

Aquilegia

Magazine of the Colorado Native Plant Society

Volume 46 No. 4 Fall 2022





2022 Photo Contest

Winners Front Cover: 1st place.

Clockwise from top left. **Native Plants:** *Silphium laciniatum* (compass plant) by Jim Pisarowicz; **Wildlife:**

Tradescantia occidentalis (spiderwort) by Bill Bowman; **Landscapes:**

Helianthus petiolaris (prairie sunflower) by Lucas Wheeler;

Artistic: *Populus tremuloides* (quaking aspen) by Sue Keefer;

Gardens: *Argemone polyanthemus* (prickly poppy) by Jim Pisarowicz.

This page: 2nd place. Counter-clockwise from top right. **Gardens:**

Asclepias tuberosa (butterfly weed) by Susan Tamulonis; **Artistic:**

Hesperostipa neomexicana (New Mexico feathergrass) by Ron West;

Landscapes: *Coreopsis lanceolata* (lanceleaf coreopsis) and *Quercus gambelii* (Gambel's oak) by Carol McGowan;

Wildlife: *Castilleja integra* (wholeleaf Indian paintbrush) by Rick Brune. **Back cover: 2nd place (tied).**

Clockwise from left. **Native plants:**

Gentianopsis barbellata (perennial fringed gentian) by Stan Wagon; *Salix planifolia* (plane-leaf willow) by Celia Greenman;

Echinocereus coccineus (claret cup) by Donald Barnett.

Aquilegia: Magazine 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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Editor's Note: To improve readability, weblinks, when included, are now provided at the end of each article rather than written out in full within the text. Text that refers to a weblink will be highlighted in bold and in color. These weblinks can still be directly accessed in the digital copy of *Aquilegia*.

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Featured Story

19TH Annual Colorado Rare Plant Symposium Recap By Jessica Smith and the Botany and Vegetation Ecology Team at CNHP

This year's symposium was held on Friday, September 16, the day before the CoNPS annual meeting, at the Longmont Museum. More than 90 people attended the meeting; for many, this was their first time at the Rare Plant Symposium. Jessica Smith, from the Botany and Vegetation Ecology Team at Colorado Natural Heritage Program, kicked off the meeting with a welcome and then a short tribute to CNHP Senior Botanist Jill Handwerk, who is retiring at the end of the year. Jill has been instrumental in the planning and organization for all the Rare Plant Symposia from 2004 through 2022.

Presentations commenced with a photo review of globally rare plants of northeastern Colorado by Susan Panjabi, botanist with CNHP. Summary information was presented on each taxon listed in the table below, including a distribution map, photos of the plant and habitat, last observation date, population-size estimates, management concerns, and land

ownership. Meeting attendees participated in a discussion of each taxon, adding information on recent observations. In the table below, the G rank refers to the global rarity of the species, and S refers to state rarity, with a 1 indicating critically imperiled, 2 indicating imperiled, and 3 indicating vulnerable. For more information on ranks, see [NatureServe's website](#). Herbarium specimens for each taxon, provided on loan by the University of Colorado Herbarium, were also available for reference.

Additional data and photos are needed for all these taxa, and CNHP welcomes efforts from the Colorado Native Plant Society and others to help expand our knowledge of these plants through targeted field surveys and observations. See the CNHP website for ways to [submit data](#) or contact Susan at susan.panjabi@colostate.edu to contribute information on these species. ►

Scientific Name	Common Name	G-rank	S-rank
<i>Aletes humilis</i>	Larimer aletes	G2G3	S2S3
<i>Aquilegia saximontana</i>	Rocky Mountain columbine	G3	S2
<i>Astragalus sparsiflorus</i>	Front Range milkvetch	G2G3	S2S3
<i>Carex oreocharis</i>	Grassy slope sedge	G3	S3
<i>Draba globosa</i>	Rockcress draba	G3	S1
<i>Eriogonum exilifolium</i>	Dropleaf wild buckwheat	G3	S3
<i>Lomatium nuttallii</i>	Nuttall's desert-parsley	G3	S2
<i>Mentzelia speciosa</i>	Jeweled blazingstar	G3	S3
<i>Mimulus gemmiparus</i>	Rocky Mountain monkeyflower	G1	S1
<i>Oenothera coloradensis</i> (<i>Gaura neomexicana</i> ssp. <i>coloradensis</i>)	Colorado butterfly plant	G3T2	S1S2
<i>Oonopsis wardii</i>	Ward's golden-weed	G3	S1
<i>Parthenium alpinum</i>	Alpine feverfew	G3	S2
<i>Phacelia denticulata</i>	Rocky Mountain phacelia	G3	S3
<i>Phacelia formosula</i>	North Park phacelia	G2	S2
<i>Potentilla ambigens</i>	Southern Rocky Mountain cinquefoil	G3	S2
<i>Potentilla rupincola</i> (<i>Potentilla effusa</i> var. <i>rupincola</i>)	Rocky Mountain cinquefoil	G5?T2	S2
<i>Sisyrinchium pallidum</i>	Pale blue-eyed grass	G3	S3
<i>Spiranthes diluvialis</i>	Ute ladies' tresses	G2G3	S2

◀ Presentations from rare plant conservation partners followed. Carol Dawson, botanist at the Bureau of Land Management, provided an update on the BLM's new Threatened and Endangered Species Program strategic plan, the Seeds of Success program, and new initiatives on pollinator conservation.

Raquel Wertsbaugh, Colorado Natural Areas Program coordinator for Colorado Parks and Wildlife, discussed CPW's new conservation dashboard, which tracks conservation actions for Colorado's Species and Plants of Greatest Conservation Need, Recovering America's Wildlife Act, and conservation actions being led by CNAP for several globally rare plants.

Sami Naibauer, University of Northern Colorado researcher, presented the results of genomic investigations of *Draba weberi* (Weber's draba) and *Corispermum navicula* (cresen, two taxa that their research has shown not to be distinct species. Slides from these and all meeting presentations are available on the **CNHP website**.

Following lunch, Becky Hufft, botanist with the Denver Botanic Gardens, presented an update on the ongoing rare plant conservation actions of the gardens, including monitoring for several globally rare plants, ex situ seed collections, rare alpine plant species climate research, and restoration research. Two publications from the gardens' botanists, the second edition of Jennifer Ackerfield's *Flora of*

Colorado, and a revision of Harrington and Durrell's 1944 "Key to Some Colorado Grasses in Vegetative Condition" by Janet Wingate are forthcoming.

Ross McCauley, professor of biology at Fort Lewis College, provided an update on the conservation genetics of rare *Astragalus* species in Southwestern Colorado, discussing the genetic diversity of populations across the species range for *A. schmollae* (Schmoll's milkvetch), *A. deterior* (Cliff Palace milkvetch), and *A. tortipes* (Sleeping Ute milkvetch).

Next was a presentation about a project to investigate the speciation of a hybrid between *Physaria vitulifera* (fiddleleaf twinpod) and *P. bellii* (Bell's twinpod), which has been made possible through a collaboration of several organizations. This presentation was made by Pam Smith, CNHP botanist; Tanner Marshall, Jefferson County Open Space botanist; and Mit McGlaughlin, University of Northern Colorado associate professor.

Emily Griffoul, conservation scientist with the Betty Ford Alpine Gardens, capped the session with an update on the North American Botanic Garden Strategy for Alpine Plant Conservation.

Colorado Natural Heritage Program botanists then showcased several tools and resources available to facilitate rare plant conservation. Jessica Smith presented updates on a species distribution modeling project, which has resulted in a model for each of Colorado's Plants of Greatest Conservation Need and the inclusion of the models in CNHP's **Conservation Data Explorer** tool. She also

introduced the idea of holding a collaborative workshop of rare plant monitoring practitioners to produce a series of templates for monitoring protocols based on ecological niche. Georgia Doyle updated the group on changes to the rare plant tracking list between 2020 and 2022, the revised description of *Descurainia kenheilli* (Heil's tansy mustard), and how to contribute data to CNHP with iNaturalist. Susan Panjabi walked the group through the new and improved format of the online Rare Plant Guide and discussed available new and updated profiles. She also described the Siegele Conservation Science Internship program, hosted at CNHP, which is accepting partner organization mentors.

The final presentation of the day was on the natural history and distribution of *Telesonix jamesii* (James' alumroot) by Andrew Gaier, a graduate student at the University of Colorado Boulder. Andrew presented his findings on the pollination ecology of the species and species distribution models informed by various sources of distribution data.

Weblinks:

NatureServe:

https://help.natureserve.org/biotics/content/record_management/Element_Files/Element_Tracking/ETRACK_Definitions_of_Heritage_Conservation_Status_Ranks.htm

Data submission:

<https://cnhp.colostate.edu/ourdata/contribute-data/>

CNHP Rare Plant Symposia:

<https://cnhp.colostate.edu/projects/colorado-rare-plant-symposia/>

CODEX website: <https://cnhp.colostate.edu/maps/codex/>



Spiranthes diluvialis (Ute ladies' tresses). © Dee Malone, CNHP

Featured Story

Recap of the 46TH CoNPS Annual Conference

Below are summaries of the 46TH CoNPS annual conference, which occurred on September 17. Summaries, written by CoNPS volunteers, are organized by the order of the presentations.

Conference Overview and Introduction Presented and Reported by Pat Butler

The Boulder chapter welcomed conference participants, noting that with almost half of the state's vascular plants and terrain stretching from alpine to grassland, Boulder County is the subject of ongoing ecological research. The conference speakers explored the experience of flora in this array of ecosystems, with a focus on their response to natural and human disturbance. From the opening presentation on "Disturbance, Plants, and the Butterflies That Love Them," to the concluding observations by Ava Hamilton from the Arapaho Tribe, "The Cycles of Life—Everything is Related," speakers invoked the notion of the "butterfly effect" of the world's interrelationships as we collectively face impacts of climate change and other environmental forces on the state's flora.

In addition to the conference presentations, the bookstore, silent auction, and photo contest were popular hubs of activity. The money raised at the silent auction and the bookstore will support the CoNPS missions of knowledge and conservation.

We also witnessed the presentation of a lifetime achievement award to Linda Smith. Linda was the first paid employee of CoNPS, serving as administrative coordinator for about 13 years. Her friendliness served our society well, since she was often the first point of

contact for many people. Unfortunately, Linda could not attend the conference in person, so Mo Ewing accepted the award on her behalf.

Many thanks go to the Boulder Chapter steering committee (Sam Ahler, Laurel Brigham, Pat Butler, Alyson Ennis, Debby Martin, Jackie Ramaley, Lynn Riedel, and Anna Theodorakos, with assistance from Denise Wilson) and the conference volunteers (Megan Bowes, Erica Cooper, Jenny Favell, Barbara Gardner, Hazel Gordon, Anna Mahorski, Sharon O'Brien, and Janette Wesley). Special thanks go to Justin Veach and Jim Fladmark from the Longmont Museum; Tom Schweich, presentations manager; Anna Theodorakos, photo contest manager; Sue Dingwell, auction manager; Patrick Murphy, bookstore manager; and the Community Table Kitchen.

Disturbances, Plants, and the Butterflies That Love Them

Presented by Christian Nunes
Reported by Alan Moores

Leaning on the definition of a "disturbance" as "an abiotic event that kills or damages some individuals and thereby creates opportunities for other individuals to grow and reproduce," City of Boulder wildlife ecologist Christian Nunes takes the more sanguine, possibly more contrarian, view that events such as avalanches, floods, fires, and rockslides can result in positive "successions" that support higher species diversity, particularly where butterflies are concerned.

As examples, he pointed to both the Anasazi skipper (*Ochlodes yuma anasazi*), whose larvae rely on *Phragmites* spp. (common reed), and the hops azure butterfly (*Celastrina humulus*), which lays its eggs on the flowers of male wild hops (*Humulus lupulus*). In both cases, Christian said that the floods of 2013 ►



Maggie Gaddis presenting Mo Ewing with Linda Smith's lifetime achievement award. © Jim Pizarowicz



Hops azure butterfly (*Celastrina humulus*) on a wild hops bine (*Humulus lupulus*). © Christian Nunes

◀ scoured riverbeds and downed trees, which allowed the reeds and hop vines to flourish. As a result, these butterfly populations increased.

Moderate fires remove woody vegetation and allow fire-adapted shrubs, forbs, and grasses to proliferate, said Nunes. He cited buckbrush (*Ceanothus* sp.), which provides food to at least eight species of butterfly, but whose seeds germinate only when exposed to temperatures between 176°F and 203°F. Fire suppression also suppresses the lepidopteran diversity of a site.

Wide-scale tree mortality can likewise support more butterfly species by allowing for more growth of understory plants, Christian argued, pointing out that beetle outbreaks on both pines and spruces have allowed the Scudder's sulphur butterfly (*Colias scudderi*) to “explode in abundance.”

Even irrigated fields used for grazing can diminish the growth of woody plants and, when mowed, encourage the fresh growth of plants like milkweed. And pockets of unmowed grass can provide rich habitat for butterflies, Christian pointed out.

“Of course,” Christian admitted, “with any disturbance there are losers.” One “loser” he cited is the jutta arctic butterfly (*Oeneis jutta*). This butterfly is dependent on dense lodgepole pine forests, and has therefore become critically imperiled following pine beetle outbreaks.

All of which is to say that while such abiotic (and biotic) events can be devastating to many of the flora and fauna of a region, they can be beneficial to others.

“A deeper understanding of the ecological connection between disturbance, plants, and butterflies, and so much more,” Christian said, “can help land managers decide where, when, and how much disturbance to apply to managed landscapes.”

Alpine Plant Responses to Changing Climate: Long-Term Trends and Experimental Insights from the Niwot Ridge LTER Program

Presented by Nancy Emery

Reported by Stephanie Mayer

Professor Nancy Emery from the Department of Ecology and Evolutionary Biology at CU Boulder presented some of the amazing data that have been accumulated since the establishment of the Niwot Ridge Long-Term Ecological Research Network at the University's Mountain Research Station.

The MRS is 25 miles northwest of Boulder and is one of few sites that collects long-term information about alpine weather and organismal responses to changes



Winter measurements at Niwot Ridge D-2 meteorological station. © John Marr

in the weather. One might expect alpine plants to be more vulnerable to climate change because the alpine environment is very harsh, with short growing seasons; long, cold winters; and high levels of irradiation. Also, snowfall is quite variable from year to year, and there is evidence that mountains might be warming faster than non-mountainous areas. However, it appears that alpine plants are quite adaptable to variable environments. The rugged terrain of alpine areas generates much fine-scale structure, including fellfields, dry meadows, snow beds, moist meadows, and wet meadows. Alpine plants may be able to change their distribution just a few centimeters to find a new appropriate habitat.

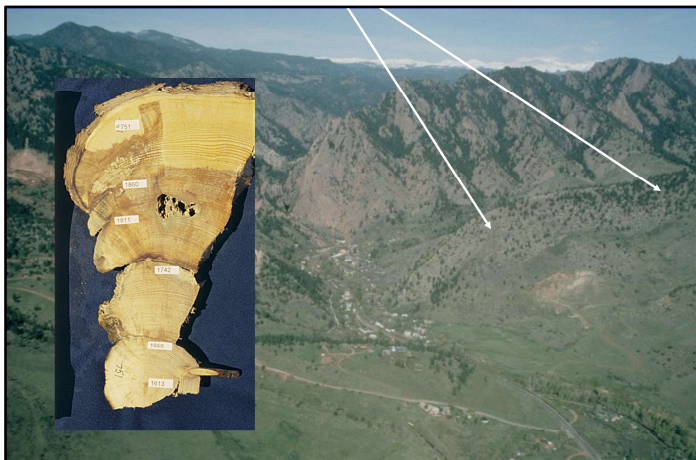
The MRS LTER began monitoring atmospheric CO₂ in the 1950s, making it the longest record of atmospheric CO₂ levels in the country. There are 42 data sets being collected, ranging from pika behavior and ecology to plant diversity. Nancy mentioned a few of those datasets, such as timing of snowmelt, snow depth, soil moisture and temperature, annual surveys of plant species, and the phenocam. The phenocam documents greening up of alpine plants using a system of time-lapse cameras that sense vegetation greenness. Some changes that have been noted include increased shrubification (expansion of shrubs) and its effects on soil moisture and compositional and phenological shifts that vary across the landscape.

The Challenge of Shifting from the Forest Restoration Narrative to an Evidence-Based Climate Adaptation Paradigm in Colorado

Presented by Tom Veblen

Reported by Jenifer Heath and Kelly Ambler

Dr. Thomas Veblen is a geographer and distinguished professor emeritus at CU Boulder, with an interest in vegetation dynamics in relation to natural and anthropogenic disturbances, especially as related to climate variability. His laboratory has reconstructed ▶



Cross-section of a fire-damaged tree from the lower montane ecotone. © Tom Veblen

◀ the occurrence of fires, beetle outbreaks, and droughts over centuries using tree-ring data. These data are correlated with data obtained from monitoring long-term forest plots.

The retrospective data show that the frequency and severity of fires varied with forest type. The lower-elevation montane forests experience more frequent, but usually low-intensity, fires. The regular fires reduced fuel buildup and maintained an open, park-like forest. The upper-montane regions experience fires less frequently and with variable severity; the fires in this region had a large impact on shaping the forest. The subalpine forests were subject to fires very infrequently. When these fires occurred, they often destroyed entire stands of trees. The primary causation of subalpine fires was weather, not fuel levels.

Based on tree-ring data, Tom found that beetle outbreaks (such as those of bark beetles) have been common historically, and driven primarily by climate at the regional scale, such as drought. Even very large-scale beetle outbreaks are natural and cannot be entirely attributed to fire-suppression efforts. Bark beetle outbreaks have led to virtually no conversion from forest to non-forest shrublands or meadows, but rather result in shifts in the relative dominance of various species. “Beetle outbreaks, even at the regional scale, are the historical norm,” he explained, noting that background tree mortality has been driven by drought and warmer temperatures (climate change).

“We cannot avoid the worst consequences of climate change,” Dr. Veblen cautioned. “We *will* see change.” And as the impacts of climate change mount, it is important that we be intentional about our approach to managing our forests.

Veblen shared his perspective on this process in the context of one of several evaluation frameworks: **Resist, Accept, or Direct**, also known as RAD. The

Resist approach requires proactive management to keep ecosystem structure and function as they have been or as they are now. Actions hewing to this approach include thinning forests, removal of fire fuels, and firefighting. The Accept approach relies on nature-based solutions, avoiding human intervention, and accepting the resulting changes in ecosystem structure and function. In the Direct approach, managers intervene to accept change in ecosystem structure and function while actively steering that change toward preferred new conditions.

Our dominant strategy to date has been to resist fires. Thus, we practice mechanical fuel reduction and prescribed burns, along with some limited grazing.

In the past, the goal was to restore the forest to the same conditions that were lost to a fire. Modeling based on data from forest plots suggest that forests are not regenerating following extensive fires. Veblen emphasizes that now is the time to talk about the big questions, such as whether we want to reforest former subalpine forests or instead accept the loss of conifer forest to be replaced with aspen forest.

As Tom pointed out, each type of tree is adapted to specific combinations of environmental and climatic conditions that allow it to grow, thrive, and reproduce. The rapid pace of climate change may exceed the ability of many species to adapt in place or to migrate to suitable habitats, and this raises the possibility of extinction or local extirpation of species. Based on his data, evaluations, and experience, Veblen suggests that changes to land-use zoning and building codes, along with the hardening of homes, may be a better choice, and that acceptance of more managed wildfires should be pursued. In addition, he advocates for investing more resources in assisted migration—i.e., human-assisted movement of species in response to climate change.

Weblink: <https://www.nps.gov/subjects/climatechange/resistacceptdirect.htm>

State of the Society

Presented by Maggie Gaddis

Reported by Stephanie Mayer

Dr. Maggie Gaddis, Executive Director of the Colorado Native Plant Society and an instructor at CU Colorado Springs, opened the second half of the conference with a presentation about the mission and activities of the society. She welcomed all to the conference, especially those who weren't already members of CoNPS, and began the presentation with a fun interactive activity for people to self-identify their interests. She noted that CoNPS was founded in 1976, with John Marr, a former professor of biology at CU Boulder, as its first president. The organization is ►



Maggie Gaddis.
© Jim Pisarowicz

◀ run by a board of directors consisting of an operating committee (in lieu of a president and vice-president), board members at-large, and chapter leaders.

CoNPS is structured around two main organizing groups: chapters and committees. There are seven chapters across the state, organized by geography; Maggie

wants to create an eighth, an intermountain chapter. There are 10 committees: Annual Conference, Conservation, Education, Field Studies, Finance, Grants, Horticulture, Media, Restoration, and Scholarship.

The CoNPS website, <https://conps.org/>, has many resources, including information on Colorado's native plants and habitats, gardening with native plants, and access to digital copies of the society's magazine, *Aquilegia*. *Aquilegia* is published quarterly and includes a wide range of articles. Members can publish results of their research in the magazine, a big bonus for college students who need recognition for their work. CoNPS also has a social media presence on Facebook, Twitter, Instagram, LinkedIn, and Scistarter.org.

One of the greatest needs that Dr. Gaddis sees is to generate native seeds for restoration because they are generally not available commercially. CoNPS is partnering with nurseries and municipal horticulture departments to increase native plant availability through seed donations and CoNPS volunteerism. Maggie's own research in dryland seed bank and riparian restoration involves college students at UCCS.

Mechanisms of Change: How Disturbance and Drought Shape Current (and Future) Plant Communities in Diverse Front Range Grasslands

Presented by Julie Larson
Reported by Stephanie Mayer

Dr. Larson began this work while pursuing her PhD at CU Boulder. She worked in the City of Boulder Open Space & Mountain Parks xeric tallgrass prairie to investigate the impact of grazing on vegetation. The City of Boulder leases more than 15,000 acres to farmers with grazing animals. Julie was interested in how to manage grazed lands in the face of increasing drought. She created paddocks with three grazing



Front Range study area. © Julie Larson

treatments and three rainfall treatments, collecting data from 2018 to 2021. Her principal question was, "How do plant communities respond to interacting rainfall and grazing conditions?" She found that spring grazing reduces biomass, especially in very dry years, and dry conditions reduce overall plant biomass. Delayed grazing reduced vegetation loss and led to positive responses to wet conditions. Annuals and biennials increased quickly under drought and grazing treatments. C4 grasses had the most stable response to grazing and drought treatments, while perennial forbs and C3 grasses decreased in diversity in response to those treatments. Plots that did not experience grazing had a decrease in biodiversity.

Wetland Biodiversity, from the Peaks to the Plains

Presented by Sarah Marshall
Reported by Dale Brown

Dr. Marshall presented an overview of 11 ecological types of wetlands found from the Eastern Plains to the Continental Divide (of 15 total statewide), together with prototypical native plant associations. Wetland and riparian areas comprise less than three percent of Colorado's land area, yet are by far the most ecologically and economically significant ecosystems in Colorado, with important impacts for downriver states dependent on Colorado snowmelt. The Colorado Natural Heritage Program has established the **Colorado Wetland Information Center** to provide guidance on working in wetlands, geared toward diverse users ranging from landowners and managers to watershed groups. A mobile app with wetland map function is also available from the website for field use. Resources include information on restoration, conservation, and best management practices. This effort is part of a larger wetland assessment network throughout the western hemisphere.

Wetlands are classed according to ecological systems, defined as recurring groups of biological communities found in similar physical environments and influenced by similar dynamic processes. A separate classification based on wetland natural plant communities is also available. An important metric in wetland studies is the Floristic Quality Assessment, a vegetation-focused assessment tool that evaluates wetland ecological integrity based on plant species composition. Plants are assigned "C-values" from ▶



A beaver dam on Crystal River in Colorado. © Sarah Marshall, Colorado Natural Heritage Program

◀ 1 to 10 to represent their sensitivity to landscape alteration, with a value of 1 equaling “tolerant of disturbance” and 10 requiring a high-quality, undisturbed environment. These related assessments emphasize the intimate linkages between wetland habitats and native plant communities. Sarah’s presentation highlighted plains and foothills wetlands and higher-elevation wetlands.

Plains and foothills wetlands:

- Plains playas—Ephemeral ponds filled by seasonal precipitation (e.g., summer monsoon). Their viability is highly sensitive to surrounding land uses, best in undisturbed short-grass prairie.
- Saline depressions—Similar, but rarer; dependent on groundwater supplies. They support unique salt-loving plants. Sombrero Marsh in Boulder County is an example.
- Wet meadows and marsh-drainage networks—Require more abundant groundwater inputs. This ecotype also includes low-elevation fens (see below).
- Plains floodplains—This is a much more widespread ecosystem and includes backwater channels, swales, and sloughs. However, much of this habitat is highly altered by human disturbance; little remains undisturbed.
- Plains and floodplain riparian—Riparian areas around smaller and narrower channels. They are characterized by more woody species. Beaver activity is often observed and beneficial for ecosystem health (e.g., along foothills corridors in Boulder County).
- Slope wet meadows and fens—Very rare, fed by groundwater. May include organic (peat) soils, quaking soils, and springs.

Higher-elevation wetlands (above 7,000 ft):

- Subalpine-montane wet meadows and subalpine-montane riparian shrublands—These two related ecosystems often occur together. They are very important for snowmelt collection.

- Subalpine-montane fens—Fens are unusual old-growth wetlands defined by >40 cm of peat within the upper 80 cm of soil. They are further classified based on hydrology and vegetation types, and are highly sensitive to disturbance.

Weblink: <https://cnhp.colostate.edu/cwic/>

Shifting Composition: Short-Term Impacts of the Calwood Fire on Native and Non-Native Plant Species

Presented by Megan Matonis

Reported by Anna Wilson

Dr. Matonis, a wildfire behavior analyst with the Ember Alliance, launched her engaging talk by asking the audience’s emotional reaction to wildfires. Perhaps surprising to many of us, her response was that fire can be beneficial if it is not too severe. Burned areas provide habitat for both plants and wildlife and may even increase biodiversity.

Main questions she expounded on: Does forest structure affect how it burns? How does the understory vegetation respond a year after fire?

Before 1860, fires in the ponderosa pine ecosystems occurred every three to 23 years, with an average of nine years between fires. After fire suppression became common practice, the fires became much less frequent and far more destructive. It turns out that the more-frequent, lower-intensity fires remove understory fuels, reducing tree mortality, whereas high-intensity fires are more likely to reach the tree crowns. When fire encounters an area already cleared of understory fuels, such as from a prescribed burn or thinning, the spread of fire may occur more slowly. ▶



The Calwood Fire resulted in highly variable soil and vegetation burn severity within stands (top) and across the landscape (bottom) conditions due to high variability in topography and pre-fire forest structure and changing weather conditions during the incident.
© Megan Matonis

◀ The 2020 Calwood fire began on October 17 and burned more than 10,000 acres and 26 structures, causing 5,000 people to be evacuated. The fire was intense in some areas, but moved quickly at ground level in other areas which didn't cause as much damage.

Because Megan had previously surveyed several plots prior to the Calwood fire, she was able to present evidence (such as stand density, scorch height, and fuel loads) that the extent of damage in areas that had undergone ecological restoration was reduced compared to the untreated areas. After the fire, the number of native and non-native plants increased, as well as the number of species present in the burned areas. Several species, such as silverleaf phacelia (*Phacelia hastata*) and Venus' looking-glass (*Triodanis* sp.), had not been recorded previously. Understory plant communities change rapidly from year-to-year post-fire. Monitoring and integrated weed management are important for post-fire recovery. Long-term studies are necessary to fully understand the eventual health of the burned area.

Overall, Megan's message was upbeat. Prescribed burns can limit the severity of wildfire as long as the conditions are not too dry and windy. Naturally, a significant concern is that climate change is creating drier and windier conditions, which result in more extreme fire conditions. However, her research suggests that modifying the understory structure can mitigate the effects of future wildfires.

The Cycles of Life: Everything Is Related

Presented by Ava Hamilton
Reported by Dale Brown

This presentation was structured as a dialogue between Ava Hamilton, presenter, and Jackie Ramaley, Boulder Chapter, discussant.

How are Native and non-Native peoples working on biodiversity challenges together, now and going forward? Ava participates in the **Rising Voices Center for Indigenous and Earth Sciences**, an international network of indigenous peoples and physical, biological, and social scientists sponsored by National Center for Atmospheric Research, Boulder. Rising Voices seeks to develop collaborations that integrate Indigenous knowledge with earth science research; to provide opportunities for Indigenous students and early-career scientists; and to support adaptive and resilient communities through sharing scientific capacity.

Ava stressed her strong belief that hope for the future comes from young people—they combine technical knowledge with optimistic attitudes toward effecting

change. They are open toward sharing and welcome collaboration with diverse team members.

How can Native knowledge inform science?

Indigenous knowledge holders preserve collective and detailed site-specific knowledge of physical and natural environments. With relevance to western drought, this knowledge includes traditional ecological knowledge about historic water sources and water systems that can integrate with contemporary earth-science data to assess impacts of contemporary landscape transformation.

How can Native cultural traditions inform science?

Indigenous tradition contributes an attitude to approaching climate issues that is based on working together with shared love and respect for all life, and love of the unity of nature, which lead to recognizing the limits of the world relative to human populations and their demands. With respect to western drought, this leads to the attitude that water is life, and all water is connected. Drought is the natural world speaking to us. We are all charged to be "water protectors." Native knowledge thus offers a balanced perspective for understanding the interactions of human attitudes with our study of, and relationships with, the natural world.

How can Native knowledge inform policy? Indigenous peoples are also part of the modern world: 75 percent of Indigenous peoples in the US live away from their tribal homelands. This experience can provide insights toward integrating traditional and modern approaches to climate solutions.

Question from audience [Maggie Gaddis]: How can non-Native scientists be sensitive when asking to share in Native knowledge? Be a good listener. That is, ask questions but respect limits. There is no need for guilt over the past; the aim from all should be to build respect and tolerance going forward. Approach questions from a collaborative perspective as one human community sharing a fundamental love of life and the natural world.

Weblink: <https://risingvoices.ucar.edu> 🌀



Field Trip Reports

Boulder's Tallgrass Prairie

Reported by Tom Schweich

The tallgrass prairie field trip explored a parcel owned by Boulder Open Space & Mountain Parks that is west across Highway 93 from Rocky Flats. Led by Lynn Riedel and Lynne Sullivan, we explored micro-habitats that supported tallgrass prairie, mixed-grass prairie, and short grasses, including several large patches of buffalo grass. Cross-country across flat plains, over a small hill, and overlooking incised Coal Creek, we reviewed the proximity of the Continental Divide to the highest plains of Boulder County. Resulting increased rainfall may contribute to the presence of tallgrass on this parcel. Finally, we talked about the need to preserve native species (and genetics) as reservoirs of biodiversity in the face of global climate change.



Scenery at the tallgrass prairie field trip.
© Jim Pizarowicz

Esoterra Culinary Garden

Reported by Sharon O'Brien

The conference members who toured Esoterra Culinary Garden with proprietor Mark DeRespinis were delighted to find themselves on a tasting tour among the rows of exotic produce that Mark and his team grow on the farm. Most of the vegetables and greens we sampled were brand-new taste sensations. One participant was delighted to find Mark growing a vegetable she knew from her native South Korea, which, until the tour, she had been unable to find anywhere in Colorado.

First, we hesitantly nibbled the serrated cranberry hibiscus leaves Mark plucked from a dense row of unusual, burgundy-colored plants in a hoop house. Next, Mark waded into a bushy row of greens and uprooted a leafy rosette, revealing an odd tap root that resembled a Brussels sprout stem. He shaved and sliced the root so we could sample the bright green bits of watery celtuce, a vegetable originating in

China. After that, we munched on ice lettuce, an attractive succulent that appeared more suitable for a pot than a plate. Entering another hoop house, we were surrounded by a wall of tangled vines growing well above our heads. Mark encouraged us to look closely and taste cucamelons, a berry-size fruit resembling a miniature watermelon, stripes and all. When Mark led us down a sun-kissed row of golden raspberries, no one hesitated to sample the glowing fruits.

Esoterra, which opened in June 2020, sits on the former site of the Hartnagle Farm. The original farm, established in the late nineteenth century, produced sugar beets, poultry, and livestock, and was farmed for more than a century. The property sat idle until it was purchased by Boulder Open Space & Mountain Parks. The Esoterra/OSMP partnership is part of an effort to bolster the county's agricultural heritage. The produce that Esoterra grows today is sold to high-end restaurants in Boulder and Denver.

Mark calls Esoterra a "no-till market garden farm." He uses sustainable practices including crop rotation, no till, solarization, intercropping, and biocontrols. The farm grows produce in 15 beds, each 100 feet long. Since introducing Japanese techniques for small farms, Esoterra now produces yields closer to what you'd expect from a 12-acre farm, Mark claims.

The CoNPS group peppered Mark with questions about his innovative growing practices, and he was happy to give us an up-close look at the farm's special techniques. One of his principles is succession planting, meaning not leaving any beds idle upon harvesting, but immediately sowing the next crop. He also leaves the roots from the original crop in the ground to promote a continuously healthy soil biome. Special bottomless "air prune" seedling trays ensure that healthy plants will take off growing immediately upon contact with the soil.

Another fascinating technique that Mark described involves using undesirable non-native plants to ►



Esoterra Culinary Garden field trip attendees.
© Sharon O'Brien

◀ promote the growth of natives. Although the riparian areas of the farm adjacent to Boulder Creek have been overrun with invasive Russian olive trees, Mark prefers not to uproot and dispose of the trees immediately. Instead, he uses the Russian olives as sheltering "nurse trees" to promote the growth of native Saskatoon serviceberry shrubs that he plants. He gradually prunes the Russian olives as the serviceberries thrive and take over, eventually removing the trees altogether.

After observing Mark's cultivation techniques firsthand—and sampling their tasty results—the group wondered which enchanting dishes local chefs might create from the farm's bounty. The lucky restaurants that Esoterra supplies include Tavernetta, the Greenwich, the Fifth String, and BRUTØ in Denver; and Corrida, Frasca, Blackbelly, and Dry Storage Bakery in Boulder. If you notice an exotic-looking salad leaf or garnish on your plate while dining out, there's a pretty good chance it came from Esoterra Culinary Garden.

Golden Gate Canyon State Park

Reported by Denise Wilson

We hiked the full 3.5 miles of the Raccoon Trail Loop from Panorama Point in Golden Gate Canyon State Park, southwest of Boulder at about 9,000 ft elevation. We started going west down the steepest, stair-like part of the trail in order to take the not-so-steep switchback on the return. Panorama Point offers long views to Longs Peak and Mount Meeker, as well as a view south to Pikes Peak!

This trail winds through several ecotones, starting with lodgepole pine and Colorado spruce, then alongside the riparian willow and Engelmann spruce zone, and through wooded aspen groves. Thus, we saw a good variety of montane species. Although white fir, *Abies concolor*, exists here, it is deep in the woods, and we did not see it.

Our group of seven, led by Denise Wilson, identified more than 40 native plants along the way. There were the typical montane species with late bloomers in the aster family, some in the color purple, such as tansyaster (*Machaeranthera tanacetifolia*), and various aster species (*Symphyotrichum* sp.). Still blooming in yellow were hairy goldenaster (*Heterotheca foliosa*), Fendler's ragwort (*Packera fendleri*), and various groundsel species (*Senecio* sp.). White asters were also prevalent.

Of course, many plants were seen in the fruiting stage, including three orchids—frog orchid (*Coeloglossum viride*), spotted coralroot (*Corallorhiza maculata*), and Huron green bog orchid (*Platanthera huronensis*). The group was especially captivated by the attractive red berry clusters of elderberries



Golden Gate Canyon State Park field trip attendees.
© Sarah Morelli

(*Sambucus racemosa*). The berries of false Solomon's seal (*Maianthemum stellatum*), marked with their dark, cross pattern, were hard to misidentify, and we also saw the large false Solomon's seal (*Maianthemum racemosum*) and twisted stalk (*Streptopus amplexifolius*). In the piney forest, we got a zing to see the magenta stalks of pinedrops (*Pterospora andromedea*).

We stopped for lunch at an historic log cabin along the creek. This was a long, but very enjoyable hike!

Harlequin's Gardens

Reported by Alan Moores

Visitors to the website of Boulder's Harlequin's Gardens will find copious information about the plants offered for sale, with a focus on natives (ranging from *Abronia fragrans* to *Zinnia grandiflora*). The nursery sells grasses, pollinator plants, fruiting plants that are adapted to Colorado conditions, xeric ground covers, and a variety of adapted bulbs, along with herbs and vegetables. Harlequin's also offers a wealth of online resources, detailed growing advice, classes, and information on everything from managing weeds to mitigating conditions like fire blight.

Visitors to the nursery itself, such as our group hosted by the nursery's founder, Mikl Brawner, will discover, *in situ*, gloriously healthy, established groupings of native and adapted specimens throughout the property that will inform and inspire. Available for purchase from March through October are hundreds of plants, composts, mulches, fertilizers, and more.

All of which is to say that this fully mature, self-contained business enterprise is certainly light years beyond its hardscrabble, early '90s origins. In an informal chat after the tour, Mikl reflected on the changes he's seen in the public's perception of native plants over the past three decades. "It's enormous," he explained. "In the beginning, I would buy 50 native shrubs at the [start] of the season and [still] have 10 left at the end of the season." ►



Harlequin's Gardens field trip attendees. © Anonymous

◀ Mikl describes those changes as coming in waves: first, people who liked natives for their low maintenance needs; then, people replacing natives lost in development; then, the planting of natives to support pollinators; then, people who said, “I don’t want my landscape to look like New Jersey; I want it to look like Colorado.” And today? Mikl says customers now say, “I don’t want anything besides natives.” And so, along with his own developing interest in natives, his customers led him to focus Harlequin’s Gardens on native plants, even as he has still encouraged noninvasive, non-native plants for use in supporting trees, ground covers, and more. “What has happened,” Mikl explained, “is that the more people got interested in natives, the more we brought natives in.”

And for those new to creating a native plant garden? “The first thing you do before you start going wild is understanding your microclimates,” he advises. “Say, the difference between the north side of your house, the east side of your house, and the west side of your house.” Second, he says, is soil preparation, which means amending on a larger scale rather than just around individual plants. “Most yards have five different kinds of soil that have been brought in over the years. You have no idea what the soil is.” Finally, he suggests designing a home landscape to fit one’s schedule, lifestyle, interest in, and time for, gardening. “Gardens are very personal. You don’t want to make a garden to someone else’s tastes,” Mikl pointed out.

Heil Valley Post-Fire Recovery

Reported by Kelsey Backiewicz

David Hirt, senior plant ecologist with Boulder County Parks & Open Space, discussed the County’s recovery efforts after the 2020 Calwood fire and took CoNPS members on a tour of some of the restored burn sites. The Calwood fire began on October 17, 2020, and burned over 10,000 acres, 5,000 acres of which were on Boulder County property. Due to concerns of hillslope erosion, debris flows, and increased stream flow, the County embarked on a restoration endeavor in 2021 that included cutting and

mulching burned trees on site and installing sediment and erosion control structures. With funding secured from the Natural Resource Conservation Service’s Emergency Watershed Protection Program, 2,000 acres were mulched by helicopter, and sediment and erosion control structures were installed on Geer Creek. Only drainages with a high chance of increased debris flows were reseeded due to the cost of seeding large areas and research that indicates natural regeneration may be just as effective, if not more successful. CoNPS members were able to explore one of the helicopter landings and a meadow near Geer Creek that is used for County seed collections of *Psoralea tenuiflora* (slender scurfpea), *Ceanothus fendleri* (Fendler’s buckbrush), *Dalea purpurea* (purple prairie clover), and *Geranium caespitosum* (pineywoods geranium).

Plants of interest found blooming on the tour included bottle gentian (*Gentiana affinis*), California brickellbush (*Brickellia californica*), and sunbright (*Phemeranthus parviflorus*).



Heil Valley field trip attendees. © Kelsey Backiewicz

Rabbit Mountain Field Trip

Reported by John Vickery

We had fine weather and fine company on our trip to the Indian Mountain portion of the Ron Stewart Preserve at Rabbit Mountain, one of the largest contiguous landscapes in the Boulder County Parks & Open Space portfolio. We had nine participants and two trip leaders (myself and Stephen Hauptli, an ecologist with Boulder County Parks & Open Space). I previously had led a botanical survey effort at Rabbit Mountain in 2021, and Stephen made local arrangements and prepared maps for both the field survey and the field trip. Rabbit Mountain is a huge area, and the known occurrences of uncommon species are quite spread out geographically and often a good hike to get to. But we knew of a few easily accessible co-occurrences, so that’s where we headed.

Our first stop was the south edge of a very rocky, east-facing flank of a leaning hogback ridge where we found dryland flatsedge, *Cyperus lupulinus*. We observed but a few, one of which had a short pedicel allowing us to determine—without bothering with the ▶

◀ spikelet characters—that it was not *C. fendlerianus*, another uncommon species.

Next, we found winged loosestrife, *Lythrum alatum*, in fruit at a developed spring area in a rundown channel that cuts through the same hogback. This shorter (50–100 cm), native rhizomatous species is poorly distributed statewide, with scattered collections from the northeast quarter of the state. The flower color is very similar to that of the taller List A, noxious weed species, *Lythrum salicaria*, but the petals are shorter.

We then headed south to another channel. In an area dense with coyote willow, *Salix exigua*, we viewed many clumps of *Carex hystericina*, bottlebrush sedge. This species is well-collected in Boulder County but is not common statewide.

The few channels to the south feed a pond, ditches, natural drainages, and a large, wet meadow, all on the way to Dowe Flats. We walked south along the bottom of the west flank of the northern of two knolls to a site with a dense, tangled mass of *Eleocharis rostellata*, beaked spikerush. The stems of this plant can be more than a meter long, bending over to the ground, sometimes sprouting roots, which is why it is also known as walking sedge! There are a number of such stoloniferous sedges and rushes across North America, but this is the only one reported for Colorado.

We went further south from Dowe Flats to a prairie-dog colony, which has a developed spring. At the downhill side of the dampened area was a huge, dense colony of *Erigeron tracyi* (Tracy's fleabane), perhaps five meters in diameter—the largest such mass of trailing and tangled stems I have seen. As is often the case, the grass complement of the prairie-dog colony was largely absent. But we did find some fine examples of *Muhlenbergia torreyi* (Thurber's muhly), oft on the edge of the burrows. In this area we also found the less-common species of prickly poppy, *Argemone hispida*.

We ended the day with a group picture. Thanks to all for a nice outing of native plant enthusiasts! Thanks to Stephen for procuring a van.

Rocky Mountain Botanic Gardens Reported by Sharon O'Brien

A group of Colorado Native Plant Society conference participants felt truly privileged to get an in-depth tour of Rocky Mountain Botanic Gardens in Lyons. This recently established site is Boulder County's only botanic garden! The ambitious project is the brainchild of Garima Fairfax, a self-taught botanist who is a wealth of native plant knowledge and who makes her love of native plants obvious to all who come to the beautifully laid-out gardens.



Tracy's fleabane (*Erigeron tracyi*).
© Bob Lagier

Garima, a Lyons resident and former employee of Harlequin's Gardens, had been searching for a site for an educational native plant garden, but had been unable to find a suitable location. In a twist of fate, the catastrophic flood of 2013, which devastated Lyons, provided a solution. Today's Rocky Mountain Botanic Gardens is located on ground that was previously a neighborhood of mobile homes at the confluence of the North and South St. Vrain Creeks. The flood tore through the creekside neighborhood, washing the mobile homes off their foundations. FEMA later declared the area off-limits for any type of permanent structure. Because the property is still considered a flood zone, Rocky Mountain Botanic Gardens today is not even permitted to install so much as a tool shed or a fence to keep out browsing deer.

Garima explained how, for five years, the former neighborhood sat in ruins, with homes flipped on their sides, and trees and vegetation growing where doors and windows had been. After much wrangling, finagling, and filing of paperwork, permission was granted for a public botanic garden on the 1.25-acre site. If you visit today, you won't find much evidence that the garden was a former homesite except a stone bench donated by a former resident in memory of a loved one who lived there. Hauntingly, Garima and her crew regularly unearth personal possessions and household objects of former residents; the most recent buried treasure they found was a hibachi grill.

The garden has a pleasing and practical layout, with a winding gravel path that runs through five native plant habitats: prairie grassland, foothills, montane, southwest, and riparian. Each habitat features trees, shrubs, grasses, perennials, and annuals. The plants have labels showing both Latin and common names. There is also a plant list available in Spanish. Garima and her team of around a dozen volunteers install ►



Garima Fairfax and Rocky Mountain Botanic Gardens field trip attendees. © Sharon O'Brien

◀ new plants regularly; however, the garden, after just a little over two years in existence, is already beginning to look lush and well established.

Rocky Mountain Botanic Gardens receives funding from the Lyons Community Foundation, Colorado Garden Foundation, and private donations. They hold a plant sale twice a year—a large one in spring and a smaller one in fall. The gardens are free to the public and open from dawn until dusk. They are adjacent to Bohn Park, which has restrooms and ample parking. Garima invites anyone to volunteer at the garden on Sundays, Tuesdays, and Fridays, from 9 – 11 AM. Volunteers create pathways, install plantings, collect seeds, prepare for fundraisers, and more. There is also a lovingly curated Little Free Library by the front entrance featuring books and brochures on plants and nature (consider this location the next time you have nature or gardening books to donate). Plans include creating a comprehensive brochure and map of the garden plantings, plus an informational display featuring pre-flood photographs and information.

When you visit, you will not only get a sense of the durability and hardiness of our Colorado native plants, you'll also feel the resilience of Lyons residents. Through their willingness to roll up their sleeves and get their hands dirty, they have transformed a disaster area into an astonishing place of beauty.

White Rocks: Sand Prairies and Turtlebacks Reported by Anna Wilson

Plant ecologist Lynn Riedel and naturalist Dave Sutherland led a group of CoNPS conference attendees to White Rocks Nature Preserve (Boulder County Open Space). The area in northeastern Boulder County is so fragile it is closed to public access except by special permit. From October through August, the area is closed for bald eagle

nesting habitat. Dave pointed out that several coincidences contributed to this land being preserved, rather than being mined for gravel or sold for development.

Flood plain pasture covers the southern third of the property along Little Boulder Creek providing riparian habitat. Some of the rarer flora and fauna rely on disturbances such as flooding and grazing to maintain healthy populations. This property is the western limit of prairie gentian (*Eustoma grandiflorum*). Ute lady's tresses (*Spiranthes diluvialis*) and mountain sneezeweed (*Helenium autumnale*) can also be found here in the summer. We did see other plants in bloom, more than were expected this late in the season.

Not all the trees and shrubs along Boulder Creek are natives, but they are tolerated as they provide shade, which keeps the water cool and limits algal blooms from the nutrient rich effluent released from the wastewater treatment plant upstream. Peach-leaf willow (*Salix amygdaloides*, native) and crack willow (*Salix x fragilis*, introduced) dominate.

Cretaceous Fox Hills sandstone, roughly 80 million years old, forms the series of cliffs on the northern side of the property. At time of deposition, it was on the western margin of the Western Interior Seaway and represents the presence of slow-moving waters and shallow sediments. Here at White Rocks, it is substantially thicker than normal (400 feet versus the more common 10 feet). Fox Hills Sandstone is friable (easily crumbled), and the soils derived from it create a sand ecosystem. This sandstone is host to an unusual assemblage of plants including sunbright (*Phemeranthus parviflorus*), slender snake cotton (*Froelichia gracilis*), and forked three-awn grass (*Aristida basiramea*) on the dry open slopes. And in seeps below the ledges, the unusual *Lobelia siphilitica* var *ludoviciana* (great blue lobelia), and *Asplenium adiantum-nigrum* (black spleenwort, a rare fern) cling to the rocks. Two new lichens were also recently discovered here. Even the fauna are special in this bit of paradise: six-line racerunner lizard, miner bees, leopard frogs, olive-sided flycatchers, and more.

Sadly, we had to hustle out of there as our time was limited by the agreement with Boulder County Open Space. I'm pretty sure every one of us would jump at the opportunity for a return visit. ☺



White Rocks field trip attendees. © Kelly Ambler

Featured Story

Front Range Grasslands as Part of Nature-Based Solutions to Climate Change

By Tim Seastedt

There is an increasing urgency to *do something* about the climate crisis. Those of us at risk of losing our homes to catastrophic fires in Colorado are perhaps more cognizant of the current crisis, but this phenomenon is an issue of global concern and one that needs to be addressed at a global scale. Not surprisingly, then, there have been a large number of articles discussing the merits of various actions proposed to reduce the negative impacts of warming. While we absolutely must reduce greenhouse gas emissions to solve the problem, ecologists have been focused on the extent to which nature-based climate solutions, also called “green solutions,” may be both feasible and worth the effort (1). While solutions must scale up globally to impact climate, actions are local and will vary across different natural, agricultural, and built communities.

Green solutions can provide a fairly large portion of potential atmospheric carbon reductions—up to about 30 percent—in this decade (2). Often overlooked, grasslands have the potential to be major players in this effort, at least at local and regional scales. Grasslands are already helping reduce net carbon dioxide emissions to the atmosphere—and they can do more. Also, in the effort to remove carbon dioxide, we can benefit from the increased plant productivity and diversity of grassland landscapes. Many nature-based climate solutions are free or can add economic value to landscapes and their uses.

The growth of trees is often espoused as the leading landscape-based green mechanism to pull carbon dioxide out of the atmosphere. I suggest there is a bias in this assessment. There are far more studies of forests than grasslands; for example, Google Scholar searches in July 2022 found 4.3 million citations for the word *forest* compared to only 1.4 million citations for the word *grassland*.

The services provided by grasslands, including their ability to capture and store carbon, are often underappreciated. Trees can certainly outperform grasses in removing carbon per unit of time. However, in keeping this carbon out of the atmosphere, grasses can in fact be superior in terms of long-term carbon storage, especially for a fire-prone region such as ours—and climate mitigation is very much a long-term proposition. What we don't get from grasslands is

shade, but beyond this deficiency, grasslands may in fact be the more desirable community type in our region. This is due, in part, to the amazing property of grassland soils to outperform many forests in terms of storing and protecting organic forms of carbon. It is also because we can quickly and easily manage fire risk in grasslands with a very simple tool: livestock grazing.

In this regard, the Front Range of Colorado is something special (Figure 1). As we travel the short distance from the foothills to the eastern plains of Colorado, we get to see all three major prairie communities found in North America: tallgrass, midgrass, and shortgrass prairies. This variation often produces very high local diversity in plant species and offers substantial options for managing grasslands both for diversity and for contributing to nature-based climate solutions.

Soils are the major terrestrial storage sites for carbon (Figure 2A). And grasslands are the second most important storage sites per unit area after wetlands (Figure 2B). While these data are averages, there is good reason to believe that our grassland soils, in many cases, hold more carbon than adjacent forests and, further, the restoration of cropland soils to grasslands offers a major opportunity for carbon drawdown from the atmosphere. Let's look at a Colorado grassland in more detail (Figure 3). ►

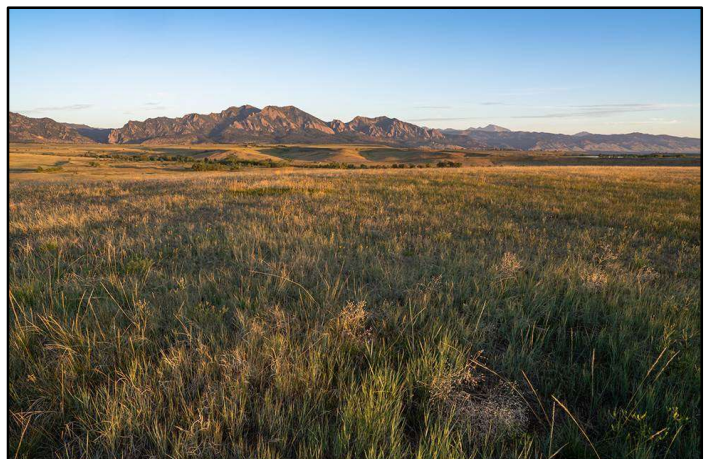
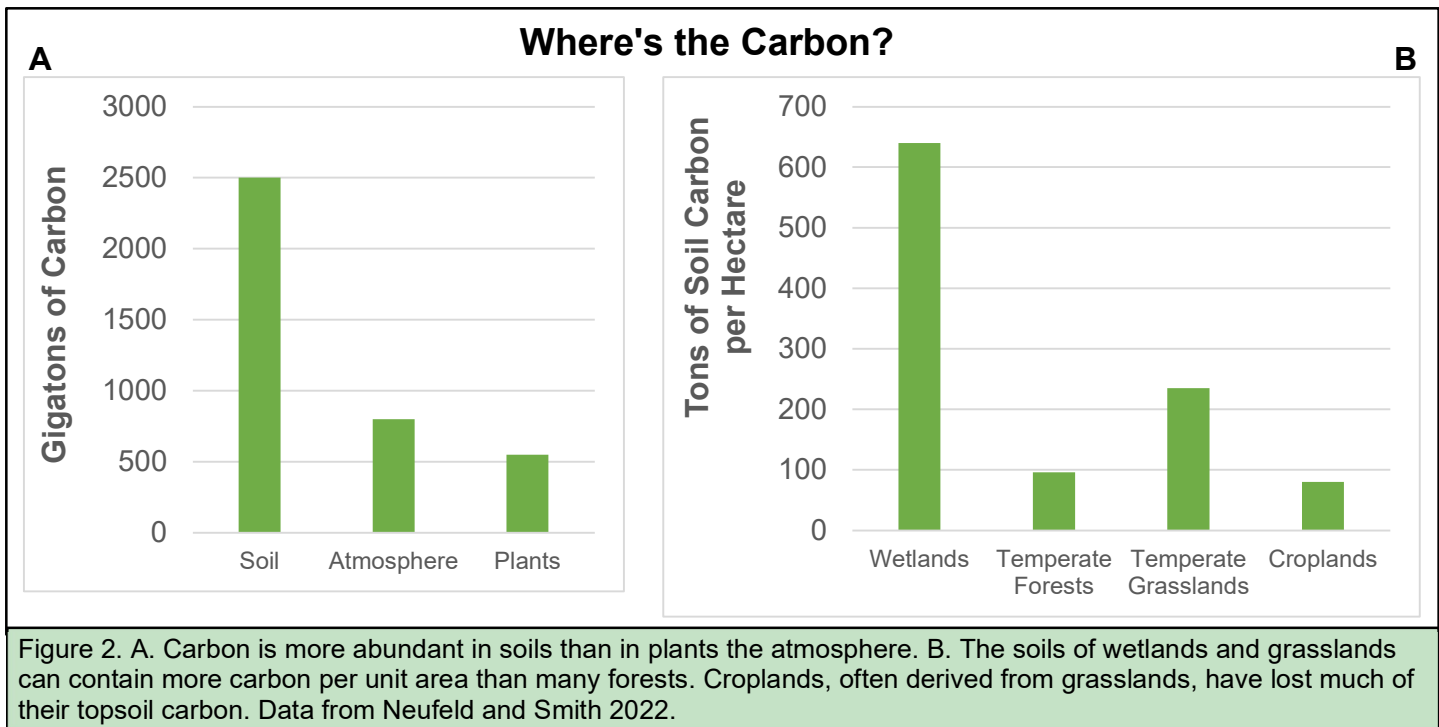


Figure 1. The Front Range grasslands are a mix of plant communities that store tons of carbon. Restoring or enhancing these with appropriate management can contribute to the green solutions that mitigate climate change. © William Bowman



◀ Grasslands, especially diverse grasslands, are more resilient to both drought and fire. In fact, it's this resilience that allowed grasslands to dominate the center of North America for millennia! They were, unfortunately, no match for the moldboard plow.

In this example, no carbon is lost to surface erosion, fire, or groundwater movement, and that is likely true for most grasslands in most years. Over the time the prairie has established itself, the net gain in carbon storage has resulted in the massive amount of soil carbon seen here. *The net gain through time represents a nature-based climate solution, an example of natural carbon drawdown.* In general, the productivity of the grassland is a good index of soil carbon storage potential. Tallgrass prairie, which has extensive root structures, can house well over 10,000 grams of carbon per square meter. While warming of our region may lower plant production potential somewhat, this decline can be more than offset by proactive management actions.

Carbon in the soil, along with organic materials not decomposed and respired by soil organisms, is a major part of soil carbon storage (Figure 4). A very reasonable question to ask is: If this organic material represents energy that can be used by organisms, why isn't it consumed? The answer is multifaceted.

First, the organic leftovers are very hard to consume, especially if you have no teeth. Microbes need to release enzymes into the soil to break down this material, and many soil scientists believe that the amount of energy used to make the enzymes may exceed the amount of energy gained from absorbing the usable carbon pieces produced by the enzyme

activity. In fact, while these leftovers can be consumed with the waste product released as carbon dioxide gas to the atmosphere, scientists believe this process is very slow and largely occurs so that the microbes can obtain other nutrients, particularly nitrogen, which is used as a building block to make biomass, not as an energy source to power that biomass.

A second reason that organic carbon is not totally consumed by microbes is that this carbon becomes physically protected in soils, surrounded by clay minerals that block enzymes from breaking down the carbon compounds. While invertebrates (and a few burrowing vertebrates) help make this carbon available to microbes by stirring things up, the process remains slow. The importance of this factor is evident when you compare tilled agricultural lands to untilled lands and grasslands. In tilled lands, up to 50 percent of the stored carbon in upper soil regions can be lost, presumably because the mechanical stirring of the soil gives microbes much more access to the organic carbon. The fact that tillage has gone on for more than 100 years in many areas means that these now carbon-poor soils are available to capture carbon using restorative or regenerative agriculture practices, and in doing so become a nature-based climate solution. Reduced tillage, no-till farming, and cover crop use, in addition to the conversion of tilled pastures to grasslands, will enhance soil carbon drawdown.

How fast can carbon be taken out of the atmosphere by grasslands?

Studies in Colorado that can be used to estimate carbon drawdown into soils are few. At an unfertilized, unwatered restoration grassland site, we estimated ▶

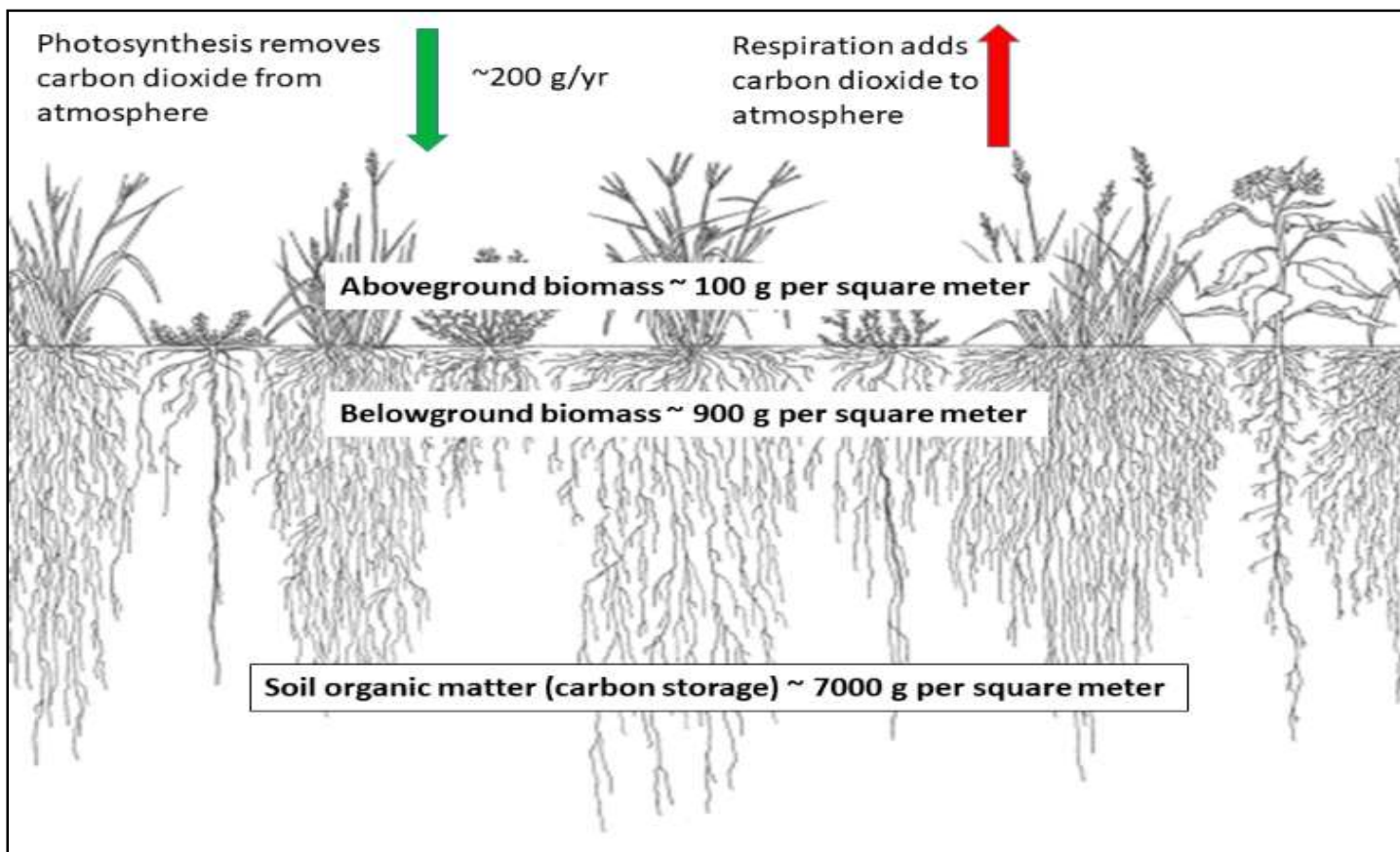


Figure 3. Amounts of carbon in living and dead organic matter to a depth of one meter from the shortgrass prairie of eastern Colorado. Data slightly modified from Burke et al. 2008 (3); 7000 grams/square meter = about 62,000 pounds per acre. Grassland sketch by Janet Prev y

◀ that carbon increased in the top four inches of soil by about 2,000 pounds per acre after a decade (4). Surprisingly, lawns built over former agricultural fields in the Front Range have been documented to accrue about 10 times the amount of carbon reported for shortgrass prairie (5). Nutrients added by landowners, in conjunction with runoff from roofs and roads, stimulate plant photosynthesis, grow roots, and benefit carbon drawdown. As long as there's "green space" and water to support the vegetation, suburban replacement of tilled cropland can potentially add soil carbon.

A back-of-envelope calculation for carbon drawdown

Let's assume that the average carbon dioxide emission per resident of Colorado is about 4.6 metric tons per year (6). If you purchased about 50 acres of recently restored prairie and received credit for its carbon drawdown, you would very likely neutralize (or zero out) your carbon footprint (the grassland removes the carbon that you and your lifestyle release to the atmosphere). At a larger scale, this natural drawdown action of a plot of restored grassland the size of Colorado could zero out the carbon footprint of over a million people. Unfortunately, our state population is about six times larger than that, so we can be sure the

state as a whole will remain a source of carbon dioxide to the atmosphere into the coming decade. However, we can increase that local drawdown number with a host of management options on lands we do control. Any mechanism that increases plant productivity can put more carbon into the soil. Whether it stays in the soil is less certain, but most examples suggest that we can retain some of the gain.

Suggestions to increase carbon drawdown found in the literature include, but are not limited to:

- Doing nothing (but leaving a grassland relatively undisturbed) likely accrues small amounts of carbon per year. Proactive management to maintain healthy grasslands also should have a similar effect.
- Reducing surface disturbance (human or animal) will increase carbon storage. There is evidence that grazing can both increase and decrease soil carbon storage, with light to moderate grazing capable of increasing carbon drawdown (7).
- Rewetting abused (either by natural or human causes) landscapes using erosion control or water spreading techniques will increase local carbon storage. A variety of structures (e.g., beaver dam analogs, structures that reduce erosion and slow ►

◀ the loss of water from snowmelt and storm runoff, etc.) can do this. Using runoff from impermeable surfaces (roofs, roads, etc.) to subsidize water inputs to grasslands (including the artificial grasslands of lawns and parks) makes sense. Slow the flow and you can rewet the landscape, particularly in semiarid regions such as ours.

- d) Converting formerly tilled (plowed) landscapes to grasslands would greatly increase carbon storage; this, along with very selective forestation or reforestation (where this has a low probability of fire or can be defended from fire—hopefully, in most towns and suburban areas) could result in the largest gains for the Front Range.
- e) Increasing plant species diversity of grasslands will increase carbon storage of those areas under some, but not all, situations (8).
- f) Solar array areas can be shared with gardens (called *agrivoltaics*) for both increased food production and soil carbon storage.

Fire also can affect soil carbon storage in multiple ways

When the next fire occurs (and it will occur), aboveground plant biomass will be largely converted to carbon dioxide, and the net drawdown gain from years of plant growth of aboveground biomass will be lost. Carbon in the soil, however, rarely goes up in smoke. Therefore, if net carbon storage into the soil occurs between fires, some benefit is obtained. While data are not yet available, the loss of our lower elevation Front Range forests to fire may have a long-



Figure 4. A soil profile from a moist meadow area of the Front Range foothills. Soil organic carbon composes about 4% of the topsoil, which is about 30 centimeters (one foot) deep (the orange strip = 12 inches). A square meter of this soil contains about 26 pounds of carbon in the top foot. That is the equivalent to the carbon found in about five gallons of gasoline. An acre of this ground therefore contains the equivalent carbon content of 20,000 gallons of gas. Thus, finding ways to increase soil carbon storage is important, and every (often free) contribution helps. © Tim Seastedt

term benefit to carbon storage in soil. If we can restore the ponderosa pine savannas that were historically present in much of the Front Range, in addition to the meadows that will naturally colonize burned areas, net carbon drawdown should occur. Restoration would create an herbaceous layer beneath the dispersed trees, generating what should be superior soil storage relative to the former closed-canopy forests (e.g., Figure 2B). These savannas will periodically burn, but almost always only the above-ground herbaceous layer is burned, leaving the live, dispersed, more mature trees and an herbaceous layer capable of rapid regrowth. In theory, these fires have relatively low impacts on carbon release when they occur, and actually could result in net carbon dioxide removal over a longer term from the starting point of our recent catastrophic fires.

Conclusions

Creation, retention, and enhancement of grasslands in our region offer what may be the largest, long-term contribution to atmospheric carbon dioxide reduction of any land management action. Procedures to enhance carbon drawdown will concurrently increase grassland productivity and can also be used to enhance and maintain native biotic diversity. Of the many grassland communities that can exist in eastern Colorado, the remnant tallgrass prairies found along and within our foothills may provide maximum carbon storage and should be prioritized for both preservation and restoration. Water redistribution structures for proactive erosion control can help maintain mesic grasslands and benefit both species restricted to such habitats and those in areas further out on eastern prairies. These actions can at least temporarily negate the reduced production caused by increasing aridity in our region. Post-fire restoration efforts to prevent water quality issues downstream can concurrently provide these on-site benefits. In more human-dominated landscapes, collecting and using water from a variety of impermeable surfaces can similarly enhance plant productivity and carbon drawdown.

Acknowledgements: Special thanks to Dr. Jeffrey Herrick, USDA soil scientist, for suggesting improvements to this paper, and to William Bowman for his photograph of the Front Range grassland.

Tim Seastedt, professor emeritus and senior fellow of the Institute of Arctic and Alpine Research at the University of Colorado, Boulder, initiated his work on North American grasslands at Konza Prairie in Kansas in 1981 and moved to the Front Range of Colorado in 1991. He is an ecosystem ecologist and sees plant communities as interactive systems, responding to climate in ways that can affect future communities and future climates. He can be contacted at Timothy.Seastedt@colorado.edu ►

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Botanicum absurdum by Rob Pudim



June to December

By Arthur Clifford

The fullness of Fall is ripe in the mouth
of plaintiff geese whose trumpets cry to the
south

The strong sun lays still on the meadow
where grasses brown bend in Autumn's
breeze mellow

The lateness of mornings the long afternoons
are waving goodbye to the seductress of June

The budding mistress who birthed bloom in
July soft Summer babes who before Winter
will fly

These packaged promises like Fall's ripe
seeds wing with October betrothed to red and
orange leaves

Fall reflects fully remembering the nights will
dwell long

When wet nurse December gives milk making
promises strong



Top: winterfat (*Krascheninnikovia lanata*); bottom:
autumn colors. © Kelly Ambler

Making Sense of Name Changes

By Jennifer Ackerfield

With the completion of the second edition of *Flora of Colorado* (Ackerfield 2022), many of you may be wondering, “Why do all these darned plant names keep changing?” It’s important to remember that a flora is a snapshot in time, representing our most current understanding of plant taxonomy. One of the most contentious definitions in biology is that of species. However, a species name is just a hypothesis based on multiple lines of evidence, such as morphology, molecular systematics, and geography. Plants don’t even know they have scientific names! Scientific names are human constructs given by us in an attempt to categorize and pass along information about the natural world. Over time, family, genus, and species designations are updated and refined as our understanding of the relationships among these groups improves.

If you ever look back through older botanical floras, you will see that many of the scientific names used in the late 1800s are quite different from those used today. For instance, when Alice Eastwood wrote *A Popular Flora of Denver, Colorado*, in 1893, she used the scientific name *Mammillaria missouriensis* Sweet (Missouri foxtail cactus). This species was then renamed as *Escobaria missouriensis* (Sweet)

D. R. Hunt when additional lines of morphological evidence were presented, leading the English botanist David Hunt to separate the genus *Escobaria* from *Mammillaria*, recognizing both as distinct **natural** “groups” (see photo). [Side note: a full species name consists of *Genus species* Author. When a species is renamed, its new name consists of *Genus species* (original-Author) new-Author.]

In fact, just prior to the publication of the 2022 *Flora of Colorado*, an even newer name came out for this species—*Pelecypora missouriensis* (Sweet) D. Aquino & Dan. Sánchez based on genetic analysis. Taxonomy never rests!

Today, one of the best lines of evidence that taxonomists use to determine natural groups is DNA characters. The genetic code for each plant is contained within their cells, with each DNA base pair considered an individual “character” within each DNA sequence. When this genetic sequence, or code, is aligned and compared to the genetic code of other plants, we can further define the relationships among different members of a group by inferring a phylogeny (Figure 2). A phylogeny consists of a series of groups (clades), where each clade includes a common

ancestor together with all of its descendants. Taxonomists strive to recognize only natural, or monophyletic, groups as genera or families. These groups usually have a set of shared, unique morphological characteristics that distinguish them from other groups. *Flora* seeks to recognize only monophyletic, or natural groups, as families or genera.

When a group is analyzed and it is determined that not all members of the clade share a common recent ancestor, this clade is said to be non-monophyletic. A taxonomist then has two choices: (1) recognize the entire group as one, or (2) split it into smaller, monophyletic clades. Most of the time, the latter option is chosen, especially if there are morphological characters that are unique to the

groups. And then that genus that you thought you knew is split. For example, the genus *Aster* is now split into *Eucephalus*, *Herrickia*, and *Symphyotrichum*. Whew! Another example in the newest edition of *Flora of Colorado* that may irk folks is the split of the genus *Erythranthe* from *Mimulus*. This split was necessary based on genetic sequencing in order to recognize only monophyletic genera. At least the more you say *Erythranthe*, the easier it gets.

All of these name changes can be confusing and, honestly, sometimes annoying. Change can be hard! However, it is also necessary. In the end, we need updated taxonomy to best document and protect our natural world. ►



Missouri foxtail cactus, *Pelecypora missouriensis* (Sweet) D. Aquino & Dan. Sánchez. © Jennifer Ackerfield

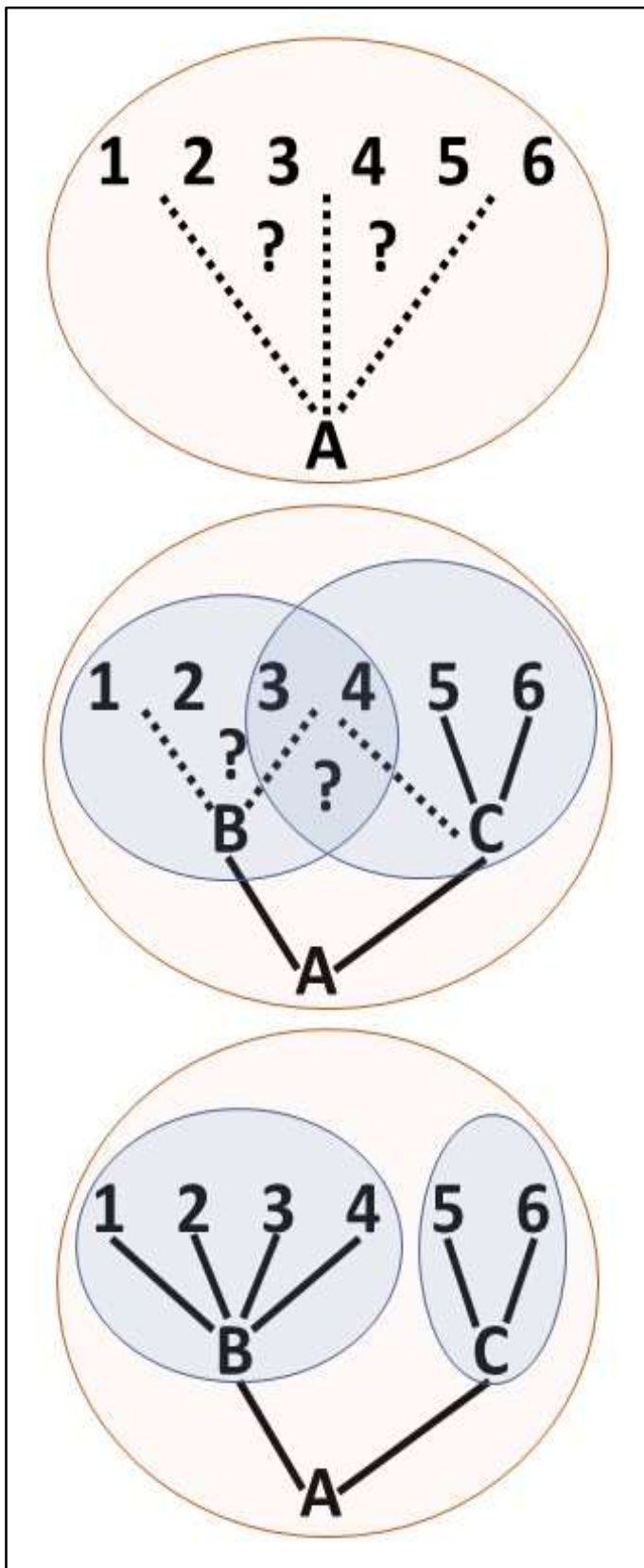


Figure 2. Refinement of taxonomic phylogeny. Members 1–6 are descendants of ancestor A. Morphologic analysis suggests two intermediate ancestors, although the specific clades are not well defined initially. Genetic analysis refines the two clades, with members 1–4 descending from ancestor B and members 5 and 6 descending from ancestor C.

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Glossary

clade: a group of organisms composed of a unique common ancestor and all the evolutionary descendants of that ancestor. The term is derived from the ancient Greek word for “branch.”

genera: plural of genus

genus: a group of species sharing structural or phylogenetic similarities.

molecular systematics: the use of molecular genetics to study the evolutionary relationships among species.

monophyletic: equivalent to a clade. A group of organisms arising from a recent common ancestor.

morphology: the study of shape.

phylogenetics: the study of the relationships among or within groups of organisms based on observed heritable traits, such as DNA sequences, protein amino acid sequences, or morphology. The result of such an analysis hypothesizes the evolutionary history of a group of organisms.

phylogeny: a branching diagram, often called a tree, showing the evolutionary relationships among various species based upon similarities and differences in their physical and genetic characteristics.

plant systematics: relationships between plants and their evolution, usually based on molecular analysis (e.g., DNA sequencing). Note that the line between “plant systematics” and “plant taxonomy” is not precise.

plant taxonomy: the science of classifying and naming plants, usually based on physical examination of specimens.

polyphyletic: A group of organisms with multiple ancestors (e.g., mammals and birds).

species: a group of organisms sharing distinctly similar characteristics.

taxon: a scientifically recognized entity. ☞

Rare Plants Still Under Threat

By Brad Klafehn

My Conservation Corner in the Spring 2021 issue of *Aquilegia* discussed the 2019 Colorado law that revamped state regulation of the oil and gas industry (SB19-181) to mandate protection “against adverse environmental impacts on any . . . biological resource resulting from oil and gas operations” (CRS § 34-60-106(2.5)(a) (1,2). As the Colorado Native Plant Society representative on the SB19-181 “mission change” rulemaking, I, along with the Butterfly Pavilion’s Amy Yarger, repeatedly requested that the Colorado Oil & Gas Conservation Commission define “biological resources” and write rules that explicitly protect these resources, including pollinators and rare plants. During the extensive rulemaking under SB19-181, however, COGCC did not address the issue of biological resources. In fact, many references to biological resources were ultimately removed from the draft regulations, using the justification that removal of the “biological resources” phrase would “make the Commission’s Rules more readable and understandable” (3). This resulted in the idea of protection of biological resources being out of sight—and, therefore, out of mind. Under the second oil and gas drilling permit approved under these new rules, the Bureau of Land Management and COGCC allowed a known population of at least 53 *Penstemon harringtonii* (Harrington’s penstemon) plants, a BLM Species of Special Concern, to be extirpated south of Rifle in Garfield County by Terra Energy Partners.

In response to our raising this issue repeatedly, however, COGCC did create a Biological Resources Working Group, which was to meet within a year and formulate ideas for the protection of biological resources. Commissioner Priya Nanjappa, COGCC’s then-wildlife representative, chaired the group. A number of CoNPS members participated in the group, including Colorado Natural Heritage Program Director David Anderson, Richard Alward (Aridlands LLC), and David Inouye of Rocky Mountain Biological Laboratory. The Working Group’s report was delivered in March 2022 (4).

The report was a good starting point for subsequent rulemaking on protecting biological resources from oil and gas; however, three years after the legislation passed, COGCC still has no regulatory language specifically protecting rare plants or pollinators, and there is not likely to be any without a concerted effort

by CoNPS and allies, including environmental lawyers, to force the commission to do so. In the meantime, Commissioner Nanjappa has left COGCC. She has been replaced by Brett Ackerman, a former 22-year veteran with Colorado Parks and Wildlife.

So, to answer the question posed in the Spring 2021 *Aquilegia* Conservation Corner article, “Will Colorado protect rare plants from oil and gas?” the answer apparently is, “No.”

Harrington’s penstemon

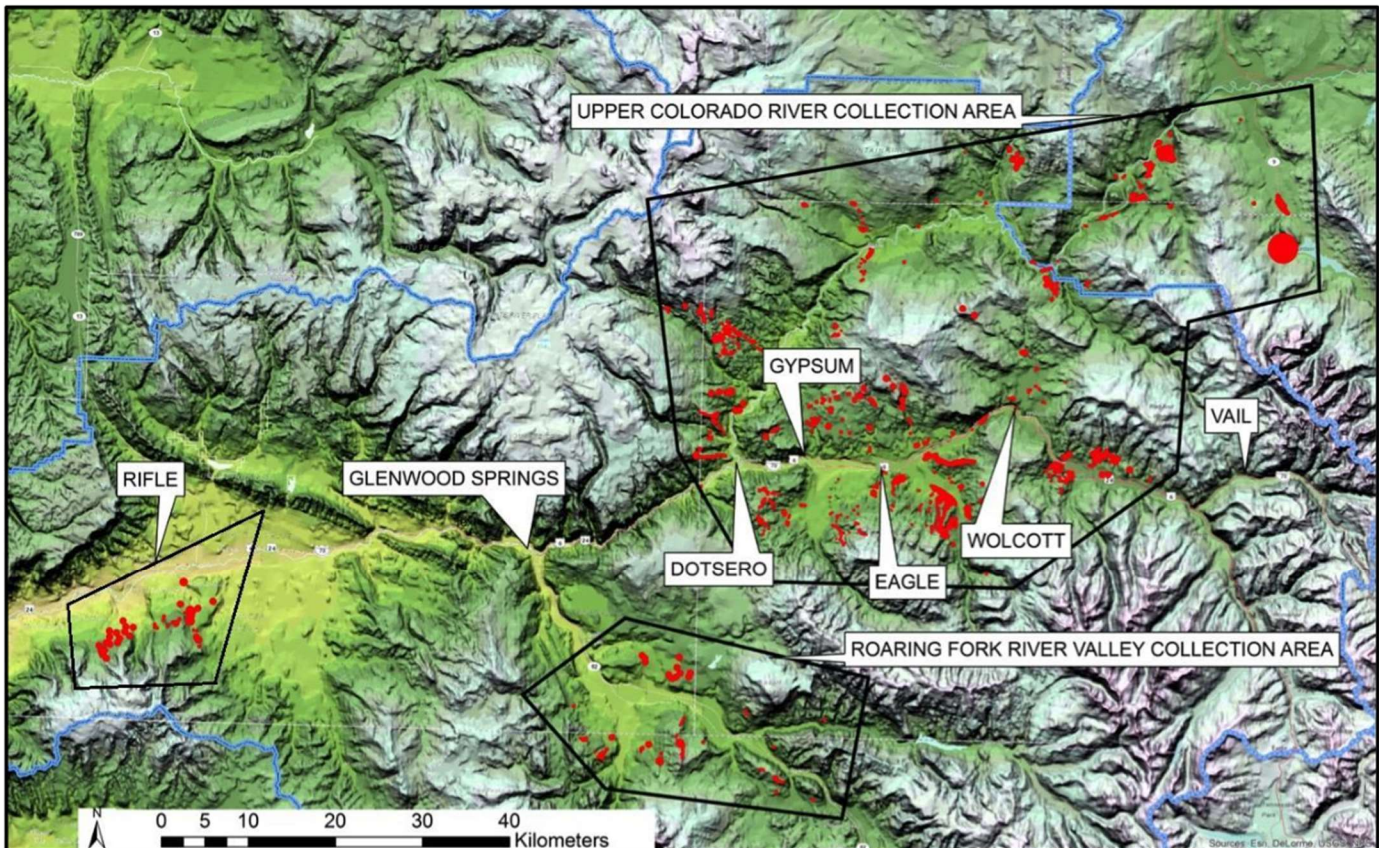
Penstemon harringtonii is a Colorado endemic, found in 44 populations across six north-central Colorado counties: Garfield, Eagle, Pitkin, Summit, Grand, and Routt. It is found in sagebrush and pinyon-juniper habitats from 6,800 to 9,200 feet on rocky loams and rocky clay loams. With two exerted anthers and deep-blue to pinkish lavender corollas, it is most often confused with Osterhout’s penstemon. Its primary pollinators are medium-sized bees and wasps (5).

The Colorado Natural Heritage Program ranks it as G3/S3 (“Vulnerable”), with the primary threats being residential development, recreation development, and grazing. However, as this Conservation Corner article shows, energy development has also negatively impacted the species. Populations are monitored by Denver Botanic Gardens.

Nathan Redeker profiled the genetic diversity of existing Harrington’s populations and found that ►



Closeup of Harrington’s penstemon (*Penstemon harringtonii*). © Pam Smith, CNHP



Current occurrence records for *Penstemon harringtonii* across its range. Data from the Bureau of Land Management, Colorado Natural Heritage Program, and personal observation.

◀ they include three distinct genetic groups: Rifle, Roaring Fork, and the Upper Colorado area, east of Glenwood Canyon. He found that “[h]igh levels [of] genetic diversity are present with exceptional level of gene flow between genetic groups” (5).

Redeker also noted: “Of the few populations in this region, Flat Iron Mesa [southwest of Rifle] should be considered as a conservation priority population for the region. Flat Iron Mesa seems to be the point of incoming gene flow from the Eagle region (Figure 11), and is therefore critical to maintain connectivity with the rest of *P. harringtonii* populations” (Redeker, 2017). Unfortunately, the extirpation of 53 of the plants noted in the Conservation Corner article occurred in this Flat Iron Mesa population. However, Jennifer Neale from Denver Botanic Gardens stated at the 2022 Rare Plant Symposium that the population appears stable, so hopefully adequate gene flow between different localities will continue.

Brad Klafehn is a member of the Conservation Committee and has been a citizen watchdog of fossil-fuel development projects in Colorado for nearly 50 years.

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Rhus Revealed by Sleuth to Contain Ruse

By Jim Borland

Recently a friend asked me my thoughts regarding the status of an item often encountered in local nursery catalogs and usually labeled "*Rhus glabra cismontana*" (Rocky Mountain sumac). Since most of the current floras of the western United States do not treat this as either a valid variety or subspecies of our smooth sumac, *Rhus glabra*, I decided to do a little sleuthing.

Without boring everybody with the details revealed in a search through 80 or more books, suffice it to say that at one time many botanists recognized the existence of at least two species: *Rhus glabra* and *Rhus cismontana*.

Basically, *R. cismontana* was a name assigned to what most of us know as simply *R. glabra* but which occupied the then-western part of its known range, specifically "this side of the mountain," as the epithet "*cismontana*" implies. Among other attributes, its height is noted as ranging from three to 18 feet.

According to a 1940 article in the *Journal of the Arnold Arboretum*, it differed from *R. glabra* "chiefly in the smaller and narrower, less numerous leaflets, lighter green above and only glaucescent not glaucous beneath, and in the smaller pyramidal inflorescence."

With time, more than 47 synonyms and combinations of the current *Rhus glabra* have been named, supposedly by the "splitters." The "lumpers" consider the species a polymorphic one with much variation in leaf color, leaf glaucescence, leaf edge revolution and serration, and leaflet number. Fred A. Barkley in his 1937 monographic study of *Rhus* (*Annals of the Missouri Botanical Garden*, v. 24) notes that the number of leaflets on a leaf from a single plant may vary by as much as 14 leaflets. This sort of observation, similar to that which occurred with the now-known polymorphic nature of *Quercus gambelii*, is usually the death knell for the continued existence of far too many names for the same thing.

One of the more curious aspects of all this is the continued use by nurseries of the name "*Rhus glabra cismontana*," which is used to denote a dwarf form of *Rhus glabra*.

The first literary combination of what was at one time two specific epithets, "*glabra*" and "*cismontana*," was by Francis Potter Daniels in his 1911 *Flora of Boulder, Colorado, and Vicinity*. In this flora, Mr. Daniels assigned all the *Rhus glabra* in the county to this new

combination form without noting if *cismontana* was a subspecies, variety, or form of the species.

Further confusing the matter is that no author, including Daniels, ever considered the height of this thing variously attached to *cismontana* as a definitive character. And yet, nursery people who associate the name *cismontana* with a particular size of plant do so only because of the overall dwarf nature of the plant.

The confusion is clarified perhaps permanently with a review of the early nursery catalogs of D.M. Andrews' Rockmont Nursery, which operated at the corner of ►



Smooth sumac (*Rhus glabra*) plants are dioecious—the female and male flowers reside on separate plants. Top: pistillate flowers; bottom: staminate flowers. © Bob Lagier



Smooth sumac (*Rhus glabra*) fall color. © Sue Dingwell

◀ 23rd and Bluebell in Boulder. As far back as 1916, he listed *Rhus glabra cismontana* as a shrub attaining a height of four to six feet, not necessarily small even by today's standards. Sometime between 1916 and 1930, the name *glabra* was dropped and replaced in 1930 with *Rhus cismontana*, a special selection of which was named "Rockmont Sumac." This was "a selected type that differs in its dwarfer habit," attaining only four feet in height. This selection continued its place in Andrews' catalogs until at least 1941.

The bottom line, then, is that most botanists today do not recognize *Rhus glabra cismontana* as a valid combination and that those in the nursery trade who believe that the name *cismontana* indicates a dwarf plant are mistaken. The nursery trade should be encouraged to continue their exploitation of the vast diversity to be found in nearly every species, but they should select another way to indicate their line of smooth sumacs that exhibit a shorter stature.

Wait! There is another bottom line.

Those who are familiar with the habitat of *Rhus glabra* in Colorado will have observed that in any one colony of this root-spreading shrub, only one height prevails—and that within the species as a whole, heights vary from one to 10 feet-plus.

Much to the advantage of nursery folks is the fact that seed taken from any one particular colony usually begets plants of similar size. This is somewhat unusual among woody plants.

Wait, there's more.

Sometime before 1922, Andrews found a form of smooth sumac in Boulder County whose leaves turned yellow in the fall instead of the usual reddish colors and whose berries too were yellow instead of red. This "albino" form, as he called it, was transplanted

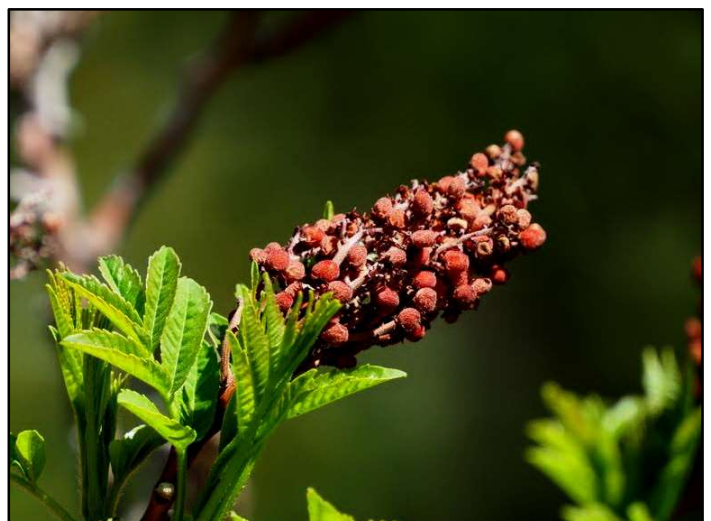
into his garden and found its way into his catalog in 1922. In 1925, he sent a plant to the Arnold Arboretum, where it is noted that it flourished. The Rockmont Nursery catalog continued to carry this item into the 1940s. This form Mr. Andrews called *Rhus cismontana flavescens* but was later changed to *Rhus glabra* var. *cismontana* forma *flavescens* by A. Rehder.

One more.

In addition to this form there is at least one other that merits horticultural attention. Whether one uses "subspecies," "variety," "forma," or "cultivar" to properly place this plant between *Rhus glabra* and *laciniata*, local horticulturists should welcome the bipinnately compound leaves that this form offers. Since its only known native site is in the southeast corner of Pennsylvania, it may not prove to be as drought-worthy as our own local *Rhus glabra*. Note that a natural hybrid between *Rhus glabra* and *Rhus typhina* is also known.

During this search of the nomenclature for smooth sumac, a parallel search was also conducted for the three-leaf sumac, which seems to be making a literary move from *Rhus trilobata* to some association with *Rhus aromatica*. Due probably to their even greater polymorphic plasticity, the history and nomenclature of these two species and their associates is even more complicated and confusing.

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



Smooth sumac (*Rhus glabra*) berries. © Sue Dingwell

In Memorium: Susan S. Martin (1938–2022)

Sue Martin: A Founding Member of CoNPS

By Denise Culver



Sue Martin at a 1998 CoNPS field trip. © Denise Culver

It is with profound sorrow that we report that Sue Martin passed away on May 11, 2022. I first met Sue in 1995 at a Colorado Native Plant Society board meeting, which I was attending as the new membership assistant and treasurer. Sue and her partner, Myrna Steinkamp, sat on either side of me, and before I left the

meeting, I knew we would be best friends. Sue and Myrna influenced my life both professionally and personally. Regretfully, Myrna passed away in June 2000. The Myrna P. Steinkamp Memorial Fund was established in her memory.

Sue was active in scientific adventures from early in her life. As a young woman, Sue (nicknamed Skip) participated in Girl Scouts and activities such as boating and ham radio. Through scouting, she joined several archaeological digs in New Mexico headed by Dr. Bertha P. Dutton, an anthropologist who specialized in the American Southwest. This group of lifelong scouting friends called themselves Dutton's Dirty Diggers. These experiences led to Sue's lifetime love of Southwestern indigenous art.

Sue went on to receive a BA in chemistry from the University of Colorado Boulder and an MS in plant



Sue (left) and Myrna (right) pointing out an American three-toed woodpecker hole in northern New Mexico in 1999. © Denise Culver

biochemistry from Utah State University. She earned a PhD in biology from the University of California-Santa Cruz under Dr. Jean Langenheim in 1973, specializing in plant biochemistry and chemical ecology. For 28 years, until her retirement in 2002, Sue was a scientist with the US Department of Agriculture's Agricultural Research Service in Fort Collins, CO, focusing on the biochemistry, ecology, and physiology of sugar beets. She was active in, and served as president of, the American Society of Sugar Beet Technologists and was an instructor for the Beet Sugar Agriculture School of the Beet Sugar Development Foundation.

It was Sue's love of, and dedication to, the native flora of Colorado that stands out the most. Not only was Sue a founding member of the Colorado Native Plant Society, but she also served as president and helped produce two editions of *Rare Plants of Colorado*. In 1988, CoNPS awarded her an honorary life membership in recognition of her contributions to the knowledge and conservation of Colorado native plants. She was also a lifelong member of the California Native Plant Society and maintained memberships with the National Audubon Society, the American Birding Association, the Nature Conservancy, and the Museum Foundation of New Mexico.

Sue and Myrna maintained a second home in Santa Fe, NM, and looked forward to the Santa Fe Opera and Indian Market each year. They loved to travel and visited many parts of the world to pursue their shared interests in plants, birds, and archaeology. In her later years, Sue continued to pursue her interests in Southwestern archaeology and American Indian culture with fellow Dutton's Dirty Digger Mary Anne Stein. They enjoyed Southwestern cooking and watching sports, especially college football, women's college softball, and basketball.

Sue's dedication to CoNPS, her intellect, and her knowledge of Colorado's native flora contributed to a strong foundation for CoNPS' success. Next time you have a margarita or a bourbon on the rocks, please raise your glass to Dr. Susan S. Martin. She will forever remain in our memories and will be truly missed. ☺

Sue generously supported CoNPS throughout her tenure with the society. Her final legacy to CoNPS was a substantial gift left to the society in her will and naming CoNPS as a beneficiary for memorial donations. Her contributions to native plants will continue through her funding of CoNPS activities.

News, Events, and Announcements

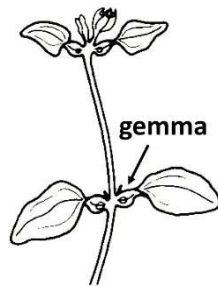
Please check the **Calendar of Events** online at <https://conps.org/event-calendar-2/#!calendar> for up-to-date information on webinars, chapter meetings, garden tours, field trips, and other events. Events may be in-person or online. Note that CoNPS membership is not required, although encouraged, to attend events.

CoNPS Society-Wide Events and News

Comments from Alert Readers

CoNPS is fortunate to have many alert readers to correct errors in our publications!

Karin Edwards pointed out that we overstated the unique aspect of gemma reproduction by *Mimulus gemmiparus*; Rocky Mountain monkeyflower; *Aquilegia* 46.3, 2022, page 2). The unique aspect of reproduction in this plant is not that it reproduces by gemmae, but that the gemmae are formed within the leaf petioles. Gemma reproduction is relatively common in non-vascular plants (e.g., mosses and liverworts), but can also be found in some vascular plants such as ferns and sundews. However, the gemmae in these plants do not form within petioles.



Drawing by Linda Boley.
From Weber WA. 1971.
Madroño. 21:423-425

Loraine Yeatts noticed that one of photos in the plant quiz (*ibid*, page 35) was mislabeled. The plant listed as pygmy goldenweed (*Tonestus pygmaeus*) should have been identified as four-nerve daisy (*Tetaneuris acaulis* var. *caespitosa*).



Thank you both! KA

CoNPS Research Grant Deadline February 15, 2023

Funds to support research on knowledge and/or conservation of Colorado plants are available from the Marr and Steinkamp research grant funds. The John Marr grants support research on Colorado native plants in general, while the Myrna Steinkamp grants focus on research on Colorado rare plants. Grants are awarded once per year and the deadline for grants is February 15th annually. Applications and more information on the grants can be found here: <https://conps.org/home-2/conps-grants/>

New CoNPS Address

CoNPS has secured space at The Alliance Center in downtown Denver. We have a virtual office and a physical storage room, plus access to conference and meeting rooms. Our new mailing address is 1536 Wynkoop St., Suite 911, Denver, CO 80202. Our first virtual office hours will be December 8, 9 – 11 AM. Go to <https://conps.org/home-2/events/event-calendar-2/#!event/2022/12/8/conps-virtual-office-hours> to register for this event.

CoNPS Bookstore Open House and Volunteer Event

**First and third Thursdays of each month
9:00 – 11:00 AM**

CoNPS has a physical office at the Sustainacenter in Colorado Springs. The CoNPS bookstore is now a place, not just an online retail space! Come browse our book selection and help us process book orders. We will provide refreshments. Please register through the CoNPS event calendar if you plan to attend. We can't wait to see you!

CoNPS Virtual Office Hours

**Second and fourth Thursdays of each month
9:00 – 11:00 AM**

Do you have questions about CoNPS? Would you like to get to know other members? Register via the CoNPS calendar to attend a virtual office hours session!

Committee Meetings

Please attend these virtual meetings to express your interest in committee work. We will plan our projects for 2023 and facilitate the cooperation of chapters and committees in meeting the mission of CoNPS. Note that you can join a committee without the requirement of meeting attendance. Let's see what we can generate!

These committee meetings are set to convene two to three committees at the same time. If necessary, we will split out the committee meetings and/or meld committees to concentrate our efforts. See the CoNPS calendar for registration details. ►

CoNPS Webinar

Pollination of Glacier Lilies by Bumble Bees: Adequacy of Service and Demographic Consequences

Presented by James Thomson

December 15, 6:00 – 7:30 PM



Dr. Thomson will discuss topics that frame “the pollinator crisis,” focusing on how to measure the adequacy of pollination service. He will present data on the continuous series of such measurements on the long-lived geophyte, *Erythronium grandiflorum* (glacier lily) near the Rocky Mountain Biological Lab. His presentation will end with observations on how successful pollination determines fruit set and how the cost of fruit development affects subsequent growth and survival. Some numerical data will be presented, but the emphasis will be on general concepts that should apply to many other systems.

Dr. James Thomson is a professor emeritus of the University of Toronto, a fellow of the Royal Society of Canada, and a past president of the American Society of Naturalists. As an undergraduate at the University of Chicago, he was inspired by Dan Janzen’s pioneering model of focusing on plant-animal interactions. For his PhD dissertation at the University of Wisconsin, he pursued community-wide studies of pollination interactions, and came to the Rocky Mountain Biological Lab in 1977 to study subalpine meadow systems. While on the faculty at Stony Brook University, he continued to spend summers at RMBL. In the mid-1980s, Thomson and his wife purchased lots in the silver-mining ghost town of Irwin, west of Crested Butte. He began what have become unusually long-term studies on glacial lily reproductive biology. He continues to spend summers in Irwin, extending the data sets.

\$30 members, \$40 nonmembers. <https://conps.org/home-2/events/event-calendar-2/#!event/2022/12/15/conps-special-speaker-series-live-webinar-an-evening-with-dr-james-thomson-pollination-of-glacier-lilies-by-bumble-bees-adequacy-of-service-and-demographic-consequences>

Chapter Updates

Boulder Chapter

The Boulder chapter will hold its monthly meetings on the first Wednesday of the month. We plan to schedule several field trips for the summer. Please contact us at BoulderCoNPS@gmail.com if you are interested in leading a field trip.

Metro-Denver Chapter

The Metro-Denver chapter will hold its monthly meetings on the second Wednesday of each month, unless otherwise noted.

Metro Denver CoNPS, Wild Ones (Front Range Chapter) and People and Pollinators Action Network hosted the annual Fall Native Seed Swap and Giveaway on October 15 in Denver! We surpassed last year’s seed swap with over 200 participants, almost twice as many than the previous year! Our thanks to everyone who came out, those who donated seed, and to the volunteers! A special thanks to Table Public House in Denver for hosting us!

Northern Chapter

Northern chapter meetings will be on the first Tuesday of each month. The chapter is recruiting new members for the leadership team. Please contact Ann Grant at odygrant@gmail.com if you are interested in helping to shape the direction of this chapter.

Plateau Chapter

Plateau chapter meetings will be held on the third Thursday of each month.

San Luis Valley Chapter

San Luis Valley Chapter meetings will be held on the second Tuesday of each month. In addition, the chapter is recruiting new members for the leadership team. Please contact Carol English at slvchapterpresident@gmail.com if you are interested in helping to shape the direction of this chapter.

Southeast Chapter

The Southeast chapter meetings will generally be held on the third Tuesday of each month. In addition, we gather at Phelans Gardens Greenhouse on the third Friday of each month for TGIF (Thank Goodness it’s Flowering!) for volunteer work. The chapter is recruiting new leadership team members! Please contact Curtis Nimz at curtisnimz@gmail.com if you are interested in helping to shape the direction of this chapter.

Southwest Chapter

Southwest chapter meetings will be held on the fourth Tuesday of each month, unless otherwise noted. ►

CoNPS Chapter Events

Note that chapter events are free and open to all, independent of chapter affiliation.

Sunflowers at the Extreme: Mechanisms of Adaptation and Divergence in the Great Sand Dunes

Presented by Peter Innes

November 30, 6:30 – 8:30 PM

Hosted by the Metro-Denver chapter

Freyer-Newman Center, Denver Botanic Gardens

An unusual variety of prairie sunflower (*Helianthus petiolaris*) has adapted to the extreme environment of Great Sand Dunes National Park in southern Colorado. As a result, it is rapidly diverging from the prairie sunflowers growing on the periphery of the dunes and is on its way to becoming a separate species. Peter will present a summary of what is currently known about the natural history and evolution of this dune-adapted sunflower and will discuss his own research into the genetic mechanisms that underlie its divergence from neighboring non-dune sunflowers. Virtual option available.

<https://conps.org/home-2/events/event-calendar-2/#!event/2022/11/30/november-chapter-meeting-sunflowers-at-the-extreme-mechanisms-of-adaptation-and-divergence-in-the-great-sand-dunes-presented-by-peter-innes>

The Collaborative Science of Planning Landscape Scale Restoration

Presented by Maria Pezza

December 7, 7:00 – 8:30 PM

Hosted by Boulder chapter, Virtual

Maria Pezza, Program Associate of the Watershed Center, will discuss the Center's work in the St. Vrain Basin on projects to improve watershed resiliency. She will focus on how the Center selects restoration projects that have the biggest benefit to people and the environment by combining input from community stakeholders with the best available science.

<https://conps.org/home-2/events/event-calendar-2/#!event/2022/12/7/-8220-the-collaborative-science-of-planning-landscape-scale-restoration-8220>

CoNPS Holiday Party

December 13

3:00 – 6:00 PM, tour the Alliance Center (tentative)

6:30 - 8:30 PM, Denver Botanic Gardens

Hosted by the Metro-Denver chapter

Title TBD

Presenter Jacqueline Mattos

January 11

Hosted by the Metro-Denver chapter

Mattos is a PhD student at the State University of Campinas in São Paulo, Brazil. She is currently a visiting scholar/intern at CU Boulder.

Rare and Restoration Plants of The Navajo Nation: Conservation Activities of the Navajo Natural Heritage Program

Presented by Nora Ventrella

January 20 (Friday)

Hosted by the Southwest chapter

Ventrella is a botanist for the Navajo Natural Heritage Program.

Title TBD

Presenter Chris Helzer

February 8

Hosted by the Metro-Denver Chapter

Helzer is The Nature Conservancy's director of science in Nebraska. His main role is to evaluate and capture lessons from the Conservancy's land management and restoration work and share those lessons with other land managers. He also works to raise awareness about the value of prairies and prairie conservation through his photography, writing, and presentations.

Title TBD

Presenter Hannah Ertl

February 28

Hosted by the Southwest Chapter

Ertl is the indigenous lands ecologist for Trees, Water, People (<https://treeswaterpeople.org/>)

Botanical Adventures in Belize

Lauren Bansbach and Michael Remke

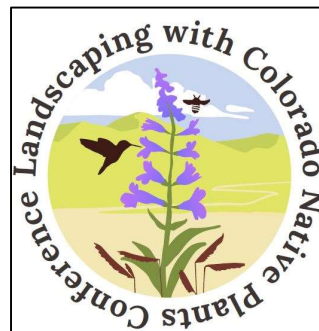
March 30 (tentative)

Hosted by the Southwest chapter

Lauren Bansbach and Michael Remke are instructors of biology at Fort Lewis College in Durango.

Neighboring Events and News

2023 Landscaping with Colorado Native Plants Conference



On February 25, the Landscaping with Colorado Native Plants Conference will offer a full day of virtual programming promoting the cultivation and maintenance of native plants in the home and commercial landscape. Landscaping with native plants benefits pollinators and songbirds, saves water, and restores the beauty and health of nature in the places we live, work, and play. Attendees will learn how to use native plants in both home and commercial landscapes. ►

◀ This year's conference theme is **Native Landscapes for Climate Resilience**, focusing on applicable solutions for resource conservation and biodiversity using Colorado native plants. The beginning keynote speaker will be Dr. David Inouye, professor emeritus in the Department of Biology at the University of Maryland, who will discuss his research about shifting pollinator-plant relationships in high-altitude environments. Other sessions will provide information about growing native trees; natives for hotter, drier climates; and climate-resilient parks. The ending keynote will be a discussion of no-water garden systems from Kenton Seth. Kenton is the founder of Paintbrush Gardens, a landscaping business based in western Colorado which specializes in using native plants, as well as other low-water plants.

The Landscaping with Colorado Native Plants Conference regularly reaches more than 700 attendees, and is a great educational opportunity for home gardeners, students, horticulturists, growers, parks departments, and land managers. The conference comprises two tracks: "New to Natives" and "Knows the Natives." New to Natives sessions are geared to a general audience that is just getting started on native landscapes. Knows the Natives sessions presume a strong background in species knowledge as well as experience with managing native landscapes.

Registration for this online conference opens in early December. More information will be available on the **conference website** soon.

The Landscaping with Colorado Native Plants Conference is brought to you by a coalition of partner organizations: **Butterfly Pavilion, Colorado Native Plant Master Program, Colorado Native Plant Society, Colorado State University Department of Horticulture and Landscape Architecture, Colorado State University Extension Service, Denver Botanic Gardens, High Plains Environmental Center, Wild Ones Front Range Chapter, and Susan J. Tweit**, author.

Weblinks

Conference website:

<https://landscapingwithcoloradonativeplants.wordpress.com/>

Butterfly Pavilion: <http://butterflies.org/>

Colorado Native Plant Master Program:

<http://jeffco.extension.colostate.edu/metro-to-mountain-npm/>

Colorado Native Plant Society: <https://conps.org/>

CSU Department of Horticulture and Landscape

Architecture <https://hortla.agsci.colostate.edu/>

Colorado State University Extension:

<http://extension.colostate.edu/>

Denver Botanic Gardens: <http://www.botanicgardens.org/>

High Plains Environmental Center: <http://suburbitat.org/>

Wild Ones Front Range Chapter: <https://frontrangewildones.org/>

Susan J Tweit: <http://susanjtweit.com/>

Funding Opportunity

Proposal deadline is January 13, 2023.

The Open Space & Mountain Parks Department of the City of Boulder has funding available through its Funded Research Program for scientific inquiry on OSMP lands. Preference is given to original proposals that address priority research topics identified by the department. However, all proposals will be considered based on their merits. For research that crosses the boundaries of OSMP and our neighbors (Boulder County Parks & Open Space, Jefferson County Open Space, and the City of Longmont), we will also consider interagency grant proposals for joint funding.

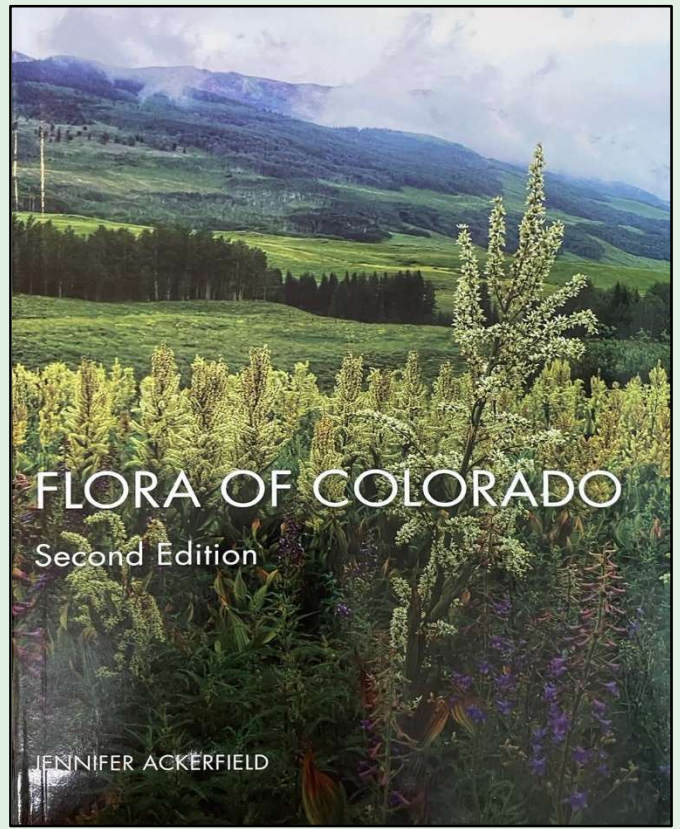
The maximum award amount is \$10,000.

Full details are available here:

<https://bouldercolorado.gov/services/osmp-funded-research-program> ►

In celebration of the release of the second edition of *Flora of Colorado*, Jennifer Ackerfield invites you to attend a special book signing event. This event will take place on Friday, December 2, from 2 – 5 PM in the Freyer-Newman Center at the Denver Botanic Gardens. Event registration also includes admission to the Gardens. Register for the event [here](#). Jennifer hopes to see you there!

https://catalog.botanicgardens.org/DateSelection.aspx?item=4783&_ga=2.34402913.1970804261.1666297368-721041612.1661187340 \$10 member, \$12 non-member.



◀ Funding Opportunity

Proposal deadline is February 15, 2023

The Boulder County Nature Association is a private, non-profit membership organization committed to our mission to “Conserve resilient natural ecosystems in our region through science, education, and advocacy.” BCNA is pleased to offer research funding as small one-year grants for projects consistent with our mission.

General BCNA grants of up to \$4,000 for projects to further our understanding of Boulder County ecosystems with an emphasis on effects of climate change and expanding Front Range development on our flora and fauna, streams, and recreation areas. Research findings should add to the knowledge base available to Boulder County decision-makers to both protect and enjoy our natural resources.

Full details are available here: <https://bcna.org/grants-for-research/>

Internship Opportunity

Proposal deadline is February 15, 2023



Horticulture Interns, Adair and Maggie, planting in the Gardens. © Betty Ford Alpine Gardens

Located at 8,200' in the central Rocky Mountains, Betty Ford Alpine Gardens Internship Program provides the next generation of horticulturists, conservation scientists, and educators the opportunity to build their professional skills through hands-on learning and unique experiences. All summer internships are paid, and shared housing is provided by the Gardens in Vail. Learn more about the individual positions and application instructions [here](#) on our website. Join us for a summer internship opportunity like no other and learn about mountain ecosystems, alpine plants, and the operation of a unique botanic garden.

Weblink: <https://bettyfordalpinegardens.org/intern-posts/>

Cross-Pollination Events

Job Opportunity: 2023 Pollinator Poster Artist

Pollinator Partnership is seeking an artist to render the 2023 Pollinator Poster, this year focusing on “Climate Change and Pollinators: Little Things Matter.” To apply, please send a one-page narrative concept idea with a draft sketch to Reed Livers at reed@pollinator.org by Friday, December 9, 2022.

December 1-2

Rocky Mountain Community Science Conference
<https://rockies.audubon.org/events/2022-rocky-mountain-community-science-conference>

December 3

Arizona Botany Annual Meeting
<https://aznps.com/event/2022-arizona-botany-meeting/>

December 5

World Soil Day
<https://www.fao.org/world-soil-day/en/>

December 6

Online course: Ecological Restoration Monitoring and Maintenance
<https://www.ser.org/events/EventDetails.aspx?id=1671922&group=>

December 6-7

DMNS IPS Conference, “Living with Uncertainty”
<https://institutesymposium.dmns.org/>

December 7-8

Colorado Weed Management Association Winter Training
<https://cwma.org/>

December 9

Colorado Field Ornithologists grant deadline
<https://cobirds.org/grants-scholarships>

January 25-27

Colorado Water Congress Annual Convention
<https://web.cowatercongress.org/events/2023Annual%20Convention-848/details>

January 23

National Seed Swap Day
<http://seedswapday.blogspot.com/>

January 31

Denver Audubon Funding application deadline
<https://denveraudubon.org/lois-webster-fund/>

February 23-26

Colorado Environmental Film Festival
<https://ceff.net/>

February 22-23

Utah Weed Conference
<https://utahweed.org/weed-conference/> ☞

Become a CoNPS Member

Name _____
 Address _____
 City _____ State _____ Zip _____
 Phone _____
 E-mail _____
 Chapter (if known) _____

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

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

CHAPTERS: Boulder, Metro-Denver, Northern (Ft. Collins-Greeley), Plateau (Grand Junction and West Slope), San Luis Valley Chapter (Crestone, Alamosa, Salida), Southeast (Colorado Springs-Pueblo), Southwest (Durango) or Unaffiliated

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

Address _____
 City _____ State _____ Zip _____

Check box to receive information on volunteer opportunities

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

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

Membership dues cover a 12-month period.

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

CONTRIBUTIONS to CoNPS are tax deductible:

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

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

Alice Eastwood Scholarship fund to help support undergraduates pursuing bachelor's degrees that advance the mission of the Society \$ _____

Mission Grant to support the mission of the Society \$ _____

Total included: \$ _____

Please make check payable to:
Colorado Native Plant Society

Send completed form and full remittance to:
 CoNPS Office
 1536 Wynkoop Street Suite 911
 Denver, CO 80202



Please Thank our 2022 Annual Conference Sponsors!





3rd place photo contest winners.

Left-to-right, starting with the top row.

Native Plants (tied): *Cypripedium parviflorum* (yellow lady slipper), Leslie Madsen; *Tradescantia occidentalis*, Bruce Tohill. **Wildlife:** *Ericameria nauseosa* (rubber rabbitbush), Steven Pearlman; *Cardamine cordifolia* (heartleaf bittercress), Kelly Kirk; *Carex* spp. (sedge) Jim Pisarowicz; *Cylindropuntia imbricata* (cholla), Sue Keefer. **Landscapes:** *Castilleja* spp. (paintbrush) by Rhianna Kirk; *Persicaria amphibia* (water smartweed), Ernie Marx. **Gardens:** *Cleome serrulata* (Rocky Mountain beeplant), Irene Shonle. **Artistic:** *Betula papyrifera* (paper birch), Ann O'Leary; *Helianthus* sp. (sunflower), Linda Smith.



Colorado Native Plant Society



1536 Wynkoop St., Suite 911,
Denver, CO 80202
<http://www.conps.org>

December 6



Show your appreciation and support of local nonprofit organizations by making a donation. <https://www.coloradogives.org/organization/ColoradoNativePlantSociety>

