

Newsletter of the Colorado Native Plant Society

Aquilegia



ARTICLES & BOOK REVIEWS

Marr Steinkamp Research: Pollination Biology of the Stream Orchid

Alpine Cushion Plants in New Zealand

Interview with Barbara Fahey, Native Plant Master® Program Founder

Conservation Corner: White River Beardtongue

How Lupines Talk to Bees

Volume 38, No. 2 Summer 2014

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

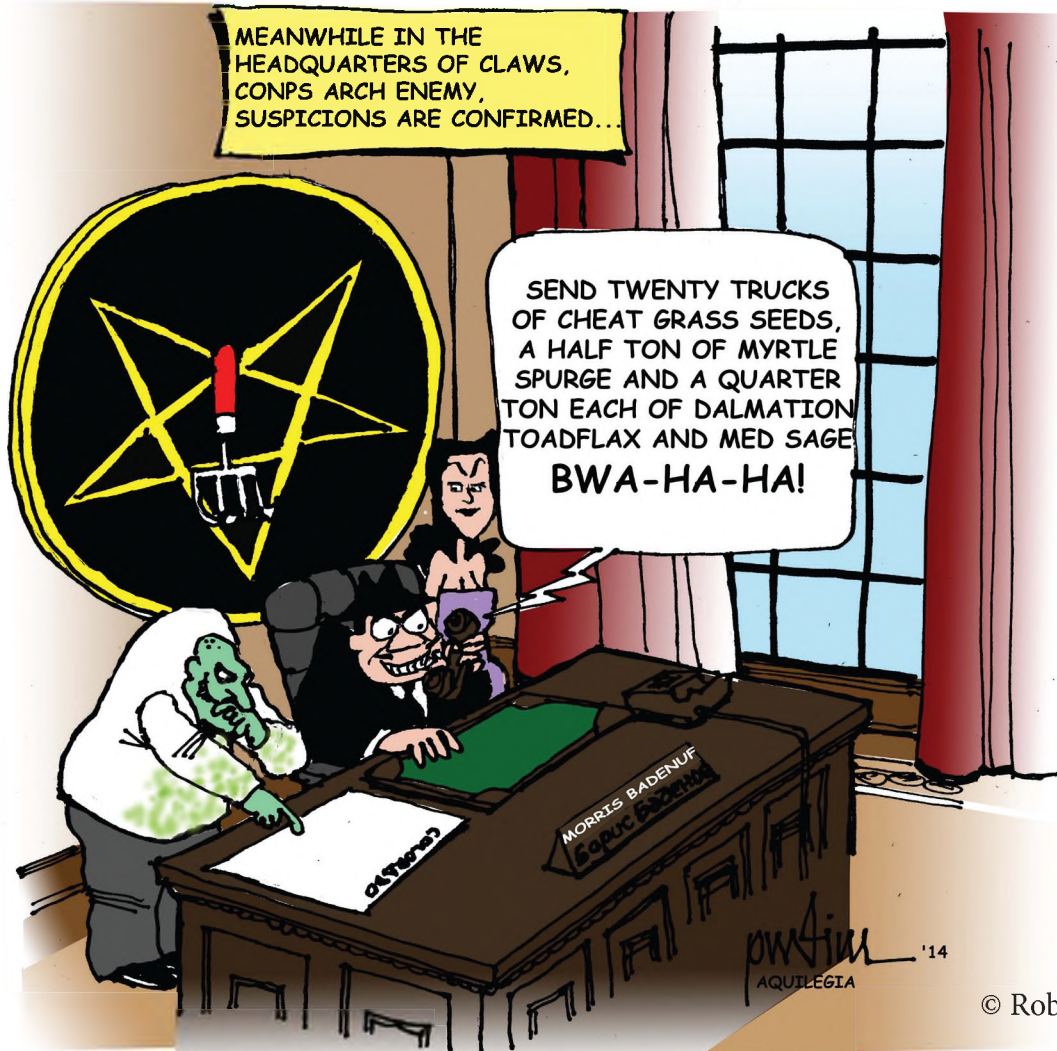
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Botanicum absurdum by Rob Pudim



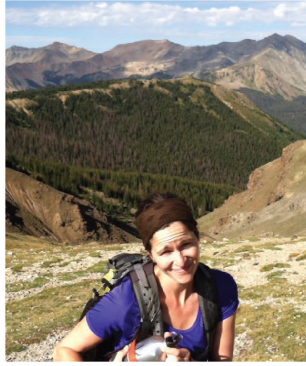
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News & Announcements

2014 CoNPS Annual Meeting, October 3-5, Fort Collins

The 2014 Annual Meeting will be hosted by the Northern Chapter on Saturday, October 4, at the Northside Aztlan Center at 112 E. Willow St. on the north edge of Old Town Ft. Collins. Group rates have been arranged at 2 nearby motels and there are many other lodging options. A social is planned at the Rio Restaurant on Friday night, following the Rare Plant Symposium. A number of Sunday field trips are being finalized. Watch for details on the CoNPS website and in the next issue of *Aquilegia*.

Congratulations!



Photos courtesy Bernadette Kuhn

Congratulations to Bernadette Kuhn and Joe Rankin on the birth of their son, Benjamin Kuhn-Rankin. Benjamin, weighing in at 7 lb. 9 oz., was born on June 23rd. Bernadette will be very busy now that she is a mom and a botanist so she has stepped down as vice president of CoNPS. She has played an important role in CoNPS as vice president and provided great support for the 2013 Rare Plant Symposium and Annual Meeting.

Welcome Our New Vice President

We are delighted to report that Irene Shonle will be joining the Board as our new Vice-President.

As the County Director of Natural Resources for CSU Extension in Gilpin County, Irene is responsible for education in natural resources, helping to support the weed program, and managing the county's Master Gardener program. Irene has a PhD and worked for Harlequin's Garden. She has also served as a trainer in the CSU Native Plant Master Program.



Photo by Yinyan Huang

Denise Wilson on KGNU

Secretary of CoNPS, Denise Wilson, was interviewed about orchids by Hannah Leigh Myers on KGNU radio in Boulder. You can listen to the interview by going to the KGNU website [kgnu.org](http://www.kgnu.org) or by clicking <http://www.kgnu.org/morningmag/6/20/2014>

The 2014 11th Annual Colorado Rare Plant Symposium

Join members of the Colorado Rare Plant Technical Committee (RPTC) for the 11th Annual Colorado Rare Plant Symposium. The RPTC is an ad-hoc group of agency, academic, and NGO botanists that has been working for years to advance rare plant conservation efforts in the state.

This year, the RPTC will provide a photo review of the imperiled and vulnerable (G2 & G3) plant species known from central and northwestern Colorado. This includes a diverse group of rare species from alpine, cliff and canyon and shale barren habitats. Discussion of their relationship to Colorado's important plant biodiversity areas, current conservation status, and potential threats will be emphasized. Come prepared to exchange your knowledge of some of our rarest plant species with other amateur and professional botanists from throughout the state! This one-day workshop will be held in collaboration with the Colorado Native Plant Society's annual meeting (October 4-5, 2014) at the Northside Aztlan Center. The symposium is open to any one with an interest in the rare plants of Colorado. Contact Jill Handwerk for more information at 970/491-5857 or jill.handwerk@colostate.edu. Registration is \$10 and will be available on the CoNPS website and at the door.

New Boulder Chapter President

Erica Cooper worked as a Plant Ecologist/Volunteer Coordinator for Boulder County Parks and Open Space for 5 years. Her main focus was native seed collection and restoration projects utilizing volunteers. Before living in Colorado, Erica worked in Environmental Education in coastal Georgia as a Field Supervisor for a private firm



Photo by Erica Cooper

in Indianapolis designing and installing habitat restoration projects, and as an AmeriCorps member working with The Nature Conservancy in Indiana to manage their preserves. Erica now stays at home with her 7 month old daughter and looks forward to studying plants with this new budding botanist!

New *Phacelia* Discovered by Gina Glenn in Colorado



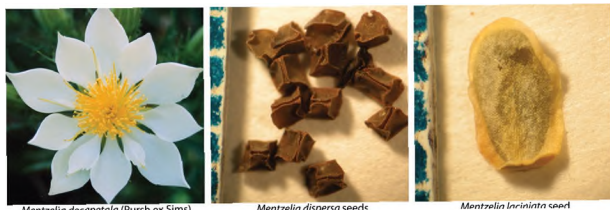
Photo by Gina Glenn

Phacelia gina-glenneae N.D. Atwood & S.L. Welsh, sp. nov.

Congratulations to U.S. Fish and Wildlife Service Botanist, Gina Glenn, on the discovery of a new species, *Phacelia gina-glenneae*, in Grand County Colorado.

From: Atwood, N. Duane & Stanley L. Welsh. (2013). New plant taxa from Colorado, New Mexico, and Arizona. *Western North American Naturalist* 73(1):113–115.

Progress Report from Jennifer Ackerfield on her *Flora of Colorado*



Currently, the manuscript is complete (minus some minor revisions), the images are nearly complete, and I am working on getting everything into InDesign so it can be sent off for publication. I am using the Botanical Research Institute of Texas for publication, and they anticipate the book will be in print by next spring. I am waiting on an estimate of cost for the book, and then am going to set up a kickstarter campaign to help generate publication funding. I thought I could offer such things as acknowledgements in the book, signed copies, botanical prints of herbarium sheets, or even a plant walk with the author. I was hoping the book would be published by this fall, but that just became unrealistic given the scope of the book. There are now species descriptions and there will also be a small county level distribution map next to each description. In all there are about 76 color plates with 12 images each. I think it's really going to take Plant ID to a whole new level here in Colorado!

New *Phacelia* Discovered in New Mexico by Arnold Clifford

Phacelia cliffordii N.D. Atwood & S.L. Welsh, sp. nov.

Arnold Clifford, Dine' (Navajo) botanist and geologist, has discovered a new species, *Phacelia cliffordii*. Arnold has led a number of hikes for the Colorado Native Plant Society and is one of the editors of *Flora of the Four Corners Region* (see p. 19 of this issue of *Aquilegia*).

"Arnold Clifford has traveled and collected widely in New Mexico and Arizona and is recognized as an outstanding field botanist. He was tutored by his Navajo grandmother from an early age. She was the wife of a Navajo medicine man, and as such, she was responsible for gathering plants with medicinal purposes on the Navajo Nation lands. Arnold has a keen mind and remembers every place he has ever been. He is familiar with most, if not all, of the plants on the Navajo Nation lands, and he has an eye for discerning anything that might be undescribed. We value him as a colleague and an able botanist. His botanical forays have added new taxa in the Hydrophyllaceae, Leguminosae, Onagraceae, and Compositae." (Atwood & Welsh, p. 214).

From: Atwood, N. Duane & Stanley L. Welsh. (2013). New plant taxa from Colorado, New Mexico, and Arizona. *Western North American Naturalist* 73(1):113–115.

Rare Plant SWAP Addendum

We'd like to inform you that we will be working with Colorado Parks and Wildlife (CPW) to incorporate rare plants into the revised State Wildlife Action Plan (SWAP). The revised SWAP will be complete September 2015. The Proposed Rare Plant SWAP Addendum which was completed in 2011 will be incorporated into the 2015 revised SWAP. We do not anticipate substantial changes to rare plant addendum, but will be doing a refresh of the document to reflect recent changes in status to some of our rare plant species, and to ensure the document meets 2015 SWAP standards. The 2011 Proposed Rare Plant SWAP Addendum can be viewed/downloaded at: http://www.cnhp.colostate.edu/download/documents/2011/rareplant_SWAP_final_june_30_2011.pdf

At this time we want to update our stakeholder list to include any botanists or organizations that were not a part of the 2011 group. If there are groups, individuals, experts etc. that are not included on the list, please share that directly with Lee Grunau (CNHP) (dnr_swap_input@state.co.us). The CPW list is not meant to be exhaustive - anyone who wants to contribute is welcome to.

Also, the CPW SWAP website has been updated to reflect recent activity. If you're interested, please see: <http://cpw.state.co.us/aboutus/Pages/StateWildlifeActionPlan.aspx>

Jill Handwerk, Botany Team Leader/Information Manager
Colorado Natural Heritage Program
(970) 491-5857 Jill.handwerk@colostate.edu

Plant Sale and Seed Swap!

Saturday, September 20, 2014, 12 pm to 2 pm, Boulder
Joint meeting with CoNPS and Front Range Wild Ones



Come to our plant sale and seed swap and pick up some new Colorado native plants for your garden! In addition to seed, we invite you to donate any “extra” plants from your garden for a fundraiser to benefit both organizations. This event is open to members of either the Colorado Native Plant Society or Front Range Wild Ones. (If you’re not a member, you can sign up with either organization at the event.)

Our host this year is Dave Sutherland, whose Boulder garden contains a diversity of vibrant Boulder County native wildflowers, shrubs, trees and grasses. Dave strives to provide habitat and larval food for native animals—all while minimizing water use. Refreshments will be provided.

How does a Seed Swap work?

Basically, bring any seed you’ve collected from your yard and take a similar amount from what is offered. All seeds should be from species native to Colorado.

1. Please bring your seed in a paper bag or envelope (one bag/envelope per species). Label the envelope with the botanical name, common name, size, flower color, and any other helpful growing tips. For example:

Liatrix punctata, Dotted gayfeather
1 to 2 feet tall, purple spikes in August-October.
Prairie plant with very long tap root.

2. To take seed, use the blank seed envelopes and paper bags provided to take a portion of the seed you want. Be sure to write the label information on the seed envelope.



How do I donate a plant?

The plant sale is a fundraiser for the Colorado Native Plant Society and Front Range Wild Ones. Plants will be sold for \$1 to \$5 each; however some plants will be available at no cost.

Simply bring any volunteer natives potted in a nursery pot or similar container. Label the pot as above. Don’t forget to water and keep the plant alive until the sale!

What if I don’t have any seed or plants to share?

Please come anyway! It’s likely that we’ll have plenty of seed and plants to share, and you can consider a small donation to either organization in lieu of seed and plants. Plus, you’ll have a great time in Dave’s garden! Please RSVP by filling out the form on the CoNPS or Front Range Wild Ones websites by September 12th and let us know if you are bringing seed or plants. After you RSVP, we’ll email directions to Dave’s garden.

Photos: Yard and *Liatrix punctata* © Charlie & Jan Turner

Volunteer Opportunities in Colorado National Parks

This summer, particularly in July and August, there are a number of potential volunteer opportunities to help with botanical monitoring for national parks in Colorado. These include plant monitoring opportunities in Rocky Mountain NP, Great Sand Dunes NP, and Florissant Fossil Beds NM. These tasks range from monitoring wetland vegetation to helping identify native and invasive plants throughout parklands. I’ve included some potential dates when volunteers would be helpful in Rocky Mountain NP. If you are interested in volunteering this summer at any of the parks mentioned above and want more information, please contact Betsy Bultema at betsylhb@rams.colostate.edu.

June 16- July 3: Cheatgrass Management Plots (Moraine Park)

July 14- 17: Canada Thistle Monitoring (Upper Beaver Meadows)

July 21-31: Bear Lake Road Monitoring (Moraine Park to Glacier Basin)

August 4-8: Toadflax monitoring (Hallowell Park)

Purge Your Spurge

This spring, the Boulder Chapter partnered with the Wildlands Restoration Volunteers (WLRV) to weed out myrtle spurge (*Tithymalus myrsinites*), a “List A” noxious weed, from a number of areas in Boulder. Myrtle spurge is designated for statewide eradication by the Colorado Noxious Weed Act.

WLRV’s Purge Your Spurge program allows people to exchange their myrtle spurge for native plants. The spurge purges have taken place in Boulder County, Jefferson County, and Denver County. For more information and to find out the dates of future events, see wlrv.org or visit the Purge Your Spurge page on Facebook. To view an Inside Boulder News video of the event, see: <https://vimeo.com/94017124>

Photo from Purge Your Spurge Facebook page
<https://www.facebook.com/pages/Purge-Your-Spurge/262057190628315>



Field Trips



Pawnee Buttes Panorama © Rick Brune

For more information and field trip updates and changes see the CoNPS website under "Chapters" <http://www.conps.org/Chapters/index.shtml>

BOULDER CHAPTER

Details and registration information at <http://www.conps.org/Chapters/boulder.shtml>. To register for the field trips: Megan Bowes at BowesM@bouldercolorado.gov or 303-561-4883.

Caribou Ranch—Conifers and Colorful Wildflowers Galore
Thurs., July 10, 5:30 p.m. to twilight - Linda Boley

Butterflies, Wildflowers and Host Plants
Sun., July 20, 10 a.m. – 12 noon - Amy Yarger

Lichens Hike (Updated)
Sat., Aug. 9, 9 a.m. – 12 noon - Dr. Erin Trip
Location to be determined

The Miraculous World of Mosses (New)
Date and Time: late fall - Ron Wittmann, Dr. Bill Weber & Paula Lehr
Meet: location to be determined
Dr. Ron Wittmann, Dr. William Weber and Paula Lehr will help us explore mosses. Learn how to shift gears from the more familiar methods of looking at flowering plants to those used for mosses. Ron and Bill are co-authors of the *Colorado Flora and Bryophytes of Colorado*. Paula has taught moss workshops with Ron and otherwise collaborated with the pair. To register: Megan at BowesM@bouldercolorado.gov or 303-561-4883.

2014 High Altitude Reveg Summer Field Tour July 22-23
This year's tour will highlight active restoration of severely scoured sites from the September 2013 floods in Boulder and Larimer Counties and roadside revegetation in Rocky Mountain National Park. Due the challenges associated with traveling to these restoration sites, HAR is requesting RSVPs with your name and contact information to Donna.Goodsell@co.usda.gov. With RSVP, more details will follow.

Guild of Natural Science Illustrators Annual Meeting, Boulder July 13-19
The 2014 GNSI Conference is being held in Boulder CO this year, on July 13-19. The conference consists of a week of presentations, workshops, portfolio sharing, techniques, and more. For more information: <https://www.conf.gnsi.org>

Walker Ranch Pulling for Colorado event July 12
8:00 a.m. - 1:00 p.m. Walker Ranch -BCOSP
Pulling For Colorado is a statewide effort to educate residents about the impacts noxious weeds have on our natural, agricultural and recreational lands. Contact: Kurt Roy: 303-594-0163 or kroy@bouldercounty.org

2014 Native Plant Master Program. Boulder. Visit (<http://www.coopext.colostate.edu/boulder/horticulture/nativeplantmaster.shtml>) to learn about this year's classes in basic botany, vegetation found in prairie dog colonies, and plains and foothills riparian corridors.

GORE RANGE CHAPTER

Digital Photography Workshop, Fairplay, CO - Bernie Nagy
Sat. July 12 – 2:30 - 5:30 p.m.

Sun. July 13 – 8:00 a.m. - 12:30 p.m.

Each workshop will be at a different location and will be limited to 8 participants *Cost: \$30; \$50 for both days*

Wildflower Walks - Linda Nagy
Sat. July 12 – 2:30 - 5:30 p.m.
Sun. July 13 – 8:00 a.m. - 12:30 p.m.

Cost: \$10 for each walk

Participants may choose to participate in both the photo and wildflower hikes on different days. More detailed information will be sent to participants.

Please contact Nanette Kuich, Gore Range Chapter President, for more information and to sign up at kix@vail.net

Pass Lake Wildflower Hike - Nicola Ripley
July 23, Wed.
Donation of \$10 to benefit the Betty Ford Gardens suggested.

CoNPS member Ginger Waymire reported, "I was hiking in early June near Silverthorne and saw thirty-three orchids in bloom! We had never seen so many. We get all excited when we see even one! So it was a very special day!"

According to orchid expert Denise Wilson, the blooms of *Calypso bulbosa* last about a week.



Photo by
Ginger Waymire

METRO DENVER CHAPTER

Register at www.metrodenverconps.eventbrite.com

Butler Gulch hike CHANGED to Berthoud Pass– Cheryl Ames
July 9, Wed. 8:00 a.m. to 3 p.m.

Flora of Horseshoe Cirque - Steve Yarbrough
July 12, Sat. 7:30 a.m. to 2:00 p.m. (call to confirm) Register with Steve Yarbrough, 303-250-5542 (cell), 303--233-6345 (home), steveandkenna@msn.com



Denver Field Trip at Red Rocks Park on June 1 Photo by Charlie Turner

Golden Gate State Park– Judy King
July 19, Sat. 8 a.m. to noon

Hoosier Ridge - West – Jane Hendricks
July 24, Thurs., 7 a.m. to 5p.m.

Shelf Lake area and optional camping – Jeanne Willson
July 25 – 27, Fri. to Sun.

Geneva Basin Iron Fens, A Colorado Natural Area
July 26, Sat. 7:30 a.m. to 5 p.m. - Dave Bathke assisted by Fran Enright

Grasses at Green Mountain Park, Forsberg Park Trailhead
Aug. 2, Sat. 8:30 - 11:30 a.m.
 15900 W. Alameda Parkway, Lakewood, CO 80228
 For questions, please contact Jessica at jpsmith24@gmail.com

Ranson Edwards Open Space –Judy King
Sept. 6, Sat. 8:30 a.m. - noon

Castlewood Canyon State Park - Jeanne Willson
Oct. 18, Sat. 10 a.m. - 3 p.m.

NORTHERN CHAPTER

The Northern Chapter offers 3 flora field trips each month during the summer. Two of each monthly field trips are on the weekend and take up most of the day. The third is a local early evening hike in a Ft. Collins natural area. Use the contact information in the hike description if you have questions. The summer field trip program directors are Hugh Mackay (970-310-4330) and Ronda Koski (970-217-5286) in case you have any difficulty reaching a trip leader. Details on each month's hike will be posted in the Northern Chapter Section of the CoNPS website (www.conps.org) by the 20th of each month (i.e. July Field Trip Details will be posted by June 20, etc....)

Lady Moon Trail (Red Feather Lakes Area)
July 6, Sun. morning, about 4 hours
 LENGTH OF HIKE: 5 miles round trip, easy.
 Car-pooling available from the mouth of the Poudre Canyon

Bobcat Ridge Natural Area (Masonville area)
July 9, Wed. evening, about 2 hours.
 LENGTH OF HIKE: about 2 miles round trip, easy.

Blue Lake Trail (Cameron Pass Area)
July 26, Sat. morning, about 4 hours.
 LENGTH OF HIKE: about 4 or 5 miles max, we will not go all the

way to the lake, moderate.
 OTHER: Car-pooling available from the mouth of the Poudre Canyon to the trailhead.

Ouzel Falls @ Rocky Mountain National Park
Aug. 3, Sun. morning, about 5 hours
 LENGTH OF HIKE: 5.4 miles round trip, moderate.
 Car-pooling available from Loveland.
Maxwell Natural Area (Fort Collins)
Aug.13, Wed. evening, 2 hours
 LENGTH OF HIKE: 1 mile, easy.

Lower Dadd Gulch Trail (Poudre Canyon)
Aug. 23, Sat. morning, 5 hours.
 LENGTH OF HIKE: 7 miles round trip if we do the entire trail, moderate.
 Car-pooling available from the mouth of the Poudre Canyon to the trailhead.

Pawnee Buttes (Pawnee National Grasslands)
Sept. 7, Sun. morning, about 4 hours
 LENGTH OF HIKE: 3 miles round trip, easy.
 Car-pooling available to the trailhead.

Ramsay-Shockey Open Space (Larimer County)
Sept. 10, Wed. evening, about 2 hours.
 LENGTH: 2 miles, easy.
 Car-pooling available from Loveland.

Soapstone Prairie, City of Fort Collins Natural Area
Sept. 27, Sat. morning, about 4 hours.
 LENGTH OF HIKE: 2 to 3 miles, easy.
 Car-pooling available from Fort Collins.



Ouzel Falls Trail Photo © Marlene Borneman

PLATEAU CHAPTER

Bullion King Lake, San Juan Mountains
July 12, Sat. Meet at 9 a.m. at Ouray Visitor Center

The Plateau chapter will join up with members of the Black Canyon Regional Land Trust (BCRLT) for a hike in the San Juan Mountains. We will meet at the Ouray Visitors Center at 9 am to carpool to the trailhead. The hike will be to Bullion King Lake where we will see the amazing show of high elevation summer wildflowers. The full hike will be approximately 5 miles with 1600 ft of elevation gain (shorter options are available since this is an "out-and-back" hike).

Bring lunch, water, a rain jacket, sunscreen, a hand lens and your favorite flora. There is no cost but please RSVP to stern.r.stephen@gmail.com

Directions to the parking area can be found here: <https://mapsengine.google.com/map/edit?mid=zkFNsLMk6dIA.kgxE7VCW2uyM>

August TBD: I hope to plan a field trip onto the Grand Mesa for August. Any input as to date and location would be appreciated! (send to stern.r.stephen@gmail.com)

SOUTHEAST CHAPTER

N. Cheyenne Canyon, Buffalo Creek - July 12, Sat.
Leader: Doris Drisgill leaderdoris@gmail.com

The Craggs - July 19, Sat.
Leader: Jeff Jones leaderjeff01@gmail.com

Putney Gulch, south of the Craggs - Aug. 16, Sat.
Leader: Doris Drisgill leaderdoris@gmail.com

Rampart Range old-growth on the Pike - Aug. 23, Sat.
Leader: Steve Olson, Botanist USFS leadersteve01@gmail.com

San Juan/4 Corners NPS

For details see <http://www.swcoloradowildflowers.com/San%20Juan%20Four%20Corners%20Native%20Plant%20Society.htm>

Ophir Pass Road From the East. July 2. Bob Powell and Al Schneider

Upper Echo Basin Mine Road. July 12. Bob Powell and Al Schneider

Annual Pass Creek Trail. July 16. Travis Ward

Alpine area above Silverton. July 22. John Bregar

La Plata Canyon, Columbus Basin. July 25. John Bregar, Bob Powell, and Al Schneider

Annual Telluride trip. July 30. Connie Colter and Al Schneider

Bolam Lake Meadows via Hermosa Creek Pass Road. August 2. Bob Powell

Mushroom trip, Lizard Head Pass. August 23. John Sir Jesse



Happy Birthday July 6
Per Axel Rydberg (1860-1931)
Author of *Flora of Colorado* (1906) &
***Flora of the Rocky Mountains* (1922)**



Awards Nominations

The CONPS Board of Directors desires to honor contributions to Colorado botany and to the Colorado Native Plant Society. Service to the Society takes many forms, from an occasional event to significant contributions over a span of five years or more. Do you know someone who deserves recognition for their time and effort given to CONPS? Perhaps you know an individual who has contributed over a lifetime to enhance Colorado botany?

Recognition Gifts: non-members who provide a one-time service to the society.

Certificate of Appreciation: members and non-members who provide occasional services to the society.

Certificate of Merit: members who have made a significant contribution to the Society in a short period of time (less than five years).

Special Merit Award: non-members for short-term contributions to Colorado botany and/or significant contributions to the Society's goals.

Honorary Lifetime Membership: CONPS member for long term, high quality service to the Society (over ten years).

Lifetime Achievement Award: members and non-members for long-term (30+ years) contributions to Colorado botany.

Nominations may be submitted to President Charles Turner at conpscturner@gmail.com or 720-284-8137 by July 31, 2014. The Directors will review the nomination and supporting materials and vote upon your nomination at their next meeting.

Marr & Steinkamp Research Grant Study

Pollination Biology of the Stream Orchid, *Epipactis gigantea*

By Denise C. Wilson

"Look Daddy, those people are wearing clothes!"

The little boy seemed confused. His parents wore nothing but flip-flops and a smile. Yet as they made their way up the trail, here were two adults, covered head-to-toe in sun hats, long sleeves and boots, carrying notebooks, cameras, backpacks, and a GPS unit, standing knee deep in the creek. It was mid-summer at Valley View Hot Springs, where clothing is optional. My husband, Orvel, and I were conducting a pollination study of the rare stream orchid, *Epipactis gigantea*. Orvel dropped his head and muttered, "I'm so embarrassed!"

Epipactis gigantea grows in cold seeps and hot springs in the Western United States and British Columbia, as well as in Japan, China, Tibet, Pakistan and India. In the southwestern US, the plant thrives in wet seeps and along river bottoms and canyons throughout California, Nevada, Utah, Arizona, and New Mexico. In Colorado it grows at elevations from 4,900 ft at Escalante Canyon, to 8,900 ft at Valley View Hot Springs (Fig. 1).

My goal was to advance the conservation of *Epipactis gigantea* by determining its pollinators and the mechanisms of its pollination.



Fig. 2 Syrphid fly with two attached pollen packets from a stream orchid, at Unaweep Seep, a cold seep in Southwestern Colorado

This would provide necessary reproductive information to manage its populations and justify the protection of its pollinators. Over two field seasons, in 2007 and 2008, I conducted pollination experiments to determine the mating system at three different elevation sites in Colorado (5900 ft, 6850 ft and 8950 ft), using seven different pollination treatments. Also, I photographed and trapped syrphid flies in the act of pollination (Fig. 2). Since then, I've made yearly visits to the sites checking up on the health of the populations.

Based on research conducted for other wetland obligate orchids, and particularly other *Epipactis* species, a likely hypothesis was that *Epipactis gigantea* had a mixed-mating system (out-crossing pollination by insects and various mechanisms for pollen transfer to the stigma of flowers) with some environment-induced self-pollination. Aging virgin flowers could contract and self-pollinate by making the pollen contact a late receptive stigma. From a conservation standpoint, a mixed pollination strategy helps ensure the persistence of the species over the short term, but may cause loss of genetic diversity in the long term,

due to the reliance on self-pollination in the absence of pollinators. However, it is a good strategy to get through drought years.

Data were collected on a total of 1667 flowers. I viewed all flowers before, during and after they were open, and assistants recorded the data. For consistency, I performed all artificial hand pollinations and bagged the flowers of the experimental treatments myself. Bags made from white tulle netting were used to exclude pollinators from flower buds before and after receiving a treatment (Fig. 3).

Successful pollination was indicated by the formation of a seed capsule. Roughly half (49%) of the study flowers resulted in fruit set, indicating successful pollination. Generally, all hand pollination treatments and the control group had about the same proportion of success, which suggests that flowers are pollinated in various ways reflecting a mixed mating system. Self-pollinated flowers set fruit 59% of the time, showing this pollination strategy to be a significant aspect of this species' reproduction. This selfing may be an adaptation due to the infrequency of true wild pollinator(s). The infrequency was hinted at because hand pollination (in lieu of a pollinator) had a greater success rate than wild controls. In other words, if pollinators were present in adequate numbers, then success in the wild state (the control group) should equal or exceed those pollinated by hand.



Fig. 3 Buds bagged prior to experiments to exclude pollinators

Catching the pollinators in the act proved to be more difficult. In the first year of the study, I positioned net traps above open flowers in hopes of capturing visiting insects. Very few insects feasting on nectar and no insects at all carrying pollinia appeared in these traps. So the following year, I staked out the sites with a butterfly net and set up a time-lapsed camera. I was at Valley View, soaking in a pool on the very last day of my allotted time, that I witnessed a fly exiting an *Epipactis gigantea* with pollen on its back!



Fig. 1 Valley View Hot Springs, one of three elevation sites of the pollination biology study of *Epipactis gigantea*.

Pollinium (plural: pollinia): a coherent mass of pollen grains often with a stalk bearing an adhesive disk that clings to insects. From Merriam Webster Online Dictionary www.merriam-webster.com/dictionary

Having no net nearby, I snatched it in my fist, but alas, I slipped on algae and lost the pollinator! Nevertheless, syrphid flies sporting pollen showed up in many of the photographs taken at the two lower-elevation sites, and the butterfly net successfully captured flies with pollinia on their backs at all three sites. At Filoha Meadows, the middle elevation site, I witnessed a fly enter and exit four flowers on the same inflorescence accumulating the paired pollinia on its back until it labored to enter a fifth flower only to become stuck inside!

The natural pollinators proved to be six different species of syrphid flies, as well as a small fly, all identified by Wouter van Steenis from the Museum of Amsterdam (see Pollinator Table). Frank Krell, Curator of Entomology at the Denver Museum of Nature and

| Pollination Biology Study of <i>Epipactis gigantea</i> | | | | | | | |
|---|--------------|----------|----------------|----------|-------------|----------|-----------|
| Pollinators Identified by Wouter van Steenis, Zoological Museum, Amsterdam | | | | | | | |
| | UnawEEP Seep | | Filoha Meadows | | Valley View | | Total |
| | Male | Female | Male | Female | Male | Female | # |
| Pollinator Species: | | | | | | | |
| <i>Copestylum satur</i> | | | | | 1 | | 1 |
| Syrphinae: | | | | | | | |
| <i>Dasysyrphus creper</i> | | | | | | 1 | 1 |
| <i>Eupeodes americanus</i> | | | | | | 2 | 2 |
| <i>Eupeodes luniger</i> | | | | | | 1 | 1 |
| <i>Eupeodes volucris</i> | | | | 2 | 2 | | 4 |
| <i>Platycheirus immarginatus</i> | 1 | | | | | | 1 |
| <i>Sphaerophoria philanthus</i> | | | 2 | 3 | | | 5 |
| Total # of pollinators | 1 | 0 | 2 | 5 | 3 | 4 | 15 |

Science, facilitated pollinator identification but chose to send the pollinators to an expert considering there are 200 species of syrphid flies in this area of the country.

Since completing the study, I've returned to visit each of the three sites to estimate population numbers. The populations are fluctuating according to precipitation conditions but, based on the limited data, appear to be stable. The UnawEEP Seep site has seasonally managed cattle grazing, and this site's

population exceeded 2,500 plants. The extensive and maze-like root system of *Epipactis gigantea* may even benefit from breakage by cattle hooves. The plants benefit because managed grazing controls vegetative competition. I continue to monitor this site as a volunteer steward for the Colorado Natural Areas Program to ensure that cattle have only seasonal access, and that trampling does not reduce the population to a level which is no longer sustainable.

Given its mixed mating strategy, *Epipactis gigantea* would be a good candidate for reintroduction, particularly into those areas in Colorado where the plants have been reported, but not recently seen. Southwest Environmental Information Network, or SEINet, a database of herbarium specimens from across the southwestern United States, contains 46 records of herbarium specimens from Colorado, representing 13 separate locations. A couple of these specimens date back to 1915, and one to 1894. Further work on this species could include an analysis of historic population numbers by reviewing the record details and visiting these sites to determine if they still have extant *E. gigantea* populations. In five of the six sites that I've visited, the plants were thriving. The one site in which *E. gigantea* was not doing well was Cottonwood Hot Springs, where the plants were purported by the owner to have been more abundant before commercial development. It is difficult now to find any plants at this site, so the impact of changes in hydrology and the stress of increased human activity negatively impacted the plants there.

This species has an advantage by using several ways to affect mating across a variety of environmental situations. That makes it a good candidate to attempt reintroduction. A variety of pollination strategies in a species help to ensure the production of seed capsules. A reintroduction of roots from a similar elevation to an existing site would help to expand the genetic base at that site. Pollen could also be transferred from one site to another, if the pollen is held in cold storage and delivered the same day. It is not known how long the pollen remains viable, or at what temperature it should be stored. The advantage of moving pollen is that there are copious amounts of it produced by the plants, and its removal is less intrusive than digging roots. Conducive conditions at elevations higher than 5900 ft must include a large, warm, springs-fed wetland to support the diverse insect populations necessary for out-crossing and successful long-term survival. Additional conservation must include an herbicide-free environment for the health of the pollinators. In these experiments, the importance of out-crossing was demonstrated by successful fruit production 75% of the time, and that was the highest seed set category. Stable hydrological conditions assuring consistent winter warmth and wet ground assures the root system remains wet but does not freeze. Criteria for reintroduction at elevations higher than 5900 ft must include the warming presence of hot springs, provided, of course, that the soil is not compacted streamside by grazing and recreational use.

Heartfelt thanks to my Masters Advisor, Dr. Leo Bruederle, at the University of Colorado Denver. The Colorado Native Plant Society supplied Marr and Steinkamp Grants to help fund my research. The Orient Land Trust and the Boulder and Denver Orchid Societies gave grants. Dr Barney Johnson of Filoha Meadows, and Terry and Neal Seitz of Valley View Hot Springs provided access and accommodations. Technical assistance and field support was provided by Frank Krell, Wouter van Steenis, Brian Kurzel, CNAP, Carol English, Orvel Ray & Theodore Wilson, Jennifer Rovetch, Janine Ballantine, Sekah Sneller, Ian Rich, and Karen Cowee.

For more information about *Epipactis gigantea*:

Conference Proceedings of the Native Orchid Conference, Inc., Green Bay, Wisconsin, June 12-16, 2009. Native Orchid Conference, Inc., P.O. Box 29010, Greensboro, North Carolina 27429-9010. 131 pages, plus CD, \$24.95 USD soft cover; or contact Denise C Wilson, denise@denisecwilson.com, to obtain the article included in the proceedings.

A Technical Conservation Assessment by Colorado Natural Heritage Program; http://www.cnhp.colostate.edu/download/documents/Spp_assessments/epipactisgigantea.pdf

Species Account and Distribution Map on the website for Flora of North America; http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=242101585

USDA Plants Website; <http://plants.usda.gov/java/nameSearch?keywordquery=epipactis+gigantea&mode=sciname&submit.x=21&submit.y=9>

Denise earned her Masters of Science in Botany, Geography and Geology from UC Denver. She is Secretary of CoNPS, a member of the Orchid Specialists Group with IUCN, avid volunteer, conducts vegetation surveys for CEMML out of CSU, and collects native seed for Chicago Botanic Garden's Dixon National Tall Grass Prairie Seed Bank.

How Lupines Talk to Bees

by Peter Lesica

Reprinted with permission from *Kelsey: Newsletter of the Montana Native Plant Society* (volume 25, no. 4, Summer 2012).

Lupines are common and pretty much ubiquitous in the Mountain West. However, it was only this year while photographing Wyeth's lupine (*Lupinus wyethii* = *L. polyphyllus burkei*) that I noticed how the flowers change as they mature. Most of our lupines have blue flowers, but the center of the reflexed banner petal is white; at least sometimes it's white. Lupine flowers are borne in long racemes with the lowest flowers blooming first. As the upper flowers open, the central banner spot of the older, lowest flowers turns from white to purple. Slowly flowers with banner spots that have turned purple are found higher and higher in the inflorescence as it matures. So what's that all about?

Several researchers have explored aspects of this question. Anthony Stead at the University of California working with white-leaved lupine (*L. albifrons*) found that the change in pigmentation from white to purple is not caused by simple withering because young, white-spotted flowers do not become purple-spotted if they are removed from the plant. Rather the pigmentation change is a response to ethylene produced by the pistil (female part of the flower) after it has been pollinated and is no longer receptive. On average, flowers with a purple banner spot have just 1-2% of the pollen as white-spotted flowers, and most of this is not viable. So the change to purple acts as a signal that the flower is done. Okay, so who cares?

Bumblebees care, and they are lupine's principal pollinators. Lupines provide lots of pollen but no nectar. Bumblebees collect the protein-rich lupine pollen to feed their young. Barbara Schaal studied Texas lupine (*L. texensis*) and found that bumblebees can and do use the color of the banner spot to guide them to the flowers with the biggest reward, so they visit flowers with a white-spotted banner and avoid those with purple spots. This arrangement helps the bees because they don't waste their time visiting empty flowers. It also helps the lupines because bees will be more likely to visit and pollinate flowers with receptive pistils. But if a lupine plant "wants" to

keep bees from visiting already-pollinated flowers, why not just drop the petals instead of evolving this color signaling system?

David Gori at the University of Washington answered this question by observing bees visiting silvery lupine (*L. argenteus*). He found that lupine inflorescences with more flowers attract more bees from afar, regardless of whether

the flowers have a white or purple banner spot. But once a bee arrives at the inflorescence, she preferentially visits the flowers with white-spotted banners. The fact that larger inflorescences attract more insects has been observed for many species of plants, and lupines are taking advantage of bee behavior by maintaining corollas of already-pollinated flowers but making them identifiable at close range. What all of this tells me is that lupines invented stoplights; only they use white instead of green to tell their clients to go.

Further reading

Gori, D. F. 1989. "Floral color change in *Lupinus argenteus* (Fabaceae): Why should plants advertise the location of unrewarding flowers to pollinators?" *Evolution* 43: 870-881.

Schaal, B. A. and W. T. Leverich. 1980. "Pollination and banner markings in *Lupinus texensis* (Leguminosae)." *Southwestern Naturalist* 25:280-282.

Stead, A. D. and M. S. Reid. 1990. "The effect of pollination and ethylene on the colour change of the banner spot of *Lupinus albifrons* Bentham flowers." *Annals of Botany* 66: 655-663.



Photo by Peter Lesica

Conservation Corner: White River Beardtongue

by Bob Berwyn, Guest Columnist

This article is reprinted with permission from the Colorado Independent: <http://www.coloradoindependent.com/147490/rare-colorado-wildflowers-survive-30-years-of-bureaucratic-bumbling>

FRISCO — Pity the poor White River beardtongue, (*Penstemon scariosus* var. *albifluvis*) growing only in a few scattered clumps on crumbly oil-shale bluffs in Northwest Colorado. If there ever was a safe haven for a plant, you'd think it would be here, where mountain lions roam and bald eagles soar above the White River Basin in one of the most remote corners of the state.

But even in the isolated Piceance Basin, fossil fuel speculators with sunglasses as black as coal are leasing up lands, hoping someday to cash in on the eternal dream of an oil shale boom. If only the engineers could figure out a way to process the oily rock without baking hundreds of acres of earth and swallowing up a river's worth of water..

If only ...

There's no oil shale development yet where the beardtongues live, but enough buzz among energy companies to raise a biological red flag about the fragile populations. After 30 years of dithering, federal officials will soon finalize a conservation plan for the extremely rare plant that grows west of Meeker, in the Colorado-Utah borderlands. There are only eight patches of White River beardtongue, totaling about 12,000 plants — covering an area about the size of a few golf courses, at most.

Earlier this month, the U.S. Fish and Wildlife Service released several studies that will determine the fate of the flowers, and the public can weigh in on the conservation effort through July 7.

Unlike mule deer or jackrabbits, beardtongues can't just up and move if the bulldozers and drilling rigs roll in someday. Long-lived, like many desert organisms, the plants stay rooted in one place for decades or longer. The rosettes of thick leaves blend in with the scrubby gray-green waves of sagebrush. But in summer, the beardtongue sends up 20-inch flower spikes with big, two-lipped pink and purple blossoms, along with prominent fuzzy stamen that gives the flower its name.

The beardtongue is part of the broader penstemon family (Greek for five stamens). Penstemon grow all over the world. But our beardtongues, growing in the unique rock of the Green River formation, are special. Some of the flowers appear to be completely dependent on the only known vegetarian wasp species, which feeds only beardtongue pollen and nectar to its offspring. It wouldn't be surprising if biologists someday find that another species, perhaps a bird, is dependent on that particular wasp, and yet another critter may be dependent on that bird. As with any ecosystem, a disturbance to one species disturbs many species, setting off a ripple effect of unsustainability.

Botanists long have suspected that the beardtongues lead a tenuous existence in the rough uplands of the Piceance Basin. That was way back in 1983 when federal biologists first said the White River beardtongue was probably threatened or endangered. The related Graham's beardtongue, which grows in Colorado's far western Rio Blanco County and in adjacent Utah, was one of the first plants ever to be considered for endangered or threatened listing under the Endangered Species Act.

Grazing was a problem. But more generally, botanists recognized that an extinction event, or some sort of human impacts, could wipe out a plant that grows only on a few thousand acres of land.

Graham's beardtongue subsist along a horseshoe-shaped band about 80 miles long and 6 miles wide extending from the extreme southeastern edge of Duchesne County in Utah to the northwestern edge of Rio Blanco County in Colorado. White River beardtongue's range extends from the vicinity of Willow Creek in Uintah County, Utah to Raven Ridge west of Rangely in Rio Blanco County, Colorado. The bulk of the species' range is a distance of about 20 miles.

In the early 1980s, when biologists first considered protection for the plants, there was talk of an oil shale boom in hardscrabble Rio Blanco County. Thirty years later, energy companies are still eyeing the land. After all, there's oil in them thar hills!

Engineers are only a little bit closer than they were 30 years ago to figuring out how to exploit the ancient rocks for their energy potential. But the U.S. Fish and Wildlife Service, which classifies and protects endangered species, now says that energy development in the region is a foreseeable threat to both species of beardtongue.

The Sisyphean 30-year squabble over the beardtongues illustrates the best and worst of our cluster of environmental laws. Well-intentioned scientists have devoted decades of their professional lives to understanding beardtongue ecology. But that science has at times been ignored and even covered up as it was under the watch of former Vice President and Halliburton exec Dick Cheney, who championed domestic energy development at high environmental costs.

Saving tiny patches of rare plants from extinction is no easy task. In most cases, you can't just put a fence around them and call it



Penstemon scariosus var. *albifluvis*
Photo by Dave Elin

good. Besides, nobody knows exactly how many plants, or patches of plants would qualify as a safe population. Surveys extending back a few decades don't show any significant up or down trends in populations, said USFWS biologist Tova Spector.

What's more, nobody knows how many of the plants grew in the region before settlers came to ranch, farm and hunt.

It's possible the plants have always been rare, sometimes expanding their range, sometimes shrinking in response to decadal climate variations or even changes in local microclimates.

Though useful populations trends are hard to come by, one thing is clear. The best thing humans can do for the beardtongues is to stay out of their way. That could be tough if the oil shale boom materializes, or if traditional and gas drilling activities expand in the area. Some tracts near the beardtongue's habitat are already leased for fossil fuel exploration, which would siphon river flows, require a web of roads through rugged plateaus that are the beardtongues' last refuge and bring behemoth earth-moving machinery scraping acres of ground.

The U.S. Fish and Wildlife Service's plans currently on the table aim to protect the plants with various combinations of measures that would include mapping conservation areas on Bureau of Land Management territory in Colorado's Rio Blanco County and other scattered patches around the region where road-building, drilling and grazing would be banned. A voluntary conservation plan that includes private ranching lands is also up for discussion.

The specifics of the plan would be hammered out after the current round of public input, but the goal is to ensure that any future fossil fuel development on public lands in the region would be required to avoid harming the plants, according to federal officials. In the meantime, the long menu of conservation options is confusing even to veteran environmental watchdogs who have watched in frustration as eight presidential administrations and generations of Interior Department officials have pondered how best to protect the plants.

"It's hard to know exactly what they want comment on," said Utah Native Plant Society's Tony Frates, who has tracked the fate of the beardtongues for more than 10 years. "We just want them to be listed, period."

Deciphering the government's intentions with regard to the beardtongues became even more challenging in 2012 when the wildlife service rolled the Graham's and White River varieties into an even more cumbersome multispecies planning process. Bundling conservation efforts for the two species obscured the fact that the Graham's beardtongue should have been listed 10 years ago when Bush administration appointees to the Interior Department blocked the move. In 2011, a federal judge said federal officials acted "arbitrarily and capriciously" when they denied protection for the plants. An investigation by the Union of Concerned Scientists showed that BLM policy makers created what they called a "strike team" to prevent listing.

A trail of emails obtained under the Freedom of Information Act shows one field biologist contemplated how he could downplay the potential impacts of fossil fuel exploitation on the beardtongues. George Diwachak, an environmental scientist with the BLM, wrote that he was "at a loss in how to address the fact that the entire area may be blanketed by oil and gas proposals."

In hopes of avoiding yet another legal showdown with conservation groups or the fossil fuel industry, U.S. Fish and Wildlife Service biologists are, among other options, considering a voluntary conservation plan developed with state and local agencies. If adopted, that agreement could forestall more restrictive federal rules and give private landowners more management flexibility. But some conservation advocates worry that the voluntary conservation plan doesn't have enough teeth.

After the public comment period ends in July, federal officials will decide whether the voluntary conservation plan does enough to address threats from grazing, invasive weeds, climate change, traditional oil and gas drilling and oil shale and tar sands development.

A decision to list the species as threatened or endangered and designate its habitat as critical would set aside protected areas and require extensive environmental reviews to avoid impacts to the plants.

Frates notes that any conservation action would affect only a few hundred square miles — a tiny percentage of the oil-rich Green River geologic formation.

For now, all the options are still on the table, and the beardtongues will just be blooming as biocrats, local land bosses and fossil fuel barons gather for a public comment period in Vernal, Utah on May 28.

Bowing their petaled heads in the wind, the flowers don't have any say about which policy ultimately will be chosen to protect them, but if beardtongues had voices, you could imagine them reciting the words of Dr. Seuss, the prescient environmentalist who in his book "The Lorax" envisioned a treeless and flowerless world in need of a savior.

"I am the Lorax. I speak for the trees. I speak for the trees for the trees have no tongues," Seuss wrote. "I am the Lorax, and I'll yell and I'll shout for the fine things on earth that are on their way out!"

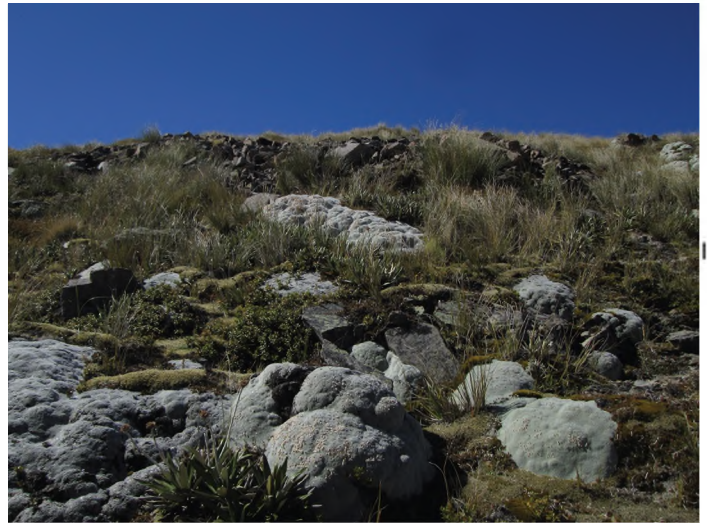
Bob Berwyn writes about energy and the environment while wandering the Colorado Rockies. He's instagram crazy, a digital-era mountain sickness. bberwyn@comcast.net

The Other Down Under: Exploring Alpine Cushion Plants in New Zealand

by Catherine Kleier

I've been drawn to New Zealand ever since I first learned about geologic time and how the isolation of islands breeds unique plant and animal species, that is, since my undergraduate university days. I never pursued my desire until this past year because I always knew I would need much more time than the traditional three week, or even three month, vacations or research trips to which I was accustomed. The Fulbright was the perfect opportunity to have the time I wanted for the exploration desired. In March of 2012, I found out that I had received the Fulbright to research and teach at the University of Otago in Dunedin, New Zealand. My award would be for five months – from February to June, 2013.

While getting the Fulbright was a dream come true, just writing my Fulbright grant proposal was exciting! I was enthralled at the possibility of actually studying some plants on New Zealand that had spurred my imagination since my doctoral program. I had been presenting my research on a large alpine cushion (mound shaped) plant in Chile at a scientific conference, when someone approached me after my talk and asked if I had seen the vegetable sheep of New Zealand. Intrigued, I immediately went to my laptop to image search vegetable sheep. I knew when I saw those plants that I would have to develop a research program to study them. Immediately, I was curious as to why the giant cushion growth form should exist only in the Southern hemisphere. I also wanted to know if these plants grew preferentially next to rocks for a heat advantage. Their unique shape also means that they trap soil and decaying material within their canopies, which means they can enhance the germination of other plants, something ecologists call facilitation.



With these ideas in my head, my family and I boarded the plane to cross the Pacific. We arrived in Dunedin on Boxing Day (I never quite figured out the meaning of that holiday). The very next day, my hosts, Dr. Kath Dickinson and Sir Alan Mark, took me on a field trip to the Old Man Mountain Range in Central Otago on the South Island. I found my first study species here, *Raoulia australis* [Asteraceae]. This plant forms pale green mats, up to a half meter in diameter. It is common all over New Zealand in areas overgrazed by sheep but particularly on the South Island. My original project suggested looking at changes in size of *Raoulia* with elevation. The hypothesis was that if *Raoulia* were responding to climate change, then smaller plants would be located at higher elevations. However, seeing this *Raoulia* in its habitat, I made two observations. First, species of *Raoulia* did not have large elevation gradients, such that going up in elevation just 500 meters would find a *Raoulia* replaced by a different species. Such narrow niches are common in islands where adaptive radiation occurs. Second, I noticed that within their narrow elevation range, species did not seem to show a pattern with size and elevation.

Finally, on this field trip, I made a separate observation. I noticed that several other species were growing within *Raoulia*. I wondered if mat plants and cushion plants are able to provide beneficial habitat to other plants. Positive association is the term for plants preferentially growing within other plants. Sometimes this process is also called facilitation, though this term has a separate meaning in facilitating later plant growth, not necessarily concurrent plant growth. Thus, I investigated positive associations in three species of the genus *Raoulia*: *Raoulia australis*, *Raoulia bryoides*, and *Raoulia eximia*.



To support my idea of positive associations, I measured the size, pH, soil moisture, and species occurring within and adjacent to three species of *Raoulia* on the South Island of New Zealand. I studied *Raoulia australis* from the Old Man Range of Central Otago, *Raoulia bryoides* on Mt. Robert in Nelson Lakes National Park, and *Raoulia eximia* on Mt. Hutt in Canterbury. The first species is distinctly a mat plant, while the second species forms more of a cushion. The third species is the largest and most defined cushion of the three. My hypothesis was that positive associations would increase with increasing cushion morphology, such

Photos on this page by Catherine Kleier

that *Raoulia eximia*, the plant with the greatest cushion shape, would exhibit the greatest degree of positive associations with other species. The geographic range of these three species may also support the stress gradient hypothesis, which supposes that as stress increases, positive associations also increase, to a point. If conditions become too stressful, positive associations may cease.

Thus far in my analysis, I've determined that the mat plant, *Raoulia australis*, does not form positive associations. Other species occur within and outside of this plant at the same frequency. Additionally, plant pH and moisture did not change with increasing size, thus supporting the finding that this plant was not changing the environment sufficiently to promote plant growth. *Raoulia bryoides* did not show positive associations even though it forms a cushion. However, this species showed more differences in canopy moisture than the mat plant *Raoulia australis*. *Raoulia eximia* formed the largest cushions of the three species, and it showed positive associations with other species. This species also showed a trend toward changing moisture within the canopy of the plant with size, which could indicate an ameliorated habitat for the germination of other plants.

Facilitative, or positive, interactions -
"encounters between organisms that benefit at least one of the participants and cause harm to neither." (Stachowicz, 2001, p. 235).

What is interesting about these findings is that morphology plays a role in positive facilitation, but that there are also individual species differences. *Raoulia bryoides* and *Raoulia eximia* both show a cushion growth form, but *Raoulia eximia* showed more positive associations than *Raoulia bryoides*. This difference may stem from *Raoulia eximia* growing further south and at a higher elevation,

though this difference was not tested explicitly. Certainly, this work with *Raoulia* lays a ground work for further studies with this unique genus. Because these species have the ability to facilitate the growth of other species, investigating their growth form is important to alpine environments.

All three of these *Raoulia* species prefer rocky habitats, much like cushion plants in Colorado. Cushion plant growth form may be in response to cold temperatures, high wind, and/or intense light levels. Interestingly, the New Zealand cushions, particularly *Raoulia bryoides* and *Raoulia eximia*, grow much larger than our Colorado species of cushions, such as *Silene acaulis* or *Phlox condensata*. I will also continue this work with cushion plants in Colorado. Positive associations have been demonstrated for a species of Rocky Mountain cushion, *Silene acaulis*, but this work was done in Montana, and it will be interesting to see if the associations still hold in Colorado, which is at the Southern range edge of this plant.

While New Zealand and Colorado are about the same size geographically and both have mountains, the similarity ends there. The plant ecology of these two places differs remarkably. In New Zealand, the treeline consists of trees that are flowering plants rather than conifers, which are the treeline species in Colorado. The Southern Beech (*Nothofagus* spp.) forms the treeline component in a very abrupt transition to the alpine zone at about 1,250 meters on the South Island (circa 4100 feet), much lower than our treeline in Colorado, which can range between 3,200 and 3690 meters (circa 10,500 to 12,100 feet). As mentioned, cushion plants are much larger in New Zealand, but other plants are larger as well. The world's largest buttercup, the Mount Cook Lily (*Ranunculus lyallii*) occurs in the New Zealand alpine and is also an example of how confusing common names can



Mt. Cook Lily (*Ranunculus lyallii*)
Photo courtesy Hebe Society, NZ

be, since it's not in the lily family but in the buttercup family [Ranunculaceae]. Additionally, because New Zealand is an island, many of the plants found there are found nowhere else on Earth, such species are called endemic by botanists and ecologists. The New Zealand Department of Conservation estimates about 80% of the flora is endemic to New Zealand. The Colorado flora is probably only about 4% endemic. The most striking difference to me working in alpine ecosystems was the lack of colorful herbs. While New Zealand is incredibly picturesque, the alpine regions lack the brilliant hues of our alpine wildflowers. The alpine flowers are estimated to be 77% white, which is about twice the number of white flowers found in other alpine regions around the world (Wilson, 2013). The accepted hypothesis for this dearth of color appears to be a lack of specialist insect pollinators, which just never made it to this faraway island.

For additional reading about the alpine flora of New Zealand, Sir Alan Mark has just revised his classic book *Above the Treeline: A nature guide to alpine New Zealand*, a vade mecum for all Kiwi alpine enthusiasts. Another book, *Ghosts of Gondwana: The history of life in New Zealand*, is an eminently readable account of the evolutionary history and biogeography of this fascinating island. For my part, I am very happy to have made it to this island at the bottom of the world, and I hope to return - at least on my next sabbatical.

References

Hugh Wilson. 'Alpine plants - Survival,' *Te Ara - the Encyclopedia of New Zealand*, updated 13-Jul-2012 URL: <http://www.TeAra.govt.nz/en/alpine-plants/page-6>

Stachowicz, J. J. (2001). Mutualism, facilitation, and the structure of ecological communities. *BioScience* 51, 235-246.

Cath Kleier is the chair of the Department of Biology at Regis University in Denver, CO. She has been a CoNPS member since 2001 and has served on the Board of Directors and as the chair of the Research Grants Committee.



The Colorado Native Plant Master® Program

Seventeen Years and Going Strong

An Interview with Barbara Fahey

by Jan Loechell Turner

Barbara Fahey proves that one person can make a difference. As founder of the Native Plant Master® Program, CSU Extension, Barbara has influenced thousands of people with her program, teaching participants to identify, appreciate, and protect native plants and their habitats.

In 1997, as a Volunteer Naturalist for Lookout Mountain Nature Center, I was able to enroll as a student in the first Native Plant Master (NPM) series of classes. Barbara had been the Director of Lookout Mountain Nature Center before she became the Director of CSU Extension in Jefferson County. She thought it would be a good idea to try out the program with the staff and volunteers at Lookout Mountain Nature Center. She taught all of the classes the first year and provided us with an excellent example of good teaching techniques. I had never experienced anything like it. We were in the field the entire time. I had taken some plant taxonomy classes at universities but learning about the plants while in their native habitat was a different experience.

The second year of the program, I became one of the trainers. Barbara instructed us in teaching techniques, the goals of the program, provided supporting material, and helped us develop the skills we needed to succeed as trainers (instructors). I was afraid of public speaking and teaching the NPM classes about a subject I loved out in nature helped me overcome that fear. When you volunteer, you often receive more than you give and becoming comfortable teaching classes paid dividends for me. Barbara provided feedback and encouragement and made it a very positive experience.

The Native Plant Master program provides the citizens of Colorado with the opportunity to learn to identify the native plants of Colorado in structured, well-thought-out courses in Colorado's open spaces and parks. It enriches the lives of the participants and produces graduates who can not only identify native plants and noxious weeds but who understand ecological relationships, the importance and reasons for eliminating noxious weeds, protecting native ecosystems, and promoting the use of native plants in our home landscapes. Many Native Plant Masters continue their education and advocacy for native plants through the Colorado Native Plant Society. Colorado is truly fortunate to be the state with the Native Plant Master Program and Barbara Fahey, its founder and advocate for native plants. Barbara's work has had tremendous impact on the protection and promotion of native plants and their habitats in Colorado. She is an inspiration to me and to the many other people she has influenced through her NPM Program. If you have not already been through the Native Plant Master Program, I strongly encourage you to sign up. You will not be disappointed.

JLT: How did you become interested in native plants?

BF: When I was very little, my Mom would put me out in the old-time equivalent of a bouncy seat on the shady side of our house in the morning. I remember seeing these incredible brightly colored flowers I later learned were called moss-rose (*Portulaca grandiflora*). Then I became enchanted with the saucer magnolia outside my bedroom window that had the most exotic furry buds, large tulip-shaped flowers and delightful fragrance. My parents had moved from Chicago to a half acre in the suburbs and planted what amounted to an arboretum in our yard. It became my personal nature preserve where I could explore all day and still find something new. Next thing you know all the kids in the neighborhood were calling me Nature Girl.



Photo by Yinyan Huang

JLT: What gave you the idea for the NPM program?

BF: When I started my position at Colorado State University Extension in 1995, I was thrilled to find out that I was encouraged to create a natural resource program to meet the educational needs of my county. Having worked at the Lookout Mountain Nature Center, I already knew how challenging it was to train budding naturalists who had the passion and desire to educate others, but who were maybe an accountant or lawyer in their other lives.

JLT: How did you pull the program together and then get it approved by CSU?

BF: I started with CSU Extension in June of 1995 and our first Native Plant Master series was offered in the spring of 1997. I worked with folks at the Lookout Mountain Nature Center including Mary Ann Bonnell, Christine Leahy, Brenda Porter, Julia Wilson, and others who provided excellent input on program mission and design and helped market the first series of courses.

JLT: What is the mission of the NPM program?

BF: The mission of the Native Plant Master Program is to educate the public in order to foster stewardship of native plant resources, sustainable landscaping and management of invasive weeds that threaten native ecosystems. We are the bridge between plant science and the public – greater knowledge leads to conservation of native plant resources.

The Native Plant Master Program focuses on a very specific subject area, plants, and goes into depth, including various

aspects such as plant taxonomy, morphology, ecology, ethnobotany and other human connections. Native Plant Master volunteers work for other agencies and report the educational contacts they make using information from NPM back to NPM.

Native Plant Master® is a registered trademark and can only be used with permission of the NPM Program. When using these words in a narrative, the registered trademark® symbol is used the first time in the text, and then can be omitted.

JLT: Would you describe your database and manuals?

BF: The database contains research-based information on more than 1,000 native and non-native species. Information is included on taxonomy, morphology, key characteristics, ecology and human uses. Our goal is to be a bridge between the public and scientific information, so the database (as well as the NPM course curriculum) is designed with a non-scientist user in mind. Even so, scientists also find it useful.

Data for the Native Plant Master site-specific manuals come directly from the Colorado Plant Database (see page 22 of this article). It took about 6 months to program the database in Microsoft Access. Jan Kray, a former county employee was the programmer who worked with me to help design the database. It took another 6 months to do the research and data entry in the database for the initial entries. We started with around 150 entries in 1997, and the database has now grown to more than 1,000 plants. Each year, we add more plants as we expand the number of course locations where we teach.

JLT: As the person in charge of the NPM program, what are you required to measure (impacts)?

BF: As the outreach arm of a major research University, Colorado State University Extension links the research-based knowledge with citizens to address real world problems that they encounter. In order to know if we are being effective in reaching the public and helping them to solve their problems, we use a national logic-based model to design research questions that document the impacts the program has. These questions are asked in an annual survey. We then summarize the results of the survey in an impact report that is given to stakeholders including program participants, decision makers and elected officials.

Here are the impacts from the survey since 2008 along with a few quotes from program participants:

Acreage impacted statewide: 2,690,205
Statewide economic impact: \$1,778,1711
Program revenues: \$158,577
Educational contacts: 103,306
Courses and classes: 371
Participants: 6,886
Volunteer hours: 5,120
Volunteers: 2,892

"It is the best educational experience I have had through my local Extension office. It is outside, hands-on, taught by passionate, intelligent people, and has real world applications."

"I have used my identification skills to educate my crew mates

about what plants to collect for restoration projects, what plants to leave alone, and what plants to remove during invasive plant control efforts."

"I worked for two golf courses and thanks to this program I was able to change landscaping on the courses into more native areas, reducing labor, and water and chemical use. This helped save the golf course's money and helped me retain my job."

"I took two NPM classes prior to applying for a position on with the city's ecological restoration crew. I was told that my experience identifying native and invasive plants was a deciding factor in my selection."

"I was campaigning for elected office by canvassing the neighborhoods in my district. I used the knowledge I gained from the Native Plant Master courses to speak to voters and constituents about their lawns and sustainable gardens."

JLT: How has the program changed over the years?

BF: The program actually hasn't changed that much over the years. We always had an emphasis on use of natives for sustainable landscaping and invasive weeds as threats to ecosystems. We just got better at articulating our themes. We still include ethnobotany and ecology in our courses. The clientele probably has changed more than the program, though. In the early years, we partnered with the Lookout Mountain Nature Center and State Parks. Their staff and volunteers were the primary participants; now we have participants that are landscape architects, green industry employees, home gardeners, outdoor enthusiasts, park naturalists, college faculty, homeowner association staff, natural resource agency employees and many more.

JLT: Which counties followed after Jefferson and do the different counties have different kinds of programs?

BF: CSU Extension in Eagle County was the first county to join us and we now have a total of 12 NPM programs across the state. The different counties all have a pretty similar NPM program.

NPM has two components: 1) the NPM courses that use a specially developed curriculum to teach identity, ecology and human connections about native and invasive plants over three four+ hour sessions and 2) special classes on topics of interest to plant enthusiasts.

The Metro to Mountain Program (Clear Creek, Denver, Gilpin and Jefferson Counties) is the flagship, and being the oldest, it is the largest and offers a wider array of special classes in addition to the NPM curriculum courses.

JLT: How has your training for trainers (NPM instructors) evolved?

BF: I taught all the courses the first year of the program and we had a course at Mt. Falcon, Lair o' the Bear and Reynolds Jeffco Open Space parks. I quickly realized I couldn't personally keep up with the demand so I sought out others to join me as a NPM trainer to teach NPM courses. There are two qualities we look for in trainers: botanical expertise and teaching skill i.e. the ability to engage, excite and empower learners in an outdoor setting.

We started doing a statewide face-to-face training for those who teach NPM courses in 2008 but that evolved to a dual-mode training model: online training materials accessible to all 12 NPM programs in the state, supplemented by local training meetings where volunteer trainers get to meet their colleagues and local agents can do training more specific to their county or areas. We now have online videos of all three sessions of a sample NPM course.



JLT: Please describe the evolution of your job.

BF: For 12 years, I was the Director of CSU Extension in Jefferson County. Being the most populous county at the time, managing the Extension office here was a more than full time job, so I did NPM in my "spare" time. Much of the initial database entry was done at my dining room table at home. When my daughter was five, a budget crisis hit, and the State Extension director asked if anyone wanted to go part-time to help save positions. I was very quick to raise my hand. A few years later, when budgets loosened somewhat, I was asked to go back full-time. Of course once I had tasted the forbidden fruit of working part-time, I wanted more! So I asked to continue part-time, and my request was granted with the caveat that I had to give up being Extension director. I did and consider that decision one of the blessings of my life as I've gotten to do mostly native plant and invasive weed education as my primary role but only part-time ever since.

JLT: How did the Jeffco/CSU budget cuts affect the program?

BF: Much of the budget for training and education, travel, memberships, books has been eliminated. NPM generates significant revenue because we have structured it that way due to continued state budget reductions. The future of the program rests on our ability to raise funds to support it.

JLT: How do you see your relationship with CoNPS? More than one member of the Board is a Native Plant Master.

BF: We love our partnership with CoNPS. For many years, we have promoted CoNPS to our students as a great way to take their learning to the next level. We appreciate very

much the support we have received from CoNPS in the areas of marketing and offering our students a free first year membership in CONPS.

JLT: What are your future plans for the program?

BF: We have a long term goal to take the program nationwide. We are seeking funding to expand and improve the program in Colorado. Specifically, we need an online interface for volunteer interaction and program management. Now volunteers send us paper data that we have to manually enter into electronic form. Talk about the 20th century! We're ready to move into the 21st and are seeking funding to do that as well is to broaden the diversity of our clientele and to add a citizen science component.

JLT: What do you think are the most important accomplishments of the NPM program?

BF: Since 2008, participants have reported that they have saved \$1,778,171 by implementing sustainable landscaping and invasive weed control projects on 2,690,205 acres in Colorado. These are real world savings that benefit Coloradans and conserve our limited natural resources such as water while at the same time improving wildlife habitat and restoring native ecosystems. We hope by knowing Colorado's plants better, people are encouraged to care about them and to conserve them in their daily actions that impact the environment.

To Sign up for Native Plant Master Classes

Denver Metro Area classes: <http://npm.eventbrite.com>

Classes in other counties: www.nativeplantmaster.org

Check out the
Colorado Plant Database
<http://coloradoplants.jeffco.us>



The Colorado Plant Database is a free, searchable online database that contains information and images for more than 1,000 Colorado plants. These are some searches available through the Colorado Plant Database:

Name Search - Find plants by family, scientific names or common names. Searches only the name fields in the database

Word Search - Find plants with specific characteristics by doing a word search. Searches all fields in the database.

Blooming Season - A list of plants blooming by season. Click on one of the season's selection buttons. The resulting list is in order by season of bloom and displays both the common and scientific names.

Park Plant List Search - Find park-specific lists of plants at locations where Native Plant Master courses are taught. See www.conativeplantmaster.org for courses at these locations.

Show All Plants - Lists entire content of database.

BOOKS & MEDIA REVIEWS

Flora of the Four Corners Region

Review by Al Schneider

Heil, Kenneth, O'Kane, Steve, Reeve, Linda Mary, and Arnold Clifford. *Flora of the Four Corners Region: Vascular Plants of the San Juan River Drainage: Arizona, Colorado, New Mexico, and Utah*. St Louis: Missouri Botanical Garden Press, 2013. Available from CoNPS Bookstore.

Whether you live near or far from the Four Corners, and whether you are a casual observer of wildflower beauty, a budding amateur botanist, or a professional working in the field, you will enjoy owning this masterfully created book.

The book was 15 years in the making after the scheme was hatched over lunch at the Elk Ridge Café in Blanding in 1996. Major collectors were Ken Heil, Steve O'Kane, Arnold Clifford, and Wayne Mietty, with considerable assistance from Rich Fleming, Cyndie Holmes, Dave Jamieson, Les Lundquist, Lynn Moore, J. Mark Porter, Tim Reeves, and Glenn Rink. The 60+ list of major contributors (especially those writing the individual keys and descriptions) reads like a *Who's Who* of botany.

The 4 pound *Flora* covers the Four Corners region drained by the San Juan River from its head waters at the Continental Divide at 4,292 meters to its confluence with the Colorado River at 1,130 meters, an area of 65,382 square kilometers -- the size of West Virginia. *The Flora* covers this region in 1,098 pages cataloging 120 families and 2,355 taxa (41 endemics). There is a Glossary of 32 pages and over 23 pages of Literature Cited. The heavy stock pages are graced with 118 of Steve O'Kane's superb photographs splendidly reproduced; 200 lovely and valuable line drawings, almost all by Linda Reeves; eleven mesmerizing color botanical illustrations (some full-page) by Carolyn Crawford; a most unusual and ethereal set of fifteen Glenn Vandre landscape watercolors of the vegetation associations and life zones covered by the *Flora*. Inside the front and back covers are full-sized political, topographic, and river maps of the area covered. The type face is large and easy on the eyes.

The introductory material very nicely contains the expected scope of the project, methodology, geology, climate, plant communities, etc. But we also get an unexpected number of other pieces of very thoughtful and welcomed information: a two page list of historical collectors in the San Juan area, a list of endemics, 1 ½ pages defining "weed", plant migration routes, and definitions of measurements, such as: Flower length = Point of insertion of the pedicel to the apex of the longest petal.

Because the *Flora* just came on the scene in September, 2013, I have not had much time to work with its heart and soul, the keys and descriptions, but those I have used and examined are compact, accurate, and helpful. For example, plant keys often require discriminating between annual and perennial plants, but how are we to do that? Certainly most of us can tell

a perennial tree from a *Gilia* but how about a *Gilia* from an *Ipomopsis*? The opening of the *Lupinus* key gives us assistance with that genus by asking us about its cotyledons:

1. Plants annual, the cotyledons commonly persistent

1' Plants perennial, the cotyledons not present at flowering

And let's have a standing ovation for the *Salix* keys, yes, plural "keys": vegetative, pistillate, and staminate keys.

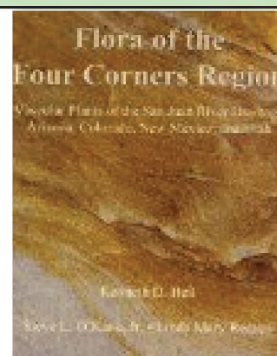
The complete plant descriptions make it easy for the reader to focus in on specific plant parts by capitalizing and bolding key words (**STEMS**, **LEAVES**, etc.). The complete descriptions also include the etymology of the specific epithet, synonyms, habitat, associated plant communities, a list of all the counties in the Four Corners area where the plant has been found (really amazing!), elevation range, flowering time, entire U.S. range, unusual characteristics, and Native American uses.

Nothing is perfect; what are some of the problems in the *Flora*? In some ways the large number of contributors that I mentioned above is good: we get the top experts in each family writing the descriptions. But in other ways, confusion can result -- and does. For example, the Angiosperm Phylogeny Group (APG) recommendations are followed by some contributors (for Scrophulariaceae) but not others (for Chenopodiaceae). Be prepared to be flexible and speak several botanical languages.

Weber & Wittmann's *Colorado Flora* very nicely indicates where its treatment of a family, genus, or species is in conflict with the treatment in the monumental *Flora of North America*. That same contrast and comparison definitely should have been carried out in the *Flora of the Four Corners Region*.

Unfortunately, the keys do not provide a way for you to backtrack when you make a mistake in keying. If, for instance, you arrive at choice #27 in a key and you realize that you are in the wrong place, there is no indication about what number you were at before #27. You cannot easily retrace your steps. Both *Colorado Flora* and Welsh's *Utah Flora* provide this thoughtful and time and frustration-saving numbering in brackets [].

The glossary gives fine definitions (and has some very unusual and welcomed entries, such as, Hawkmoth, disjunct species, relict species, Ramah Navajo, Piki, Park, sub, tuff, Ant Lion, and 2 definitions of herb), but the glossary omits some necessary entries: inflorescence, villous, limb, spp, sp, ssp, dorsal (but ventral is there!), sori, sporophore, trophophore. Scale, awn, and bristle are not defined sufficiently to assist with keying Asteraceae.



The excellence of *Flora of the Four Corners Region* enormously outweighs the few errors. After approximately 20,000 miles of walking, 150 miles of horse riding, and 150,000 miles of driving to, from, and on field trips to collect over 23,000 specimens (including 1,700 county records, 42 state records, and 17 new species), Ken and Steve deserve a great thank you from us and a long rest for themselves. The former they have been receiving; the latter they have not taken, for they immediately began work on a flora of New Mexico, and if all goes well we can expect that in the next few years.

Al Schneider is president of the San Juan/Four Corners Native Plant Society and creator of the Southwest Colorado Wildflowers website (www.swcoloradowildflowers.com).

The Intelligent Plant

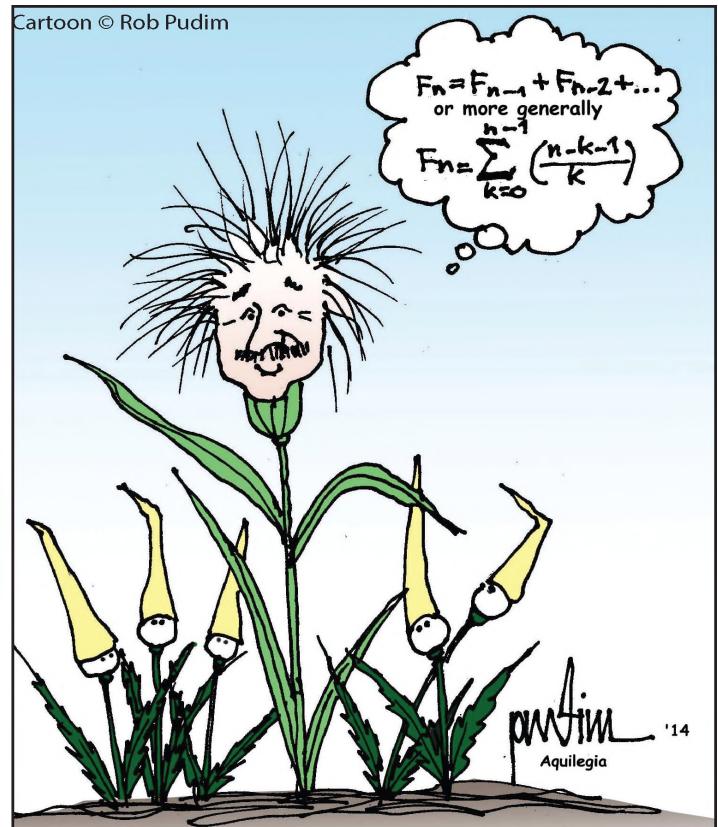
A Report on Michael Pollan's article by Elizabeth Cook

"The Intelligent Plant" by Michael Pollan, *The New Yorker*, December 30, 2013. http://www.newyorker.com/reporting/2013/12/23/131223fa_fact_pollan?currentPage=all

According to this article, "Plants dominate every terrestrial environment, composing ninety-nine per cent of the biomass on earth." They are able to respond to many environmental variables: light, water, gravity, temperature, soil structure, nutrients, toxins, microbes, herbivores, and chemical signals from other plants. Impressed? I am, but the debate in this article suggests that plants can do more. By means of a chemical vocabulary, plants have the intelligence to make choices. "Choice", not mere tropism, is the fighting word. For example, research indicates that when a plant's leaves are chewed by attackers, they have an arsenal of chemicals they can emit in the air. This signals the rest of the plant's leaves to "choose" an appropriate defense. This defense can change the texture and/or flavor of the leaves depending on the saliva of the insect. Or, in the case of antelopes chewing on acacia leaves, the toxicity of the chemical produced in the leaves, varies from being a mere deterrent, to becoming strong enough to kill an antelope, if enough of the tree is in danger from over-grazing.

A definition of intelligence is necessary in order to debate whether this faculty is present in plants. The definition of intelligence falls into two camps, one based on mental abilities that need neurons and a brain [reason, judgment, abstract reasoning] – plants need not apply. The other definition is behavior-based and involves responding in an optimal way to circumstantial challenges. Plants can do this. "Brains", the article points out, "come in handy for creatures that move around a lot; but they're a disadvantage for ones that are rooted in place." "Are we 'cerebrocentric'?" one researcher asks.

What about learning and memory? In an intriguing experiment, Monica Gagliano, who studies how animals learn to habituate, that is to focus on important cues from their environment and ignore irrelevant ones, asked this same question of plants. Sixty-five *Mimosa pudica* (sensitive plants) were dropped 15 centimeters every five seconds for sixty drops. At first, they folded their leaves immediately. However, some



plants reopened their leaves after 4 – 6 drops and eventually, all the plants stayed open during the experiment. After that, they were shaken, and again they closed their leaves. But when they were again dropped, following the shaking, none of the plants closed their leaves. Even after twenty-eight days, when the dropping experiment was repeated, none of the plants closed their leaves. The researcher concluded that learning and memory did not require neurons and a brain. "No," said others, "this is simply adaptive behavior". Ms. Gagliano considers adaptation a generational process. "Adaptation is too slow a process to explain this behavior," she replied.

This interesting article asks the question, "Do capabilities such as intelligence, pain perception, learning, and memory require the existence of a brain... or can they be detached from their neurobiological moorings?" Based on research by Stefano Mancuso, Michael Pollan writes "plants have evolved between fifteen and twenty distinct senses, including analogues to our five..." The evidence is presented in this article. "Plants," says Mancuso "are able to create scalable networks of self-maintaining, self-operating, and self-repairing units."

Research on the question of plant intelligence and signaling is discussed through a wide range of experiments in this article. Pollan concludes "The hypothesis that intelligent behavior in plants may be an emergent property of cells exchanging signals in a network might sound far-fetched, yet the way that intelligence emerges from a network of neurons may not be very different."

This is a fascinating article and the experiments cited explore the question from many intriguing viewpoints.

Elizabeth Cook is Archivist at Regis University Library and curates the CoNPS collection as well as many other special collections. She is an author of children's books and narrates audio books.

Plant-thinking: A Philosophy of Vegetal Life Review by Barb Losoff

Marder, Michael. *Plant-Thinking: A Philosophy of Vegetal Life*. Columbia University Press. 2013.

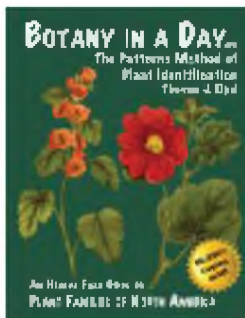
Ancient philosophical discussions on plant life and the 'vegetal soul' may, at first glance, seem arcane and out of touch with contemporary discourse, especially in a world where plants are a commodity (sources of food and fuel). In his book, *Plant-Thinking*, Marder invites us to revisit the philosophical arguments regarding vegetal life (including those of Aristotle, Goethe, Heidegger, and Nietzsche) and question our current views of plant life. Marder's chapters are postulates for vegetal metaphysics and existentiality. Lest one think Marder exceptional in his views, in 2008 the Swiss Federal Ethics Committee on Nonhuman Biotechnology released a report: *The Dignity of Living Beings with Regard to Plants*. This report expressed the need for the "moral consideration of plants for their own sake." Marder's book offers a provocative argument that embraces a new ethic for humans—that we continue to learn from plants and "to live and to think in and from the middle, like a plant partaking of light and of darkness." (p. 178).

Barb Losoff is an Associate Professor in the Science Department of the University of Colorado Boulder Libraries.

Botany in a Day Review by Sarah Myers

Thomas J. Elpel. *Botany in a Day: The Patterns Method of Plant Identification*. Hops Press, LLC; 6th edition (June 10, 2013)
ISBN-13: 978-1892784353; 235 pages

This is a book you will see in the hands of botanists, horticulturists, naturalists, environmental educators, teachers, students, herbalists, and hobbyists alike. With every edition of *Botany in a Day* (currently up to the 6th edition), readers will find improvements and advancements in the text. The new edition has colorful illustrations as well as diagrams and keys to understanding plant morphology and plant profiling. The book is structured in two parts, with the first dedicated to a tutorial covering "The Patterns Method of Plant Identification" and the second, larger portion reserved for the reference guide, "An Herbal Field Guide to Plant Families." The author gives tips in the opening "How to Proceed" section, starting with studying the book's pieces on "Plant Names and Classification" and the "Evolution of Plants." This provides the foundation to understanding how and why plants are placed in groupings by relationships. The next section to absorb is "Learning Plants by Families" which builds practical knowledge on identifying the 8 most common plant families (Mint, Mustard, Parsley, Pea, Lily, Grass, Rose, and Aster). This section helps budding botanists learn how to identify the basic patterns and gives the basis for recognizing the characteristics of each different plant family. The author highlights the plants



that are easiest to learn and also gives tips on places to practice plant identification, such as nurseries, greenhouses, and botanic gardens. The tutorial section could ideally be learned in a concentrated day; or it can be used as a long term study guide for ongoing training and knowledge building. The Reference Guide (Part II), is organized by family name and, beautifully illustrated, covers clade, order, family, and number of species within. Each family description provides pattern identification, history, evolution, biology and reproduction, and naming derivations. Part II extensively covers more than 100 plant families and over 700 genera. This Guide gives readers the ability to potentially identify over 45,000 plant species. Many family sections include a tip for Key Words to serve as a memory device. For example, Key Words for the Beeplant family (Cleomaceae) are "Mustard-like flowers with pea-like pods." Part II of this book is what inspired me to add this to my personal library to help accomplish a goal of learning all the plant family names. Of course, learning how to identify plant families is a key skill in the field, so for me Part 1 was like "icing on the cake."

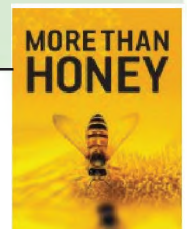
Serving as both a reference book and a field guide, some learners will be able to read through the material and swiftly cover the identification processes to take to the field. Likewise, other readers can take longer than just a day and comfortably work through the book, review content, obtain companion plant identifications books, and make a lifelong study of the plant kingdom. The book also includes a section on medicinal properties of plants, to be used as a primer on edible plants and an introduction to herbalism. This book is likely to be in the hands of - or in the field with - anyone who cares about truly knowing the plants around us, identifying and absorbing their wisdom, and providing information about the environment in which they grow in.

Sarah Myers is a member of the Northern Chapter of CoNPS who works as a digital librarian for a non-profit association and enjoys native plant study, gardening, birding, writing, music, and all outdoor activities in her free time.

Note from Editor: The 6th edition of *Botany in a Day* uses the plant families as recognized by the Angiosperm Phylogeny Group (APG). The APG relies heavily on DNA evidence to determine relationships among plant species.

More Than Honey Video Review by Sarah Myers

More Than Honey is a film that viewers will want to see more than once. With beautiful cinematography and set to the haunting string music of Peter Scherer, the film is an intimate exploration of the life of honey bees (*Apis mellifera*), from migratory bees in the almond orchards of California to the hives of native, wild bees in Switzerland. The film is full of facts about the honey bee's contributions to the world, its relationship to agriculture and horticulture, and its plight-in-progress with colony collapse disorder (CCD).



The film begins on the slopes of the Swiss Alps with an elderly beekeeper who is striving, and yet struggling, to protect the

native black honey bee. The film interweaves the story of the Swiss beekeeper with that of a commercial migratory bee keeper in the U.S. who transports his hives across the country for monoculture-based pollination and who gives the impression of greed and heartlessness toward the bees. Within these stories factual information such as research with bee brain scans, how bees communicate to find nectar sources, and research on honey bees in Australia, the last remaining disease-free honey bees in the world, is included.

The viewer is transported to orchards in China where there are no more honey bees because of the deadly chemicals that have been used; instead, migratory workers play the part of the worker bee. The film shows a beekeeper tending colonies of Africanized honey bees (*Apis mellifera scutellata* aka killer bees) along the Arizona-Mexico border. We learn the importance of biodiversity and the harm to bees caused by monoculture and chemical-based agriculture. Once you have viewed the film, you will value the bees' contributions to our world, from the pollination of beautiful flowers and the flowers of the crops we eat to the production of the liquid gold we know as honey and you will consider the choices you make and how they ultimately affect the honey bee. This is a film to see again and again.

Recent awards of International Association for Plant Taxonomy (IAPT) medals by the Engler-Stafleu Honours Committee (Larry Dorr, Walter Lack, David Mabberley, and chair Rudolf Schmid)

Stafleu medal awarded in 2014 for publications of 2011 and 2012: Charles Boewe (Pittsboro): *The Life of C.S. Rafinesque, A Man of Uncommon Zeal* (2011) and accompanying CD-ROM *The Correspondence of C.S. Rafinesque* (2011)

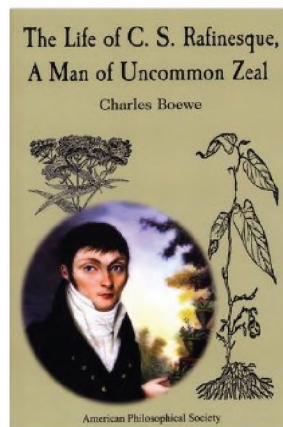
Engler medal awarded in 2014 for publications of 2009, 2010, and 2011: Hong Kong Herbarium & South China Botanical Garden (Hong Kong) (ed.): *Flora of Hong Kong*, 4 vols. (2007-11)

Engler medal awarded in 2014 for publications of 2012 and 2013: H. (Henk) J. Beentje [& al.] (Kew) (ed.): *Flora of Tropical East Africa [FTEA]*, 263 fascs. (1952-2012)

The awards are for outstanding publications in these areas:

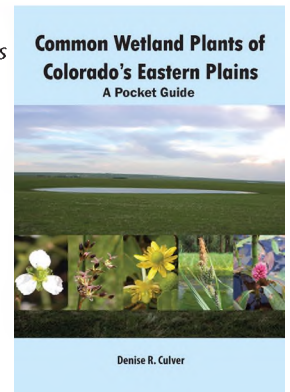
- the Engler Medal in Silver (Engler Medal sensu stricto) awarded for monographic or floristic plant systematics
- the Stafleu Medal awarded for historical, bibliographic, and/or nomenclatural aspects of plant systematics
- the Stebbins Medal awarded for phylogenetic plant systematics and/or plant evolution

From Rudolf Schmid, TAXON 62:1366, 63:219.



Common Wetland Plants of Colorado's Eastern Plains: A Pocket Guide

CNHP is excited to announce the release of the *Common Wetland Plants of Colorado's Eastern Plains: A Pocket Guide* by Denise Culver. The guide complements the comprehensive, *Field Guide to Colorado's Wetland Plants*. The Pocket Guide highlights common wetland plants, both native and non-native located within the Eastern Plains. It is designed to help landowners and other wetland managers correctly identify common wetland plants, manage for preferred species, and control noxious ones. It contains 119 species with 6 key characteristics (with bolded highlights of diagnostic characters), similar species, habitat and ecology comments, and management comments. This project was made possible with a U.S. EPA, Region 8, Wetlands Program Development Grant with in-kind match from the Colorado Parks and Wildlife Wetland Program and Colorado State University.



The Pocket Guide is available for free from CNHP or can be mailed for \$6.00 shipping and handling cost. One can order from the CNHP Wetland Information Center website <http://www.cnhp.colostate.edu/cwic/ident/fieldGuide.aspx> or contact Denise Culver, Denise.Culver@colostate.edu for more information.

Thistles of Colorado: Identification & Management Guide. 2nd ed.

Produced by the Larimer County Weed District, a number of CoNPS members contributed to this excellent color guide to the native and non-native thistles of Colorado. Entries include a description with the distinguishing characteristics in bold, color photos, habitat, range and elevation. It also contains a key to Colorado thistles by Jennifer Ackerfield and an illustrated glossary. The guide is free and is available online <http://www.larimer.org/weeds/FinalTG2ndEd.pdf>



Coming Soon!

Watch for *Wildflowers and Other Plants of the Larimer County Foothills*, available Fall 2014. Volunteers and staff of Larimer County Natural Resources have been working on this field guide of local showy wildflowers, grasses and woody plants for the past few years. Highlights of the guide include more than 120 local species, as well as comparison pages comparing similar species.



SONG

Boraginaceae with the Fuzz on Top

Lyrics by Eric Sundell, music by Richard Rodgers
(To the tune of "Surrey with the Fringe on Top")

When I try and find you in my key,
 Flora here's the way it's gonna be:
 First I take position of your ovulary,
 Then I calculate your symmetry.
 When I key you out Boraginaceae
 When I key you out Boraginaceae
 When I key you out Boraginaceae
 With the fuzz on top,
 I won't key you Scrophulariaceae,
 I won't key you Palmae or Malvaceae,
 Ain't no use to key you Cyperaceae
 With the fuzz on top.
 The petals are yaller and the sepals are green,
 The herbage is glandular pubescent,
 With stamens epipetalous, the fruit is an achene,
 That is to say a nut that's indehiscent.

Carpel, locule, capsule septical,
 Placentation axile or parietal,
 Inflorescence twice as long as widal,
 Oh my eyes will pop
 With that sweet Boraginaceae with the fuzz on the top.

Did you say the pericarp was horned?
 Wouldn't have no other kind but horned!
 Did you say the stems were armed with stipular spines?
 Some like spines, the others more like thorns.

When I key you out Boraginaceae
 When I key you out Boraginaceae
 When I key you out Boraginaceae
 With the fuzz on top,
 I won't key you Scrophulariaceae,
 I won't key you Palmae or Malvaceae,
 Ain't no use to key you Cyperaceae
 With the fuzz on top.

The wind is awhisperin' in the scorpioid raceme,
 A bee's in the sympetalous corolla,
 When Lyle and Dr. Pinkava appear upon the scene,
 And Elinor preserves it in a folder.

Carpel, locule, capsule septical,
 Placentation axile or parietal,
 Take this lab you must be suicidal,
 Cause it just don't stop,
 With that sweet Boraginaceae with the fuzz on the top.



Boraginaceae Song

The Boraginaceae song was inspired by Dr. Donald Pinkava's Arizona Flora course at Arizona State University. A group of us sang it in the last lab of the semester, spring 1972- -my first look at flowers under the brilliant light of a dissecting microscope. (I switched from a wildlife biology major to botany that semester.) Lyle [McGill] was the T.A. in our section--well, at least Lyle was the most colorful of Dr. Pinkava's grad students. A Ph.D. student who ended up in Lafayette, LA when I was at Tulane might have been the T.A. And of course Elinor [Lehto] was down the hall in that little herbarium office space. I put it on the computer to have a copy ready at hand but never risked getting it out again, even for my own Arkansas Flora labs.



Eric Sundell, Professor Emeritus, Biology, University of Arkansas at Monticello.

Thanks to Sally L. White for contacting Dr. Sundell for permission to print these lyrics in *Aquilegia*.

Sally L. White and Jan Loechell Turner of *Aquilegia* both have fond memories of Dr. Pinkava's Arizona Flora course during their graduate students days at ASU in Tempe, Arizona.

Cryptantha cinerea Photo © Charlie & Jan Turner

Rachel Carson

Rachel Carson passed away 50 years ago on April 14, 1964. As author of *The Silent Spring*, she brought awareness to the public about the dangers that pesticides pose to the environment. This eventually led to a ban on DDT in the United States. Carson was a biologist with the U.S. Fish and Wildlife Service.



Photo from U.S. Fish & Wildlife Service, <http://digitalmedia.fws.gov/>

Onosmodium items continued from page 27

- PLANTS database (<http://plants.usda.gov>) now lists *Onosmodium molle* as *Onosmodium bejariense*.
- In *Flora Neomexicana III* (2012) on p. 211, Kelly Allred states: "Recent molecular studies have shown that this genus is fully immersed within *Lithospermum, q.v.*"



Colorado Native Plant Society

The Colorado Native Plant Society is dedicated to furthering the knowledge, appreciation and conservation of native plants and habitats of Colorado through education, stewardship and advocacy.

Membership is open to all with an interest in our native plants and is composed of plant enthusiasts, both professional and non-professional.

The Colorado Native Plant Society was founded in 1976.

CoNPS Administrative Assistant Linda Smith CoNPSoffice@aol.com 970-663-4085

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AQUILEGIA: Newsletter of the Colorado Native Plant Society

Aquilegia is the newsletter of the Colorado Native Plant Society and is available to members of the Society and to others with an interest in native plants. Four regular issues are published each year (Spring, Summer, Fall, Winter) plus a special issue for the Society Annual Meeting held in the Fall.

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 author and attributed to *Aquilegia*.

The deadline for the Fall issue is August 15. Announcements, news, articles, book reviews, poems, botanical illustrations, photographs and other contributions should be sent to Jan Loechell Turner,, Editor, at JLTurner@regis.edu

Aquilegia Staff: Jan Turner, Charlie Turner, Sally L. White, Linda Smith, Rob Pudim, John Vickery, Nan Daniels, Mo Ewing, Sarah Myers

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Become Involved in CoNPS! We Need You!

Conservation Committee:

Volunteers needed to monitor issues affecting native plants and their habitats.

Volunteers needed to help write articles for the "Conservation Corner" column in *Aquilegia*.

Aquilegia:

Need additional volunteers to proofread and write articles.

Need volunteer who can assist with layout and design using Adobe InDesign CS6. Must have own copy of software.

To volunteer for the Conservation Committee call Mo Ewing and for *Aquilegia* contact Jan L. Turner.

Join the Colorado Native Plant Society



Membership in CoNPS entitles you to:

- Subscription to the CoNPS newsletter, *Aquilegia*
- Field Trips to see wildflowers
- Educational Workshops by expert botanists
- Annual Conference
- Conservation and Restoration Activities
- Camaraderie of Plant Lovers from Colorado
- Local Chapter Educational Programs & Email Updates

MEMBER APPLICATION FORM

Name(s).....

Address

City.....State.....Zip

Phone ___ - ___ - ___ E-mail

MEMBERSHIP CLASS

Dues cover a 12-month period.

- Individual (\$20)
- Family / dual (\$30)
- Senior (65+) (\$12)
- Student (\$12)
- Organization (\$30)
- Supporting (\$50)
- Lifetime (\$300)

CHAPTERS

You are free to affiliate with any chapter you choose and to attend the meetings of any chapter. Chapters do not have drawn map boundaries.

Boulder Gore Range Metro-Denver Northern Plateau Southeast Unaffiliated

Send information about **volunteer opportunities**

OPTIONAL PRINT DELIVERY OF AQUILEGIA NEWSLETTER

Most members prefer to receive the newsletter electronically via e-mail (pdf file), and this saves the Society considerable printing and postage expense. If you would like to receive a print copy of the newsletter instead, check this box. Please note that print copies usually arrive about a week later than the electronic version. Please deliver a printed copy of *Aquilegia* by mail.

DONATION

\$_____ General Fund

Endowments in support of small grants-in-aid of research:

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

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

\$_____ **TOTAL**

Mail to: CoNPS Office, P.O. Box 200, Fort Collins, CO 80522.

Please make checks payable to "Colorado Native Plant Society." Dues and contributions are tax-deductible.

CONPS 2014 CALENDAR

JULY 2014

July 6 Lady Moon Trail (near Red Feather Lakes) (N)
July 7-13 Crested Butte Wildflower Festival See their website:
<https://www.crestedbuttewildflowerfestival.com/>
July 9 Butler Gulch 8 a.m. - 3 p.m. (MD)
July 9 Bobcat Ridge Natural Area (N)
July 10 Caribou Ranch 5:30 p.m. (B)
July 12 Walker Ranch Weed Pull (B)
July 12 (date subject to change) Flora of Horseshoe Cirque
7:30 a.m. - 2 p.m. (MD)
July 12 N. Cheyenne Canyon, Buffalo Creek (SE)
July 12 San Juan Mountains (P)
July 12 Upper Echo Basin Mine Road (SJ)
July 12 & 13 Digital Photography Workshop (GR)
July 12 & 13 Wildflower Walks (GR)
July 13-19 Guild of Natural Science Illustrators Ann. Mtg. (B)
July 14- 17 Canada Thistle Monitoring at Upper Beaver
Meadows (See page 5)
July 16 Annual Pass Creek Trail (SJ)
July 18 ID of Riparian & Wetland Plants Workshop (p.12, Spring
issue)
July 19 Golden Gate State Park 8 a.m. - noon (MD)
July 19 The Crags (SE)
July 20 Butterflies, Wildflowers & Host Plants, S. Mesa Trail (B)
July 21-31 Bear Lake Road Monitoring - Moraine Park to Glacier
Basin (See page 5)
July 22 Alpine area above Silverton (SJ)
July 22-23 High Altitude Revegetation Summer Field Tour (B)
July 23 Pass Lake Wildflower Hike (GR)
July 24 Hoosier Ridge - West 7 a.m. - 5 p.m. (MD)
July 25 - 27 Shelf Lake area and optional camping (MD)
July 25 La Plata Canyon, Columbus Basin (SJ)
July 26 Geneva Basin Iron Fens 7:30 a.m. - 5 p.m. (MD)
July 26 Blue Lake Trail (Cameron Pass area) (N)
July 29-30 Wetland Plants ID class, Boulder (See page 12)
July 30 Annual Telluride trip (SJ)
July 31- Aug. 2 Native Plant Society of NM Meeting, El Paso, TX

Volunteers needed to run the Silent Auction

at the Annual Meeting

Donation of items also needed

Please contact Connie Gray to volunteer at
cpowersgray@gmail.com

WACKER RANCH PLANTS

Answers from Quiz on back cover:

1. *Astragalus praelongus*
2. *Castilleja chromosa*
3. *Erysimum capitatum*
4. *Cryptantha paradoxa*
5. *Lepidium montanum*
6. *Oenothera caespitosa*
7. *Phlox longifolia*

AUGUST 2014

Aug. 2 Grasses of Green Mountain Park (MD)
Aug. 2 Bolam Lake Meadows via Hermosa Creek Pass (SJ)
Aug. 3 Ouzel Falls at Rocky Mountain Nat. Park (N)
August 4-8 Toadflax monitoring at Hallowell Park (See page 5)
Aug. 9 Lichens 9 a.m. - noon (B)
Aug. 13 Maxwell Natural Area (N)
Aug. 15 Deadline for CoNPS Photo Contest Submissions
Aug 16 Putney Gulch, south of the Crags (SE)
Aug. 19-20 Wetland Plant ID Course, Colorado Springs (p. 12)
Aug. 23 Lower Dadd Gulch Trail (Poudre Canyon) (N)
Aug. 23 Rampart Range old-growth on the Pike (SE)
Aug. 23 Mushroom trip near Lizard Head Pass (SJ)
Aug. TBD - Grand Mesa (P)

SEPTEMBER 2014

Sept. 6 Ranson Edwards Open Space 8:30 a.m. - noon (MD)
Sept. 7 Pawnee Buttes (N)
Sept. 10 Ramsay-Shockey Open Space (N)
Sept. 20 Plant Sale & Seed Swap, Boulder (See page 5)
Sept. 27 Soapstone Prairie, City of Fort Collins Nat. Area (N)

OCTOBER 2014

Oct 3-5 The CoNPS Annual Meeting & Colorado Rare Plant Symposium, Fort Collins

Oct. 3 Colorado Rare Plant Symposium
Oct. 4 CoNPS Annual Meeting (Conference)
Oct. 5 CoNPS Annual Meeting (Field Trips)
Oct. 18 Castlewood Canyon State Park 10 a.m. - 3 p.m. (MD)

KEY

| | |
|----|-----------------------|
| B | Boulder Chapter |
| GR | Gore Range Chapter |
| MD | Metro-Denver Chapter |
| N | Northern Chapter |
| P | Plateau Chapter |
| SE | Southeast Chapter |
| SJ | San Juan/Four Corners |

Enter the CoNPS Annual Photo Contest!

The deadline for the 2014 Colorado Native Plant Society Photo Contest is August 15, 2014. There are two categories: Colorado Native Plants and Colorado Native Plant Landscapes/Habitats. The first place prize for each category is \$50. Please submit entries to: conpsphotocontest@gmail.com. Entry forms and rules can be found on the CoNPS website (conps.org). Only CoNPS members may participate. Not a member? Join using the form on page 25 or join online at <http://www.conps.org/Membership/index.shtml>

PLANT PROFILES - Which is Which? by Jan Loechell Turner

On a CoNPS field trip at Red Rocks Park in May, one of the participants wondered how to tell Scorpionweed (*Phacelia heterophylla*) from Marbleseed (*Onosmodium molle*). They are both hairy/prickly with deeply veined leaves and whitish flowers. Here are clues!

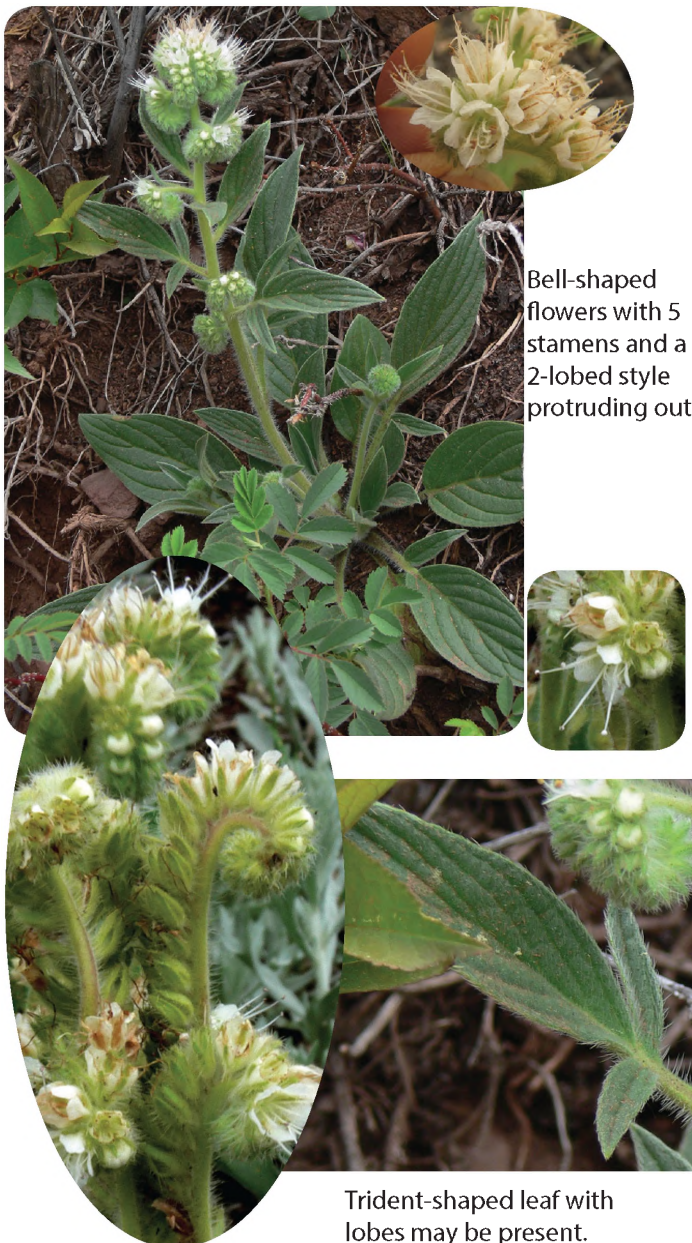
Scorpionweed *Phacelia heterophylla*

Waterleaf Family (Hydrophyllaceae)

Scorpionweed is a member of the waterleaf family. It can have two different kinds of deeply veined, hairy, alternate leaves: some are entire (with no lobes); there may also be trident-shaped leaves with a pair of lobes at the base and these are typically on the lower part of the stem. The flowers (usually off-white) have five stamens and they are exserted, extending out beyond the corolla. The flowers are arranged in helicoid cymes like the coiled tail of a scorpion. One tall, erect stem may be accompanied by smaller stems at the base.

CLUE: 5 stamens protrude from each bell-shaped flower.

CLUE: can have 2 different kinds of leaves ("heterophylla" means different leaves) - entire and trident-shaped.



Bell-shaped flowers with 5 stamens and a 2-lobed style protruding out

Trident-shaped leaf with lobes may be present.

Marbleseed (False Gromwell) *Onosmodium molle*

Borage Family (Boraginaceae)

Marbleseed is a member of the borage family. It has hairy, deeply-veined, entire, alternate leaves; unlike scorpionweed it has no trident-shaped leaves. The stamens of the whitish to greenish flowers are not exserted because the corolla narrows to enclose them with only the style protruding out. The flowers are in a coiled cyme with leafy bracts.

CLUE: only a style (1) protrudes from each tubular, hairy flower; the hairy green calyx is 5-lobed.

CLUE: only has one kind of leaf - all of the leaves are entire (no leaves with lobes).



Tubular flowers have one protruding style. The inflorescence contains leafy bracts.

See bottom of p. 23 for more about *Onosmodium*.

Photos on this page © Charlie and Jan Turner



Colorado Native Plant Society

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Wacker Ranch Photo Album by Lenore Mitchell, CNAP Volunteer



Can you identify these plants?
Answers on page 26.