of projects with volunteers. Experienced staff members train volunteer crew leaders in collection methods and techniques as well as group volunteer management strategies. Each trained leader works with three to five inexperienced volunteers to safely and efficiently collect native seeds following ethical harvesting methods. In this way, ►



Volunteers collect seed on a recent project.

◀ WRV has been able to increase the quality control in collections largely collected by inexperienced volunteers.

In hand-collection projects, crews of volunteers and staff members receive initial training at the trailhead or parking lot, and then they spread throughout the collection areas to start work. Crew leaders check in with their volunteers often in the first 30 minutes, looking inside collection bags for quality control. Good collections include seed from all types of plants (tall and short, bright pink and light pink, shaded or full sun) to prevent selecting for any one individual trait. Seeds are never collected from diseased or insect-ridden plants. Collectors never take all of the seeds from the community, but instead follow the guidelines of the project manager. As a default recommendation, no more than 30% of the total seed available should be collected from a site.

After each project, seeds are dried thoroughly and prepared for cleaning. For some species, “cleaning” may mean simply sorting through bags to ensure no weed contamination, and removing any stem material. For species with awns or pappi intact, seeds must be cleaned professionally, using specialized equipment. For many species, seeds may be cleaned by physical methods using volunteer labor. This can be quite an enjoyable task in the dreary winter months. Volunteers gather around long tables and use screens and rubbing methods to remove the seeds from the other plant materials like capsules, pods, stalks, etc. After seeds are dried and cleaned, they can be stored in a temperature- and humidity-controlled environment for years.

Consider joining WRV on a project to learn more about native seed collection. Visit the WRV website (www.wlrv.org) to learn about our restoration and community building mission. WRV hosts a wide range of projects, ranging from alpine to prairie, east to west slope, trail building to watershed restoration, and to seed collection. The seed collection schedule for 2019 can be found at <https://tockify.com/wrvcalendar>, with projects once a week from July through October. More projects in Boulder, Jefferson, and Larimer Counties will be added throughout the fall, so check back often.

Erica Cooper is the native seed project coordinator with Wildlands Restoration Volunteers. Prior to this position, she worked as a plant ecologist with Boulder County Parks and Open Space and with the non-profit coalition the Southern Rockies Seed Network based in Fort Collins. Erica served on the CoNPS board for many years, as Boulder chapter president, restoration committee chair, and as a member of several other committees. If your land management organization would like to partner with WRV for seed collection projects, please contact Erica directly at erica@wlrv.org. 🌀

Children of the Field

by Arthur Clifford

There is a wildflower, as yet unnamed
it grows down in the meadow.
In wildest bloom, he is the groom
to a maiden flaxen yellow.
She waves across thickest grass
swaying dark green seas.
Calling to his flower blue
and dreams of things to be.
In Autumn's torrid heat they wither
yet again, in the field they do rise.
From seeds that fell by winter's sword
long after summer died.
Slowly ever closer then
generations flow towards each other.
Until at last in springs to come
they drink of one another.
Stamen and pistil cannot embrace
she yellow, and he blue.
Yet finally; they wed together
as flowers sometimes do.
Now spring the children of the field,
where once flowered separate colors.
Their blue eyed, yellow skirted children rise;
to dance—
With one another!



Papaver radicum, alpine poppy. Pennsylvania Mountain. © Kelly Ambler

Research and Reports

Aquilegia coerulea and the Evolution of the Spurless Mutant var. *daileyae*

By Zac Cabin

CoNPS annually funds grants to support field and laboratory research as part of its John W. Marr and Myrna P. Steinkamp grant programs. Reporting on projects is a requirement of all grant recipients. In this issue, we are pleased to feature Zac Cabin's report. MM

Just outside of Evergreen, Colorado, in 1898 local botanist Anna Dailey first noticed a rare, spurless form of the Colorado state flower: *Aquilegia coerulea* (Rocky Mountain columbine). She sent specimens to Alice Eastwood, head of botany at the California Academy of Sciences where Eastwood first described this spurless mutant as *A. coerulea* var. *daileyae* (Eastwood). Now, 120 years later, this spurless mutant is still present in nearby Reynold's Park, Colorado, and is being studied to understand the evolution and success of rare, naturally occurring floral mutants. With the help of CoNPS funding and the Myrna P. Steinkamp Award, I was able to monitor a polymorphic population of the wild-type and spurless mutants to better understand the ecological pressures that allow this rare mutant to survive.

Study System

The normal *A. coerulea* flower (hereafter referred to as "wild type") consists of five flat, petaloid sepals alternating with five petals. These petals have a rounded blade that continues down into a tubular structure filled with nectar (a "nectar spur"). The

blades of these modified petals are white and transition to blue along the spur and the petaloid sepals are a deep blue-purple. In contrast, *A. coerulea* var. *daileyae* (mutant, var. *daileyae*) is a naturally occurring floral mutant in which the petals have been transformed into a second set of sepals (Figure 1).

While the loss of petals removes the nectar reward, and would therefore likely be detrimental for pollinator visitation, this mutant has been able to persist at relatively high frequency next to normal *A. coerulea* plants for over 100 years in Reynolds Park (Reynolds Park Open Space, Jefferson County, Colorado). Environmentally speaking, the Reynolds Park population is atypical of most *A. coerulea* populations. Normally, *A. coerulea* occurs in rocky outcrops in montane and subalpine habitats (5,500' – 13,500'), receiving full sun and summer snowmelt. *A. coerulea* var. *daileyae* populations occur at the species' edge at around 5,500' in mixed conifer forests with partial sun and no summer snowmelt. In other words, the var. *daileyae* mutant occurs on the edge of the species' range in almost every aspect. It is worth noting that as species approach the edge of their range, selection pressures are often heightened due to competition, predation, decreased resources, increased stress, and so on. Particular to plants, pollinator abundance and diversity may change drastically at the edge of the range, which may drive a shift in mating systems by plant-pollinator interactions (Levin).

Aquilegia has long been considered a great model for the evolution of floral isolation (Hodges, et al.). Whittall and Hodges demonstrated that in *Aquilegia*, pollinators are, in fact, the driving force in altering floral morphology, as there have been multiple shifts from bumblebee to hummingbird to hawkmoth pollinated plants within the genus. It can be inferred, therefore, that changes in floral morphology (especially in *Aquilegia*) can have drastic impacts on mating patterns within a population and may even lead to reproductive isolation (Whittall and Hodges). *A. coerulea* var. *daileyae* provides an excellent opportunity to test this theory.

The wild type *A. coerulea* is primarily pollinated by long-tongued hawkmoths foraging for nectar, but is also pollinated by bumblebees (Miller). Hawkmoth abundance is correlated with increased outcrossing ►



Figure 1. A and B: normal *Aquilegia coerulea*. C and D: *Aquilegia coerulea* var. *daileyae*.

◀ rates (Brunet and Sweet), so it is assumed that they are more efficient pollinators than bumblebees for this specific taxon. While hawkmoths are present in or nearby var. *daileyae* populations, they are incapable of effectively pollinating the mutant flower. With no nectar spur, the hawkmoth is physically prevented from coming into contact with reproductive structures on the plant, though not for lack of trying (personal observation). Bumblebees, on the other hand, seem to not discriminate between the two morphs, freely collecting and dispersing pollen throughout the population. Thus, the loss of nectar production in *A. coerulea* var. *daileyae* may have large impacts on mating patterns between the two morphs. Additionally, the lack of nectar spurs may have other, unforeseen benefits in this unique population that allows the mutant to survive.

Sample and Data Collection

Our goal was to survey a var. *daileyae* population to determine which, if any, selective pressures may have been acting that allowed the mutant to survive. To measure if there was a fitness difference between the two morphs, we monitored their fruit (and therefore seed) production. We conducted this monitoring in 2014 in the polymorphic Reynolds Park population, because it provides a natural common garden where both morphs experience the same environment. For three consecutive years (2014-2016), we tagged flowering plants along Eagle's View Trail in Reynolds Park in late June. We first surveyed the entire population and recorded morphology (var. *daileyae* vs. wild type), number of flowers, and any indication of herbivory.

Herbivores were classified into three categories; aphid, caterpillar, and mammal. Aphids are small sap-sucking insects. When present in high enough numbers, the flower can begin to wilt, and this could possibly affect pollinator visitation and fruit production (Figure 2A). The noctuid moth caterpillar focuses on eating the reproductive tissue of the plant. These caterpillars can eat the entire flower, but often eat only part of the perianth and the entire androecium and gynoecium (occasionally leaving 1-2 partially intact carpels) (Figure 2B). More work is currently being done to identify this caterpillar down to a species or genus level. Mammal herbivory results in an entire inflorescence being removed at the base (Figure 2C). Video evidence and personal observation suggests that the mammal in question is mule deer.

After surveying the entire population once and numbering, tagging, and recording morphology for each plant, we created a spatial map of every flowering plant using a laser-based triangulation system. This provided a coordinate-based map of every flowering plant in the population, allowing us to locate and recover fruits later in the season. By splitting this surveying and mapping process into two

separate events, we were able to record two time points for herbivory during the flowering season for every plant. This was especially helpful for plants that had suffered from mammal herbivory, as mammals remove the entire inflorescence (and therefore morphology data). If only measured once, we might have missed plants that put up inflorescences, but were eaten before we were able to record them during the mapping process.

A few seeds were collected from the tagged plants in early August each year. During the seed collection process, we recorded whether a particular flower successfully set fruit, was eaten, or aborted. It is possible for a plant to experience herbivory and still set a fruit (for example, aphids on the fruit or evidence of caterpillar herbivory that was not 100% effective). The only herbivory to result with absolutely no fruit set is mammal herbivory. To ensure that fruit set was a valid proxy for fitness, we tested if there was a ►

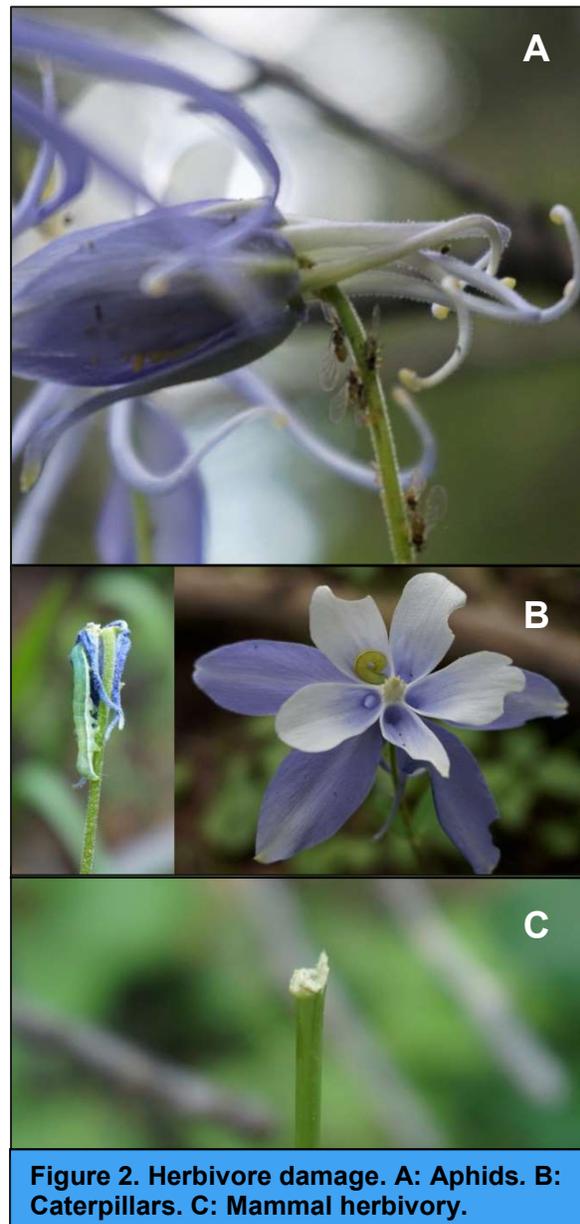


Figure 2. Herbivore damage. A: Aphids. B: Caterpillars. C: Mammal herbivory.

◀ correlation between fruit size and number of seeds and whether this differed between the two morphologies. We collected entire, undehisced fruits from just outside of the population (within 0.6 miles of the population at the bottom of the trail) and measured the height and width in two directions of each fruit to calculate a volume and then counted every seed within the enclosed fruit.

To obtain an inclusive range of fruit sizes, we collected both large and small (and sometimes obviously aborted) fruits. Using these intact fruits, we were able to obtain a distribution of fruit size versus seed number and could then determine if there was a correlation between fruit size and number of seeds. We then took the same measurements of every fruit collected in our study population. We found that there was a strong relationship between fruit size and number of seeds, but fruit sizes (and therefore seed number) did not differ between morphs. Additionally, there was no difference in the number of flowers per plant between the two morphs. Therefore, we decided that fruit production was an acceptable proxy for fitness.

Results – Fruit Set and Herbivory

Surprisingly, we found a difference in the reproductive output between the two morphs. The var. *daileyae* mutant sets significantly more fruit relative to the wild type. This pattern appears to be driven by herbivory, which has a negative impact on fruit set and was less surprising. Interestingly, herbivory was more likely to occur on wild type plants than the mutants. When controlling for herbivory, there was no difference in the ability of either morph to set fruit, suggesting that the difference in fruit set (fitness) is truly being driven by herbivory (selective pressure) and not some inherent difference in the ability of either morph to set fruit.

When parsing herbivory, it appears that caterpillars and mammals are the major drivers in this system. This is not surprising, as the caterpillar targets the reproductive tissue and the deer eat the entire inflorescence. When controlling for other herbivores, deer are the only factor that affects fruit set and have a strong preference between the morphs and actually prefer to eat the wild type flowers (perhaps they have a sweet tooth and like the sweet nectar in the petal spurs).

Thus, my findings indicate that the difference in fruit set (fitness) is being driven primarily by mammal herbivory (deer) and these deer appear to have a preference for the wild type morphology.

Discussion

Species ranges are often defined as such because of changes in selective pressures. These pressures include factors such as competition, predation, and resource limitation to name just a few. The spurless *A. coerulea* var. *daileyae* seems, to our knowledge, to

only occur at the *A. coerulea* species range in every direction and elevation. The unique selective pressures in this population (mainly herbivory) have allowed for the consistent, strong, natural selection favoring the var. *daileyae* mutant. Over three years, we have shown a consistent difference in reproductive fitness (fruit set) coupled with a consistent selective pressure (herbivory), both benefiting the mutant morphology. With this data, we have shown that while pollinators can exert strong selective pressure on floral morphology, so too can the local herbivore population.

Future Directions

Another interesting question is which species pollinate these plants. While the wild type plants are predominantly hawkmoth-pollinated, both the wild type and the var. *daileyae* mutant are visited by bumble bees. I intend to quantify mating patterns in this population and hopefully determine if this mutant phenotype drives non-random mating and reproductive isolation, which are the first steps towards speciation.

Lastly, my research has greatly benefited not only from the Myrna P. Steinkamp award but by meeting and corresponding with CoNPS members. For example, we have learned from CoNPS members of two populations in which this rare mutant is prevalent, as well as heard reports of the mutant occurring sporadically in several locales. This is especially valuable information that we can use to understand when and where this mutant is favored. We are very grateful for all of this help from CoNPS members. So please, if you have any knowledge of additional sightings of var. *daileyae*, get in contact with us at UCSB!

Zac Cabin is a PhD student in Dr. Scott Hodges' lab at the University of California, Santa Barbara. His interests lie in understanding the genetic basis and evolutionary forces that cause natural variation. He is particularly interested in plant-pollinator interactions and understanding how a shift in floral morphology (and the underlying genetics) can impact mating patterns. Contact him via email at zcabin@ucsb.edu

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In Memorium: Eleanor Ann Von Bargon

June, 1934 - April, 2019

By Loraine Yeatts



The botanical community lost a champion of Colorado native plants. Growing up on the Nebraska plain, Eleanor Ann Von Bargon developed a life-long appreciation of prairie flora. As an early and dedicated member of CoNPS she freely shared her talents with the society to raise awareness and educate the public about Colorado's special and endangered flora.

Her involvement as project director brought to fruition the first publication of *The Rare Plants of Colorado* by the Colorado Native Plant Society. She served as secretary of CoNPS (1983) when Sue Martin was President and Myrna Steinkamp was treasurer and the board of directors included Dexter Hess, Tamara Naumann, Bill Baker, and Ann Cooper, many of whom are no longer with us. She also served CoNPS as its president.

Always eager to learn more of the CO flora, she was a participant on many field trips and attended most of the annual meetings. Among other interests, frequent forays to observe prairie wildflowers, mountain hikes, and fishing favorite streams and lakes gave her great joy. As a quietly reserved person who valued her privacy, she never did disclose the location of her favorite fishing hole.

For the last 27 years, she combined her sense of artistry with scientific precision to set a new standard for mounting and preserving herbarium specimens at Denver Botanic Gardens' Kathryn Kalmbach Herbarium. Those she trained to mount plants are diligently trying to maintain her standard of excellence. Those of us who worked with her are forever grateful for the opportunity to know such a kind, talented and positive friend. Her spirit resides in our herbarium and her presence is sorely missed.

A few shared remembrances provide insight into her unique and special qualities.

"Eleanor was one of the first CoNPS members I met back in 1995. Her warmth and kindness really made me feel welcome to Colorado and to CoNPS. Her smile and the twinkle in her eyes will always be a treasured memory." — Denise Culver

"Among all her other wonderful attributes, she also had a sharp sense of humor that she rolled out in a dry way, but oh, was she funny! Lucky us to have been touched in some way by this lovely human being. I hope Heaven looks a lot like the sand hills of Nebraska so she feels at home." — Dina Clark

"Eleanor always had the most lovely sparkle in her eyes when she smiled. It was playful, slightly mischievous, and quietly wise. Every once in a while, she would nod and tap her elbow to mine as we laughed over something together, and I would so enjoy that moment of fellowship with her." — Christina Alba

"...stalwart means 'physically strong, hardy, robust, brave, and courageous.' Eleanor certainly exemplified all those traits as well as being kindhearted, witty, and radiant... Eleanor in the quietest and kindest way demanded attention and respect. In her time at the Gardens, she easily processed over 15,000 specimens. We will miss her friendship, her sweet smile, and how she made each of us a better person." — Jennifer Neale, Melissa Islam

"I first met Eleanor in the early 90s when she retired from teaching and began volunteering in the herbarium. I admired her dedication to the native flora and her eagerness to learn about every plant, whether in the field or those mounted for KHD. I was lucky to spend time in the field with her where I could see her love of the flora firsthand. I especially remember the time she took me to see one of her special prairie wildflower places discovered on her many trips to Nebraska. Eleanor was a dear friend and I will miss her greatly." — Janet Wingate ☯



News and Announcements



Bill Weber received a Certificate of Appreciation and framed photo of a variety of bryophyte species after his presentation. Top row (left to right): CoNPS leaders Erica Cooper, Denise Wilson, and Mo Ewing; Bottom row (left to right) Authors Bill Weber and Ron Wittmann. © Kathy Okon

An Afternoon with Bill Weber

CoNPS members, friends, and relatives gathered together on June 23 to listen to and honor 100 year-young Bill Weber, a legendary botanist who has contributed much to the field of botany in Colorado and throughout the world.

Participants listened to Bill share funny stories and interesting facts about bryophytes.

In attendance were CoNPS members and board members, including Ron Wittmann, who has coauthored many books with Bill over the decades; Bill's two daughters, Heather Harris and Erica Rice; and granddaughter, Heidi Alina.

After the talk, Bill was surprised to receive a Certificate of Appreciation and framed photo of a variety of bryophyte species. Participants then had a chance to chat one-on-one with Bill, have their books signed, and enjoy refreshments. Bill summed up the afternoon by saying, "This is the best time I've had in a long time!"

Congratulations, Bill!

Committee Updates

Conservation Committee

Proposed Changes to NEPA (National Environmental Policy Act): Individual comments deadline extended to August 26.

Quote from Jim Ramey, Colorado State Director, The Wilderness Society ... "the proposed changes (to NEPA) would create loopholes to increase the speed and scale of resource extraction, including logging and mining, while eliminating public awareness and input on up to 93% of proposed projects. Additionally, the Forest Service has proposed several new "categorical exclusions" that would allow the agency to move project planning behind closed doors by excluding the public from the decision-making process and eliminating any science-based review of impacts to water, wildlife, and recreation. We need to have an outpouring of opposition in this comment period.... The Wilderness Society has put together an unbranded toolkit with background information, talking points, detailed comment submission directions, and a sample email alert and comment. ...[W]e recommend you submit comments via the email provided (nepa-procedures-revision@fs.fed.us).... The Forest Service is counting all sign-on letters and group letters as ONE comment regardless of how many people sign onto it."

BLM Northwest (CO) Resource Advisory Council Upcoming Meetings

The August 22 meeting will be in Craig at the Center of Craig, 601 Yampa Avenue.

The 15-member Northwest Colorado RAC advises the Secretary of the Interior, through the BLM, on a variety of public land issues in the Northwest District, which includes the Colorado River Valley, and the Kremmling, Little Snake, and White River field offices. Topics of discussion include fire management, land use planning, invasive species management, energy and minerals management, wilderness, land exchange proposals, and more. Final agendas will be posted online at <https://www.blm.gov/get-involved/resource-advisory-council/near-you/colorado/northwest-rac>. The meetings are open to the public, and public comment periods will be held at 10 AM and 2 PM at each meeting. The public may also send written comments to David Boyd, Public Affairs Specialist, Northwest District Office, 2300 River Frontage Road, Silt, CO 81652; (970) 876-9008; dboyd@blm.gov All comments received will be provided to the Northwest RAC https://s3.amazonaws.com/public-inspection.federalregister.gov/2019-10739.pdf?utm_campaign=pi%20subscription%20mailing%20list&utm_source=federalregister.gov&utm_medium=email

2019 Event Calendar

(Please check the Events Calendar at <https://CoNPS.org> for updated information and registration.)

CoNPS Workshops

Getting Down into the Weeds

September 14; 9:30 AM - 12:30 PM

Horsetooth Area Information Center, Ft. Collins

Workshop Instructor: Casey Cisneros

This workshop will begin with a classroom presentation covering integrated weed management with a focus on native plant conservation, followed by a hike to learn more about the identification and ecology of noxious weeds. The workshop is designed for all knowledge levels. The hike will be approximately one mile with 200 ft. elevation gain. Potential hazards include snakes, mosquitoes, poison ivy, sun exposure, and uneven terrain.

Casey Cisneros is the Larimer County Land Stewardship Manager and has worked in the field of weed management for over 16 years. Much of that time was spent at open spaces where native plant conservation is a key, and critical, management goal. After completing a master's degree in natural resources stewardship with a focus in ecological restoration from Colorado State University, Casey now works with a multidisciplinary team on weed management, ecological restoration, forestry, and land conservation issues in northern Colorado.

Field Seminar: Touring the Fountain Creek Watershed from the Headwaters to the Plains

September 21; 9:00 AM - 3:00 PM

Fountain Creek Watershed

Field Seminar Instructor: Maggie Gaddis

Get ready for Creek Week by first taking a tour of the Fountain Creek watershed. Start at the headwaters at Bear Creek and travel to the plains, making stops along the way to see and learn firsthand about the watershed's riparian vegetation, water quality issues, and more. This field seminar is geared for novice to intermediate plant lovers, and the short hikes are rated easy, with a maximum of two miles total.

Dr. Maggie Gaddis teaches biology at the University of Colorado – Colorado Springs and at Colorado Mountain College. She is also a member of the Bard College Citizen Science faculty. Her research involves ecological restoration monitoring in southern Colorado and citizen science. In the education realm, Maggie investigates the efficacy of training for citizen scientists to ensure data reliability. In the science realm, she investigates the ecological success of restoration efforts in public lands. Maggie is the SE chapter president.

Field Seminar: Seed Collection

October 5; 9:00 AM – 3:30 PM

Mirador Ranch, north of Golden Gate Canyon State Park

Field Seminar Instructor: Denise C. Wilson

This field seminar is for those keenly interested in collecting seed for gardening, restoration, and fun! The morning indoor training session will include: the permitting process, targeting species, identification, and using herbariums, tracking the phenology (lifecycle) of the desired plant(s), testing for ripeness, collection process do's & don'ts, post-collection seed care, and reporting & shipping. In the afternoon, we will venture into the surrounding meadows and woodlands of Mirador Ranch to collect seeds for use in restoring the land, and for personal collections. We will coarsely clean the seed meant for restoration by using gradient screens, then store or directly broadcast them in bare areas, which received herbicide treatment earlier in the season. The field seminar is geared for novice to intermediate plant lovers, and the hike will be less than one-half mile on easy terrain.

Denise Wilson serves on the CoNPS board, and is the owner of Wilson Associates, Inc., a plant ecology firm. She worked as the Wildlands Restoration Volunteers' seed collection coordinator for two years, and for twelve years as the western contract collector for the Chicago Botanic Garden's Dixon National Tallgrass Prairie Seed Bank, as well as for the Bureau of Land Management Seeds of Success Program, and the Millennium Seed Bank Program with Kew Gardens, London.

CoNPS Board Meetings:

Anyone can attend the society's board meetings.

Saturdays, 10 AM to 1 PM;
November 16

Boulder County Fairgrounds, Longmont

Committee and Chapter Events

43RD Annual CoNPS Conference

Please join us for the 43RD Annual CoNPS Conference, held in conjunction with the 16TH Annual Colorado Rare Plant Symposium. This year's events will be held in Grand Junction, September 27-29. Please see pages 4-12 of this issue for more details. See you there!

Southeast Chapter Rocky Mountain Field Institute Citizen Science Program Revegetation Botany

September 24th, 2019, 9:00 AM-11:00 AM
Trip Leader: Maggie Gaddis

Participants will meet at the Garden of the Gods Trading Post for a 30-minute data collection training. Participants will then go out and collect data. Data collection involves measuring plant cover and richness on actively revegetated closed trail sites in the Garden of the Gods.

Restoration Committee

Love Open Space? Be a Restoration Master!

The Urban Prairies Project is recruiting individuals to be a cadre of long-term, committed open space

volunteers who assist with leading restoration workdays, collecting data, and engaging the public. To learn more and get involved, please contact Amy Yarger: 720-974-1874; ayarger@butterflies.org

First Annual Front Range Watershed Days (Bio-blitz) event: Saturday, September 28th

This project aims to engage Front Range communities in learning about watershed health and recovery through participation in a regional Watershed Days event. Part-community engagement event and part-scientific endeavor, the event will help raise awareness about watershed resiliency in Colorado, help people connect to Front Range water issues, and generate region-scale scientific data about the health and recovery of our watersheds. The event will involve a focused period (one day to one week) of intensive data collection at flood-impacted areas within at least five watersheds (Left Hand, Saint Vrain, Boulder, Fourmile, and Big Thompson), with potential for other watersheds to be added. We will also be hosting a celebration with food, drinks and music in Longmont afterward. Details to follow. To register for these trips and others yet to be announced, visit www.conps.org, sign in as a member, navigate to the calendar of events, and click on the date of the event you want to attend.

CoNPS 2019 Chapter Field Trips

Denver Chapter Field Trips

September 7: Aurora Reservoir with Bryan James and Joy Thompson

Northern Chapter Field Trips

August 24: Red Mountain Open Space Part II with Ronda Koski

Southeast Chapter Field Trips

August 22: Garden of the Gods with Maggie Gaddis
August 28: Cheyenne Mountain State Park with Pat Cooper
September 24: Garden of the Gods with Maggie Gaddis

Cross-Pollination Events

15th Biennial Conference of Science & Management on the Colorado Plateau & Southwest Region

September 9-12, 2019
Northern Arizona University

This conference creates an important opportunity to identify possible responses to challenges such as climate change, energy development, and habitat alteration that negatively affect the natural and cultural landscapes of the Southwest.

<https://in.nau.edu/biennial-conference-of-science-management/>



September 8 – 11
Rocky Mountain Water Environment Association
<https://www.rmwea.org/jac.php>

September 13
Cheatgrass Treatment Free Workshop
<https://riversedgewest.org/events/cheatgrass-treatment-free-workshop>

September 16-18
Colorado Open Space Alliance
<https://coloradoopenspace.org/conference>
<https://riversedgewest.org/>

September 24-28
World Conference on Ecological Restoration
<https://ser2019.org/about/welcome-to-south-africa/>

October 8-10
Sustaining Colorado Watersheds Conference
<https://www.watereducationcolorado.org/programs-events/conferences/>

October 8-10
Natural Areas Conference
<https://www.naturalareas.org>

October 9 - 11
Colorado Parks and Recreation Association
<http://www.cpra-web.org/page/AnnualConference>

October 31
2020 Riparian Restoration Conference
Call for Symposia submission deadline

November 1
Colorado Pollinator Summit 2018
<https://butterflies.org/copollinatornetwork/>

November 2
National Bison Day

December 4-5
Colorado Weed Management Association Winter Training
<https://cwma.org/>

December 9
World Soil Day

December 13
Desert Rivers Collaborative Meeting
<https://riversedgewest.org/events/desert-rivers-collaborative-meeting-0> 

◀ “River’s Character...” *continued from page 20*

being replaced with non-natives like *Elaeagnus angustifolia* (Russian olive), *Tamarix spp.* (western salt cedar), and *Ulmus pumila* (Siberian elm), which all have more flexible germination requirements.

Populus spp. characterize our western rivers, which connect us all in geography, politics, culture, and spiritual inspiration. Their decline on the western landscape should be a continued topic of concern for all plant lovers. Harkening back to the sentiments of Edward Abbey in *The Monkey Wrench Gang*, we need to work on preserving the natural character of our rivers for the sake of water’s freedom, for our majestic riparian forests, and for the sanity of mankind.

References

Abbey, E. (1975). *The Monkey Wrench Gang*. Philadelphia: Lippincott.

Shafroth, P.B., Auble, G.T., & Scott, M.L. (1995). Germination and establishment of the native plains cottonwood (*Populus deltoides* Marshall subsp. *monilifera*) and the exotic Russian-olive (*Elaeagnus angustifolia* L.). *Conservation Biology*, 9(5), 1169-1175. <http://www.stoppinginvasives.org/dotAsset/c62446c3-9a77-4366-b8ae-97e848cd0b04.pdf>

Dr. Maggie Gaddis teaches biology at the University of Colorado – Colorado Springs and Colorado Mountain College. She is also a member of the Bard College Citizen Science faculty. Her research involves ecological restoration monitoring in southern Colorado and citizen science. In the education realm, Maggie investigates the efficacy of training for citizen scientists to ensure data reliability. In the science realm, she investigates the ecological success. 

2019 Silent Auction: Volunteers Needed!

Two more East Slope Silent Auction Committee Members are needed immediately to help make calls/emails to prospective sponsors/donor, and to collect donated items and coordinate with Denise Wilson, Marketing & Events Coordinator. They do not have to go to the Grand Junction meeting. We already have two Grand Junction committee members, so we have the help we need on the day of the event.

Contact Denise Wilson to volunteer and/or donate: conpspromote@gmail.com. Pick-up times will be by appointment.

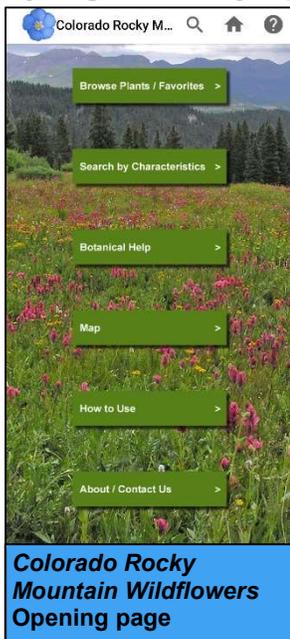
Media Review: Apps

Plant Identification Apps for Smartphones and Other Devices

By Kelly Ambler

Smartphones, tablets, and other highly portable computers have become ubiquitous in our society. They are popularly described as mechanisms for checking email, accessing Facebook, and other social media, or for watching videos and playing games. However, they are much more useful than that! Several apps have been developed for wildflower identification, giving us lightweight tools to take into the field. Unlike dichotomous keys, which compare two choices as each step of the key, these apps operate as multichotomous keys—several characteristics are chosen simultaneously to arrive at a narrowed list of possibilities. While a few of these apps require, or work best, with an internet connection, several load the database onto your device, allowing you to work without an internet. A few of these apps are described below.

Colorado Rocky Mountain Wildflowers by High Country Apps



Pros

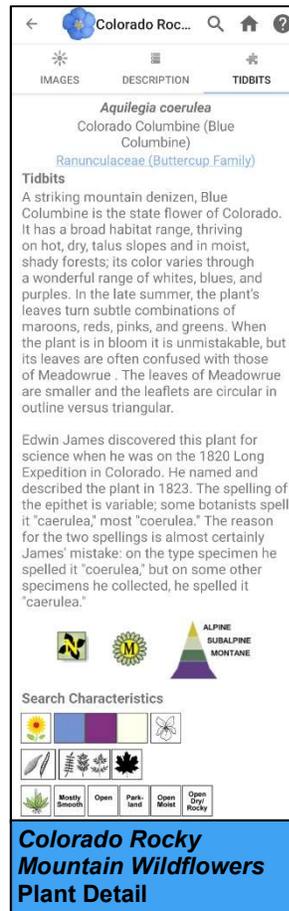
- Donates to the Colorado Native Plant Society;
- Large number of variables used for search criteria;
- Detailed description of each plant;
- BONAP distribution maps for each plant;
- Interesting facts about the plant and/or genus.

Cons

- Limited number of described plants (currently at 529).

The *Colorado Rocky Mountain Wildflowers* app is a wealth of information for the

plants that are included. Most of the information in the app can also be found on the wildflower identification website, <https://www.swcoloradowildflowers.com/>, developed by Al Schneider. Each plant has several photos detailing important structures. The images also include a botanical illustration and a BONAP of the distribution of the plant in the Western United States. The descriptions are thorough, detailed, and include at least one identifying characteristic for each species. Similar species are sometimes indicated. Finally, each



plant has a 'Tidbit' section, listing interesting information about the plant or the genus. This section gives the plant more 'personality' than is often found in most keys. Information may include flower scent, edibility, nomenclature history, and/or translation of the scientific name. While this app may not be all-inclusive of Colorado plants, it certainly is valuable for learning about the included plants.

Colorado Plants by Flora ID

Pros

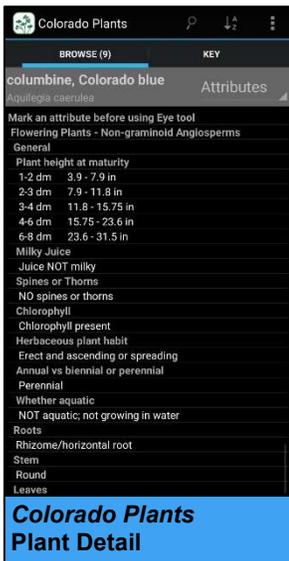
- Very large database (currently at 3193 plants);
- Includes gymnosperms, grasses, ferns, and mosses;
- Very large number of variables to key from;
- Usually multiple images per plant.

Cons

- Thumbnail not always representative;
- No detailed map;
- Doesn't include bloom period or habitat in search criteria;
- Not available for Apple products.

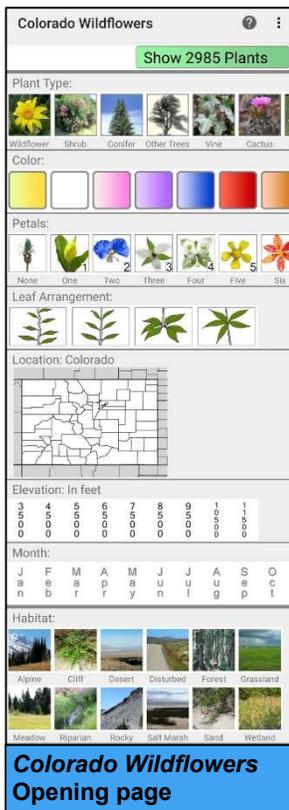
The *Colorado Plants* app contains an amazing number of plants. Almost all the plants listed in *Flora of Colorado* can be found in this app. The search criteria are equally impressive. For example, one can search by

petal/sepal/leaf length, width, hairiness, shape, etc. Certain families (such as Asteraceae, Fabaceae, ►



◀ Poaceae) have additional keys for specialized structures. Even with a minimal number of criteria, it is usually possible to generate a small list of plants for comparison to a field specimen. Most plants have more than one photograph to use for identification. Unfortunately, the thumbnails are not always chosen for optimal representation of the plant. All-in-all, this is a great app to have with you in the field or at your desk when looking through your field

photos. One note of caution—this app is very large and takes a very long time to download. It is important to be sure the app is fully downloaded before opening.



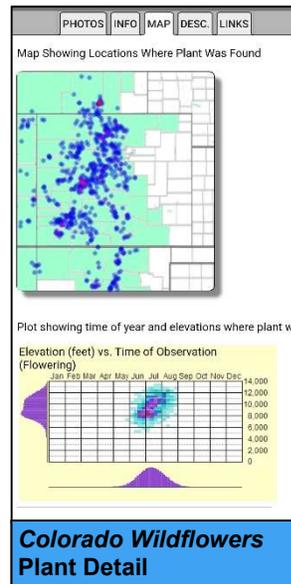
Colorado Wildflowers by Wildflower Search Pros

- Very large database (currently at 2985 plants)
- Includes gymnosperms, grasses, ferns, mosses, and lichens
- Very detailed distribution map
- Search by bloom time and habitat
- Includes links for additional information when internet access is available

Cons

- Limited number of variables to key from
- Many plants have minimal descriptive information
- Generated lists are not in alphabetical order

The *Colorado Wildflowers* app is another large database of plants. It also includes lichens, which are not included in other apps listed in this review. The search criteria stick to the essentials (type of plant, flower color, number of petals, flower type, leaf arrangement, bloom time, elevation, and habitat), which sometimes generates a rather lengthy list of plants to compare to the field specimen. However, the thumbnails are clear enough to easily narrow the choices and find the correct match. The distribution map and the graph of flowering time for each plant are



unique to this app and are particularly useful. While not every plant has a detailed description, the descriptions that are available are quite useful. Links to internet information is another useful feature of this app, although restricted to use when a connection is available.

Other apps

There are several more apps available as well. Most states have a specific app, and there are some specific to certain types of plants. For example, Colorado State University has developed an app for Colorado woody plants and the Colorado Natural Heritage Program has developed an app for wetland plants. These apps can be used offline after downloading the databases. Again, with such large databases, the download process may be quite slow. Check that the entire database has downloaded before heading out into the field.



Another fun app is the *Rockies Flower* app by

Renata Caviglia. This app has a quiz section to help you learn the wildflowers (136 species, mostly subalpine and alpine). *Colorado Wildflowers Guide* by Alpine App LLC includes a feature in which users compare personal photos with ones their database (>500 species), leading to a possible species identification. This feature does work offline. *iNaturalist* also uses photos for identification, but does require an internet connection for maximum efficacy.

Conclusion

Each app offers unique features which prove useful in either identifying an unknown plant or in learning more about the plant. Interestingly, each app has a few plants that are not found in any of the other apps. While these apps may never replace published floras, especially in the herbarium setting, they certainly are more portable in the field! Happy botanizing! 🐝

CoNPS Membership

Name _____
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 Chapter (if known) _____

Membership dues cover a 12-month period.

New Renewal

- Student \$17 Senior (65+) \$17 Individual \$25
 Family \$35 Plant Lover \$50 Supporting \$100
 Patron \$250 Benefactor \$500 Life Member \$800

Printed Color Copy of the newsletter, *Aquilegia*, \$20

CONTRIBUTIONS to CoNPS are tax deductible:

John Marr fund for research on the biology and natural history of Colorado native plants \$ _____

Myrna P. Steinkamp Memorial fund for research and other activities to benefit the rare plants of Colorado \$ _____

Total included: \$ _____

Please make check payable to:
Colorado Native Plant Society

Send completed form and full remittance to:
 CoNPS Office
 PO Box 200
 Fort Collins, CO 80522

You may also join online at
<https://conps.org/mfm-join-page/>

CHAPTERS: Boulder, Metro-Denver, Northern (Ft. Collins-Greeley), Plateau (Grand Junction & West Slope), Southeast (Colorado Springs-Pueblo), Southwest (Durango) or Unaffiliated

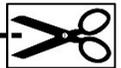
If this is a change in address, please write your old address here.

Address _____
 City _____ State _____ Zip _____

Check box to receive information on volunteer opportunities

DUES include the electronic version of the *Aquilegia* newsletter, published quarterly.

The 36-page, full color electronic publication arrives by PDF in member email boxes in February, May, August, and November. For those members without email addresses, please apply for a scholarship to receive print copies.



Make Your Garden a Certified Native Plant Garden

CoNPS now has a Certified Native Plant Garden Program. Showcase your native garden with a sign that helps create awareness in your neighborhood. A CoNPS Certified Native Garden--

- Meets specific criteria demonstrating the applicant's dedication to providing habitat for Colorado's diverse ecosystems through the seasons.
- Honors gardeners for their commitment, planning, and hard work to provide habitat for Colorado Native Plants and native wildlife.
- Contributes to the growth of healthy, diverse, and resilient ecosystems in our neighborhoods by spreading the word about CoNPS and Native Plants.

If you're interested in having your garden become a CoNPS Certified Native Plant Garden, request an application by email at conpsgarden@gmail.com



Can You ID these Flowers?



Answers (clockwise from top left): *Allium acuminatum*, tapertip onion. *Allium geyeri*, Geyer's onion. *Allium nevadense*, Nevada onion. *Allium textile*, textile onion. *Allium cernuum*, nodding onion. *Allium macropetalum*, desert onion. All plants in the Alliaceae family, which some authorities combine into the Liliaceae family.

All photos © Bob Lagler



Colorado Native Plant Society

P.O. Box 200
Fort Collins, Colorado 80522
<http://www.conps.org>



Save the Date!

Earth Day
50TH Anniversary
April 22, 2020

2019 Annual Conference September 27-29

“The Ever-changing Landscape”

Colorado State University
Western Colorado Campus.
Classroom Office Building (COB)
3168 B 1/2 Road
Grand Junction CO

The 16TH Rare Plant Symposium is Friday,
September 27TH.

The 43RD CoNPS Annual Conference is
Saturday, September 28TH.

On Sunday, September 29TH, there will be
several options for field trips in the Grand
Junction Area.

