

Douglasia



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To promote the appreciation and conservation of Washington's native plants and their habitats through study, education, and advocacy.



About This Issue

by David Giblin

The Spring 2019 issue of *Douglasia* brings with it not only the promise of warmer, sunnier days ahead with endless opportunities for botanical exploration (e.g., Study Weekend, Botany Washington, chapter hikes), but also a transition of the *Douglasia* production team. Managing editor Mary Johnson and Editorial Board chair Celeste Botha are stepping down from their roles and have turned over their reins to Andrea Cummins and Dr. Walter Fertig, respectively.

For the last several years Mary has diligently edited and helped produce three to four *Douglasia* issues annually. Mary's devotion to ensuring that articles were clear, concise, and stylistically harmonious raised the bar for what *Douglasia* readers can expect in each issue. Celeste oversaw the Editorial Board's transition from producing almost exclusively hard-copy content (*Douglasia*) to the current expanded offering of digital content (monthly eNewsletter). Celeste also recruited new members to the Editorial Board, thereby bringing new ideas and approaches to future issues. The Board thanks Mary and Celeste for their outstanding service and leadership, and we wish them all the best in their future endeavors.

In this issue you will find plenty of opportunities to expand your knowledge of Washington's flora, whether through propagating plants for your garden, reading about the Pacific Northwest's exceptional natural history, or getting out to explore areas rich with native plants. Enjoy!



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On the cover:

Common Camas (*Camassia quamash*) along the Goldendale-Klickitat Road with Mount Adams in the background. PHOTO: MARK TURNER

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* WNPS Fellow is the highest honor given to a member by our society. This title is given to those who have made outstanding contributions to the understanding and/or preservation of Washington's flora, or to the success of WNPS.

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Information for Contributors

Members and others are invited to submit material for publication in *Douglasia*. We now accept scientific manuscript submissions that will be peer-reviewed. Other articles, book reviews, poetry, photography, or illustrations are welcome. All materials submitted should relate to the study of Washington's native plants. Acceptance will be based on space and appropriateness, and materials are subject to copyediting (substantive editing with author's permission). Contributors are reminded that the *Douglasia* audience ranges from the professional botanist to the interested enthusiast. For more information about how to contribute, see: www.wnps.org/publications/douglasia/douglasia_contributors.html.

Email submissions to Douglasia@wnps.org.

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President's Message: The View from Here

by Van Bobbitt

Dear WNPS Members,

Since many of you don't know me, let me introduce myself. I am a native Washingtonian who grew up in the town of Camas. As a kid, I spent lots of time playing in the woods and took an early interest in native plants, especially the tasty fruits of thimbleberry and red huckleberry. Later I earned a degree in botany at Central Washington University and an M.S. at Cal Poly—San Luis Obispo. My early career work was in the landscape and nursery industries. By my late twenties, I moved into education—working for a small botanical garden, at the UW's Center for Urban Horticulture, and WSU Extension. My favorite job, though, was teaching horticulture at South Seattle College (SSC). The community college was a good fit for me—I enjoyed the mix of students and the balance between science and practical application in my teaching. While at SSC, I taught native plant and ecological restoration classes. I retired in 2015.



My membership in WNPS goes back to the early 1980s. While working at UW, I met Margaret and Joe Miller, who were regular volunteers at the Washington Park Arboretum. They asked me to run for the WNPS state board, and I served two terms during the 1980s. After that, I became a dormant member of WNPS until 2016 when I ran into Clay Antieau, then WNPS president. I mentioned that I would like to become active in WNPS again. The next thing I knew, I was a candidate for the board of directors, and I started my term at the fall 2017 board meeting. In my first year, I served as vice-president and on the awards committee, nominations committee, and Native Plant Appreciation Week committee.

So, what are my priorities as WNPS board president?

I want to continue work on several initiatives started by Don Schachtel. First, we need to determine how to wisely utilize the generous bequest from the estate of Joe and Margaret Miller. How can we use this bequest in a manner that honors the incredible legacy of the Millers and furthers our mission—"To promote the appreciation and conservation of Washington's native plants. . .?"

A second initiative, started by Don, was to encourage vibrant chapters. Chapters are your local connection to the WNPS. For WNPS to fulfill its mission, local chapters must thrive. WNPS needs to make it easier for chapters to succeed. One model that might prove helpful is a "Chapter Tool Chest" that the Native Plant Society of Texas has on their website. Check it out at <https://npsot.org/wp/toolchest/>.

Being on the Native Plant Appreciation Week (NPAW) committee, I want to make that event a better tool for promot-

ing wider enthusiasm for native plants. The current committee, under the leadership of new chair Gail Sklar, is working hard to make this year's 15th annual Native Plant Appreciation Week a success. To help chapters promote NPAW locally, the committee will be providing a "Native Plant Appreciation Week Activity Guide" created by Terri Knoke of the Columbia Basin Chapter.

And finally, I want to encourage all of you to consider taking a leadership role in WNPS. Each year, we recruit new board members. WNPS is specifically interested in candidates with the following skills, backgrounds, and expertise: (1) Fundraising experience or access to funding sources and organizations; (2) Legal background; (3) Science, conservation, or education leadership experience; and (4) Diversity—all backgrounds, cultures, and ages—especially young adults and students!

Let me know if you are interested!

I welcome your thoughts and suggestions. Feel free to contact me. I am happy to communicate by email or phone, but even better would be to meet in person over a cup of coffee or a beer.



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Big Genera: Why are Some Genera So Much Bigger than Others?

by Walter Fertig, Ph.D.

“Give me a large genus and several subgenera” wrote botanist William Griffith, “rather than the modern way [of increasing the number of genera]. This [latter], by the bye, is most illogical, for a genus, being a genus, should have a certain amount of character” (Griffith in Frodin 2004).

Although Griffith was writing in 1848, he captures the sentiments of many contemporary botanists (often called “lumpers”) who find comfort in the stability of large and familiar taxonomic groupings. Others (the so-called “splitters”) prefer taxonomic categories that are more homogeneous and smaller. The lumper vs. splitter debate may seem modern, but has actually been taking place since Linnaeus made the first revisions to his *Species Plantarum* in 1753 and decided to lump *Chamaesyce* and *Tithymalus* under *Euphorbia* and create the first “megagenus” — though with only 56 species at the time (Frodin 2004).

The concept of the genus can be traced to Caspar Bauhin in the late 1600s, decades before Linnaeus formalized species nomenclature. Bauhin recognized that some species were more similar than others and could be united by common characteristics. For example, oaks were easy to recognize as a group or “genus” because they shared similar traits, such as acorns, and clustered buds. While there were many kinds of oaks (each differing in leaf shape, pubescence, acorn features, etc.), it was easy to differentiate oaks from other genera, such as maples, pines, or sycamores.

Linnaeus formalized the use of genera and species epithets to provide a unique name for each taxon of flowering plant and animal that he recognized. Although it was the first word in the binomial, the genus name became analogous to a surname in Linnaeus’s system. Species that were similar in appearance could be placed in the same genus, but distinguished by a unique “specific epithet” that also was descriptive. While it would be another century before Darwin’s theory of evolution by natural selection provided the scientific underpinnings of taxonomy, Linnaeus’ system was remarkably useful in distinguishing and organizing different species, which is why it has remained in use to this day.

Genera vary widely in size. At a bare minimum, a genus must contain a single species, in which case it is called monotypic. Examples include false mermaidweed (*Floerkea proserpinacoides*), a tiny annual herb with three-merous flowers in the



Large-headed Sedge (*Carex macrocephala*) with pistillate inflorescences. PHOTO: MARK TURNER

Limnanthaceae, and ginkgo (*Ginkgo biloba*), a tree cultivated widely in the Northern Hemisphere but native to China (there were other *Ginkgo* species in the fossil record, but only one is

Megagenera of Washington: Top Ten List (based on Washington Flora Checklist,

<http://biology.burke.washington.edu/herbarium/waflora/checklist.php>)

Rank	Genus	Family	Total Taxa	Full Species *	Native Taxa
1	<i>Carex</i>	Cyperaceae	150	143	141
2	<i>Juncus</i>	Juncaceae	56	51	42
3	<i>Astragalus</i>	Fabaceae	49	44	47
4	<i>Trifolium</i>	Fabaceae	44	39	23
5	<i>Erigeron</i>	Asteraceae	42	39	40
6	<i>Penstemon</i>	Plantaginaceae	41	32	40
7	<i>Poa</i>	Poaceae	41	32	31
8	<i>Lomatium</i>	Apiaceae	40	40	40
9	<i>Ranunculus</i>	Ranunculaceae	40	30	32
10	<i>Salix</i>	Salicaceae	37	35	34

* excludes distinct varieties or subspecies.

extant today, making the genus monotypic by default). At the other extreme are the so-called megagenera (containing more than 500 species). Currently the largest genus in the world is *Astragalus* (milkvetch) with 3,270 species (Govaerts 1995). In all, 57 genera currently have at least 500 species. Many of these are tropical or otherwise unfamiliar to western botanists, but a surprising number of temperate genera fall into the megagenus camp, including *Euphorbia* (1,836 species), *Carex* (1,795), *Acacia* (1,353), *Solanum* (1,250), *Senecio* (1,250), *Croton* (1,223), *Salvia* (945), *Allium* (815), *Galium* (661), *Ranunculus* (600), *Quercus* (531), and *Potentilla* (500) (Frodin 2004, Govaerts 1995).

It can be difficult to predict why one genus becomes extraordinarily species-rich, while a similar or related genus does not. *Astragalus* (Fabaceae) is not just the largest genus globally, it is also the most species-rich genus in western North America with about 500 species, and the third largest in Washington with 49 taxa (44 full species and 5 distinct varieties). At least one kind of *Astragalus* is typically found in any given terrestrial habitat type, and locally endemic species or varieties are usually associated with each mountain range or major river basin in the state. Morphologically, the genus *Oxytropis* (locoweed) strongly resembles *Astragalus*, differing primarily in some technical characters of the keel petal, fruit, and stipules. Yet there are

only 300 species of *Oxytropis* worldwide (nothing to sneeze at, but less than 1/10 the number of *Astragalus*) and only 25 or so in western North America (3 species and 3 varieties in Washington). Why is *Astragalus* so much more diverse than *Oxytropis* (at least in North America) when they seem to have so much in common in appearance and habitat?

One explanation is that some groups are evolving and speciating much more rapidly than others. Much of the diversity in *Astragalus* comes from species or varieties that have become specialized on unusual geologic formations or soil types, especially ones with peculiar soil chemistry. Hyper-specialization can allow species to persist in areas where their nearest relatives cannot, and over time results in populations becoming geographically and reproductively isolated. By comparison, most North American species of *Oxytropis* are wide-ranging habitat generalists and not adapted to unusual soil conditions, thus presenting fewer opportunities for speciation.

High species richness in *Penstemon* (beardtongue), a large (but not truly “mega”) genus from western North America with about 270 species, has been facilitated by co-adaptation with specific pollinators. Bee-pollinated penstemons typically have blue flowers that vary in corolla width and positioning of the anthers depending on the body size of its pollinator. Bees often have limited foraging ranges (especially compared to birds), and so bee-serviced, blue-flowered beardtongues tend to show greater genetic diversity between populations than red-flowered hummingbird-pollinated species. If these genetically distinct local populations become isolated from other populations they can begin to diverge in morphologic and ecologic traits, eventually evolving into distinct varieties or full species.

Hybridization can result in new species if the hybrid event is coupled with a doubling of the chromosome number so that the resulting plants are fertile. In nature, hybrid speciation is fairly rare, as most species have various chemical, morphological, or phenotypic barriers to prevent pollination with the wrong type of pollen, but mistakes can happen. In the megagenus *Boechera* (rockcress, recently split from *Arabis*), diploid species are fairly distinct and recognizable, but few barriers exist to prevent hybridization and the resulting hybrid plants are often able to survive and persist through asexual reproduction (apomixis) until chance chromosome doubling events occur that make them fertile and recognizable (though cryptic) species. This odd reproductive strategy accounts for the bewildering array of rockcress taxa that are intermediate between their parent species and which have increasingly high polyploid chromosome numbers. Other complex genera with large numbers of cryptic species derived from hybridization, apomixis, and polyploidy include *Potentilla* (cinquefoil), *Draba* (draba), and *Ranunculus* (buttercup).

Some taxonomists have argued that large genera are an abstraction created by their overzealous colleagues naming too many species or varieties on the basis of trivial differences. Non-specialists might be forgiven for thinking that the megagenus *Carex* (sedges) falls into this category. With 150 taxa



Woolly-pod locoweed (*Astragalus purshii*). PHOTO: MARK TURNER

(143 species and 7 varieties), *Carex* is the largest genus in the Washington flora. Sedge identification is difficult because many of the floral characters used to differentiate species (such as perigynia, bract, and style traits) are microscopic, drab, or change based on the maturity of the specimen. In addition, useful vegetative features (such as rhizomes, leaf sheaths, or growth form) or ecological traits may not be noted on specimen labels.

In truth, sedge species are reasonably distinctive if care is taken to observe and collect individuals at the height of maturity. Sedge intermediates are actually quite uncommon in nature. The great species richness of *Carex* has been enhanced in part by local speciation in isolated mountain ranges, but is mostly due to extreme niche partitioning in wetland sites, with each species adapted to different degrees of soil moisture along a hydrologic gradient (Wilson et al. 2008). A similar pattern of extreme specialization may account for the high number of *Juncus* (rush) taxa in Washington (with 51 species and 5 varieties, *Juncus* is the second largest genus in the state flora).

Sometimes big genera have been accused of being a dumping ground for species that are not easily placed elsewhere, or which have not been sufficiently studied. Several studies have shown that large genera tend to become smaller over time as they are better researched and natural subgroups are recognized and elevated to the status of their own genus. Indeed, many of world's 57 megagenera are tropical groups that are much less understood than temperate zone genera.

Historically, taxonomists relied on differences in physical traits (especially flowers and fruits) to infer relationships among species and genera. Today this is augmented by data from genetics, cell structure, anatomy, breeding experiments, and the fossil record. Most importantly, taxonomists are collaborating more across states and continents to assess genera too large and complicated for any one person to understand. The results have been interesting and sometimes unpredictable.

New genomic data sets have ripped apart some formerly mega-diverse genera, resulting in the recognition of many smaller, but more natural groups. One such case is the genus *Eupatorium* (thoroughworts, Asteraceae), once thought to contain 800 species worldwide, but now split into more than a dozen genera, of which just 40 or so remain as true *Eupatorium*. But these new datasets also have reinforced the treatment of other large genera, and even justified re-constituting some mega-groups. Despite the best efforts of generations of splitters to break up *Astragalus*, molecular evidence supports its recognition in the usual, broad sense. Even Linnaeus's decision to lump *Euphorbia* is verified by recent phylogenetic studies showing *Chamaesyce* and other segregate genera well nested within *Euphorbia*.

If taxonomy teaches us nothing else, we should recognize that our current concepts of genera will change as new data accumulate and different analytical tools are applied. The lumpers/splitter debate isn't likely to be resolved either. Big genera will continue to exist because they help us make sense of the diversity of the plant kingdom.

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Walter Fertig is the state botanist with the Washington Natural Heritage Program. Before coming to Washington, he studied the floras of Arizona, Utah, and Wyoming.



Gairdner's Penstemon (*Penstemon gairdneri*). PHOTO: MARK TURNER

Botanizing from Mt. Adams to the Klickitat River: The Search for New and Historical Camas Lilies

by Susan Kephart, Jim Kephart, and Barbara Robinson

Floristically diverse landscapes provide marvelous sites for “botanizing,” a pursuit that enriches our lives while often revealing new species, habitats, and their functional roles in the ecosystems that sustain us. These botanical discoveries may reflect a myriad of environmental and historical factors affecting plant distributions, whether related to pollinators, soil, climate change, geological events, or human activities. They also help us understand both the history and ecological importance of rare and common plants, as well as their ability to persist or change spatially and temporally.

In this article, we describe our adventures solving two different botanical puzzles: one involving a common camas (*Camassia*) species, and the other the discovery of a much rarer species not previously known in Washington. Both of these species and the outcomes of our “botanizing” appear in the newly revised *Flora of the Pacific Northwest*, 2nd edition (Hitchcock and Cronquist 2018). This work reveals how long a historical population can persist and provides a chance for others to share possible explanations for a fascinating, unusual disjunction in the range of a rare species. We hope our botanical research will help guide the conservation management of both wide-ranging species and rare plants found in unusual habitats.

So why explore *Camassia* populations in Washington or elsewhere?

Once membered among a potpourri of unrelated “lilies,” botanists now classify *Camassia* with agaves and yuccas (subfamily Agavoideae) based on chromosomal, genetic, and morphological affinities. Camas species are morphologically variable and taxonomically difficult, but also ecologically important as foundation species that support plant-animal communities in diverse habitats. At least two species in the Pacific Northwest are already actively used in prairie, oak savanna, and wetland conservation efforts. *Camassia* includes rare and common species that may form hybrids, grow in serpentine soils, or show unusual vespertine (evening) flowering (Kephart 2015). These diverse factors create both challenges and opportunities, making *Camassia* a great genus to study while giving us insights as to the “best practices” for separating difficult species in other plant groups.

In Washington, two of the six North American species of camas, great camas (*C. leichtlinii*) and common camas (*C. quamash*) can form spectacular displays, whether growing east or west of the Cascades mountains. These wildflowers exhibit high morphological and genetic variability, leading Frank Gould in 1942 to describe eight subspecies of common camas and



Flowers of great camas, *C. leichtlinii*, showing radial symmetry and withering twists of tepals as ovaries enlarge to form fruits at FVC, Conboy Lake National Wildlife Refuge. PHOTO: JIM KEPHART



Common camas, *C. quamash* ssp. *quamash* with bilateral symmetry, separately withering tepals, and fruits appressed to stem at Weippe Prairie, ID. PHOTO: ADAM KOTAICH

two of great camas that are native to the Pacific Northwest and northern California.

Within Washington, Suksdorf's great camas, *C. leichtlinii* ssp. *suksdorfii* has a broad western distribution unlike ssp. *leichtlinii*, which is limited to southern Oregon. Common camas includes two related subspecies *azurea* and ssp. *maxima* that share closely adjacent western ranges in Washington, but on different soils (Theiss et al. 2015). East of the Cascades, two additional subspecies occur, ssp. *breviflora*, and ssp. *quamash*.

The presence and the cultural use of camas are part of traditional ecological knowledge (TEK) for indigenous peoples, including the Nez Perce, who are known to have shared their bulbs as food with the Lewis & Clark party in Fall 1805; by spring 1806, the "skye blue petals" of camas at Weippe Prairie, ID appeared as lakes of "fine clear water" (Sultany et al. 2007). There Lewis collected a specimen of *C. quamash* ssp. *quamash* now native to BC, ID, MT, and WA (Gould 1942, Hitchcock and Cronquist 2018). The Nez Perce's "qém'es" and transcribed words such as "cha-mass" later became "quamash" and "camas" in English (Sultany et al. 2007). Clearly, these fascinating plants have value culturally, ecologically, and historically as part of the lineages of both camas and all those who observe or study them!

Rediscovering the Historical Suksdorf Camas

When systematic botanists (taxonomists) seek to understand or revise a group of problematic species, we like to relocate, if possible, the original populations that the author of the species name used to describe it, or any pressed herbarium specimens and images linked to that site. For this work, Jim and I hoped to find two of the places Wilhelm Suksdorf had botanized in the early 1880s, "near Bingen" and "Falcon Valley," both cited in Greenman's 1902 description of a new camas species, *C. suksdorfii*, from his plant collections.

Prior to 2017, we had searched multiple times in areas around Bingen and on the Catherine Creek Trail north of the

Columbia River, but found only common camas, even after talking to property owners. Finally, a tip to contact Barbara Robinson, who lives and botanizes in the Columbia River Gorge, paid off. She didn't know Falcon Valley but connected us to photographer Paul Slichter and landowner Joy Markgraf, who are familiar with camas in that part of Washington. Serendipitously, Paul kindly shared a link to the online version of an article that Eugene botanist Rhoda Love published in the *Pacific Quarterly* in 1998. Therein, the elusive 1880 locale took form, revealing Falcon Valley as Suksdorf's name for the camas prairie at Conboy Lake National Wildlife Refuge. We now designate this site as Falcon Valley Conboy Lake (FVC).

With the help of Joy, Sara McFall and Trevor Scheffels, Jim and I found not only Suksdorf's great camas (*C. leichtlinii* ssp. *suksdorfii*), but also common camas. We spent 1.5 days arduously measuring flowering and fruiting plants of both species in full view of Mt Adams, with storms and the corresponding rainbow surrounding us! It is one of the largest continuous populations of *C. leichtlinii* that I've observed anywhere in CA, OR, or WA, and a befitting tribute to Wilhelm Suksdorf's legacy.

Discovering the Unusual on the Klickitat River Cliffs (KRC)

By 6 pm Friday we were exhausted and ready to head home, yet Barbara had urged us to head east via the beautiful Glenwood-Goldendale Highway, then southwest on 142 to the Klickitat River Trail. She needed definitive identification of unusual camas plants that grew along its steep cliffs but didn't seem to fit correctly either great camas or any subspecies of common camas known in Washington. We'd expected to finish at Conboy by noon; however, as it now stood, in a few hours nightfall would be upon us. We nonetheless headed towards Klickitat arriving at dusk just in time to measure a few plants and take pictures. Our interest piqued, we returned twice more in 2017-2018 to capture plants in fruit as well.

What is so novel about these camas plants, nestled in rocky crevices and trailside catchments where water rivulets seep from the cliffs along the Klickitat River Trail? (see habitat photo next page) The answer lies in geography, endemism (narrow geographic distribution), and deciphering the "maze" of morphological variability that characterizes camas plants and the names assigned to them across the years. For example, camas flowers often show radial (great camas) or bilateral symmetry (most common camas) but can be asymmetric. Yet, symmetry varies among plants or sometimes along a single flowering stem (inflorescence) due to differences in developmental stage or genetic makeup. Thus trait assessment may require more than one visit to a population if plants are not in full flower and fruit. For instance, old flower petals wither separately at the base of the flower and/or fruit in common camas subspecies, but in great camas twist together over the top of the enlarging ovary, falling off like a "cap" as the fruit forms.



Plants of *C. leichtlinii* in a wetland prairie at Conboy Lake, estimated to be the Falcon Valley site observed by Wilhelm Suksdorf in 1880 and 1883. PHOTO: JIM KEPHART



Camas plants at KRC growing along rocky cliffs and seeps along the Klickitat River Trail, south of Klickitat, WA. PHOTO: BARBARA ROBINSON

Not surprisingly, some visitors to the KRC population have seen tall plants with wide leaves and radially symmetric flowers reminiscent of great camas, while others may have noticed the lighter blue color and separately withering tepals of old flowers and at fruit bases, all atypical of great camas but a good fit for many common camas. When confused by plant traits, sage botanical advice argues: try another key, look for possibilities



Multiple-stemmed fruiting clump (genet) of *C. cusickii* with tepals withering separately with age. PHOTO: JIM KEPHART

outside that geographic range, or, if all else fails, consult specialists to see if the plants might be a new species.

So what did we learn at dusk late that Friday night in 2017 as Memorial Day weekend began, while missing our favorite soft chocolate ice cream stop at Cascade Locks? Amazingly, the plants were clearly Cusick's camas (*C. cusickii*), indistinguishable from the large populations we tromped through many times at Hells Canyon Overlook in Oregon, in the heart of the Snake River region. There *C. cusickii* grows, presumed endemic to just a few counties in OR and ID.

The rocky, wet slopes above the Klickitat river resemble other Cusick's camas habitats. At KRC, we recognized instantly the large plants; the clonal, clustered habit of the bulbs of Cusick's camas, and the numerous basal leaves (often 10 or more) that support up to 20-40+ flowering stalks all arising from closely adjacent basal shoots of the same plant (genet). Here Cusick's camas sports large inflorescences with variably radial, bilateral, or asymmetric flowers whose tepals wither separately as fruits form. Sometimes the multi-stemmed plant clumps visually reveal their hereditary distinctness from adjacent genets by early flowering, delayed fruiting, or differing flower color as in rare white albino plants found in many camas species. Molecular phylogenetic analyses (Archibald et al 2015) now show the close relationship between Cusick's camas and common camas predicted by Gould (1942). Although he missed the hybrids

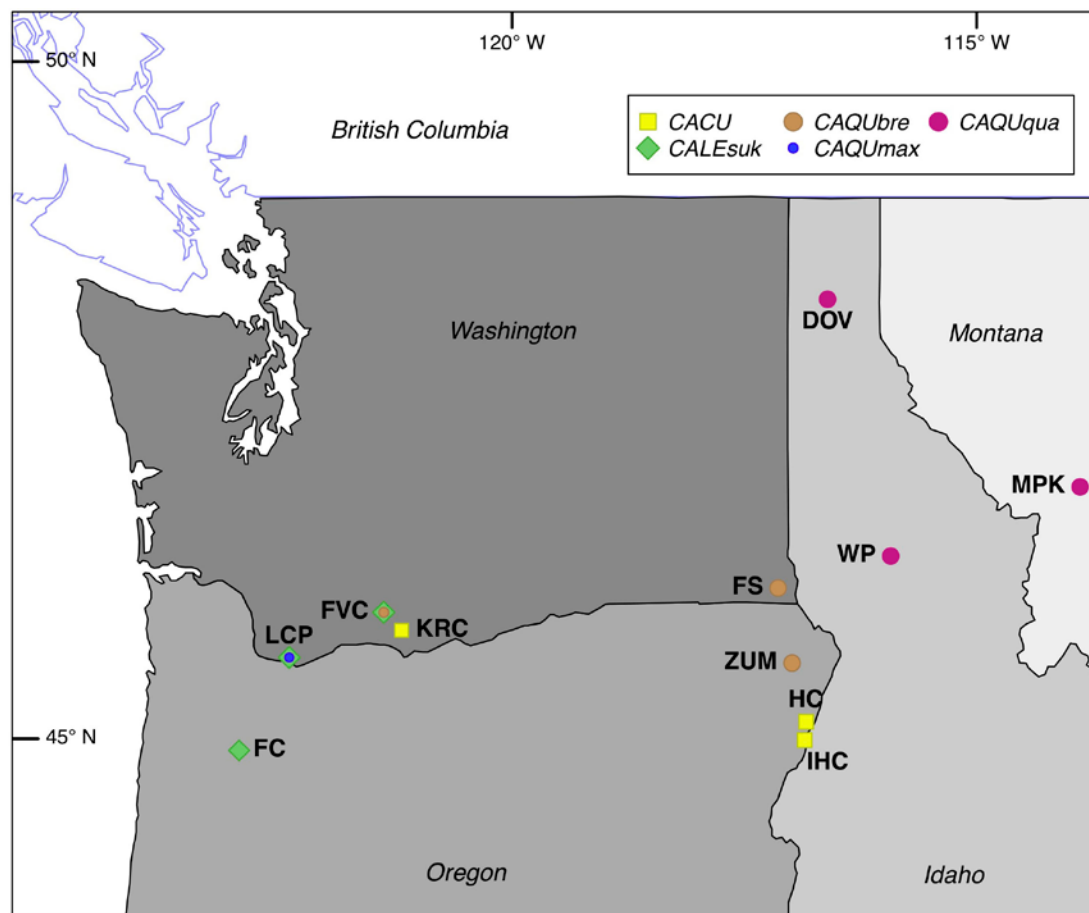


Multi-stemmed flowering inflorescences of *C. cusickii* at KRC, here shown with many light blue radial to asymmetric flowers. PHOTO: SUSAN KEPHART

between common camas and great camas, he noted correctly their ability to remain distinct (Uyeda and Kephart 2006).

Supportive Evidence for Suksdorf's and Cusick's camas

Qualitative, descriptive traits and simple quantitative counts allowed us to affirm the persistence today of Suksdorf's historic camas meadow at FVC and establish the rare presence of Cusick's camas at KRC, far from the Snake River Canyon region of Oregon and Idaho. Even so, quantitative morphological data, and ultimately genetic analyses of DNA isolates from these plants, are important for confirmation and potential insights into their genetic history and the extent of gene flow among populations in different geographic areas.



Geographic locations of all study sites compared with Klickitat River Cliff site (KRC) populations for each CACU, CALEsuk, CAQUbre, and CAQUqua. Site abbreviations are listed in charts on page 9.

For each population sampled, we measured at least 10-20 individuals for 10 or more flowering and fruiting characteristics. We also analyzed flowering traits for at least 20 individuals sampled along transects of both common and great camas populations at FVC and for 10 individuals at KRC. We ran Principal Component Analysis (PCA) to compare data for KRC plants of Cusick's camas with each possible common camas or great camas species and subspecies known to occur in central or eastern Washington, along with classic Cusick's camas sites in Oregon and Idaho. PCA distills multiple traits

into eigenvectors that explain the greatest percentage of the variation in the data. As evident from our analyses, great camas is most readily separable from Cusick's camas based on the multiple traits measured, but the common camas ssp. *breviflora* and ssp. *quamash* populations are also distinct from Cusick's camas along the X and Y axes denoting Principal component 1 and 2. In all comparisons, KRC plants clustered with Cusick's camas, confirming it as the correct name for these puzzling WA plants.

Conservation and Implications for the Future

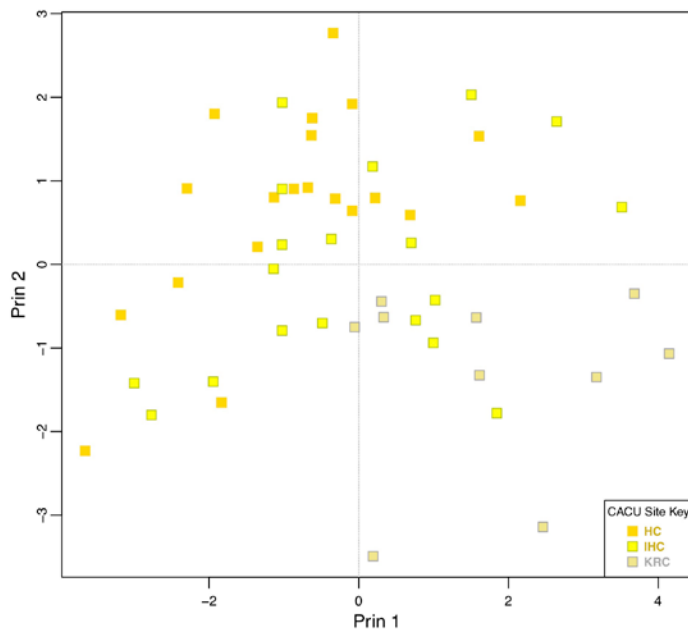
Notably, we found Suksdorf's camas at Conboy Lake Wildlife Refuge (FVC) and Cusick's camas along the Klickitat River Trail (KRC) growing east of the Cascades, in areas that are botanically rich yet perhaps less often studied than populations

in western Washington. The FVC site lies SSE of Mt Adams but north of the Columbia Gorge in the transition zone defined by the ridge of the Cascades from Mt Adams to Mt Hood. Many years ago Gould (1942) wrote that various common camas species intergrade in this zone. Today the Conboy Lake Wildlife refuge is the first well-documented location that common camas ssp. *breviflora*, distributed east of the Cascades, and great camas ssp. *suksdorfii* occur in close sympatry (i.e., in distinct patches or intermingled), making it an important site for future study. It is the easternmost great camas population I've observed for a plant that largely grows west of the Cascades in Oregon and Washington.

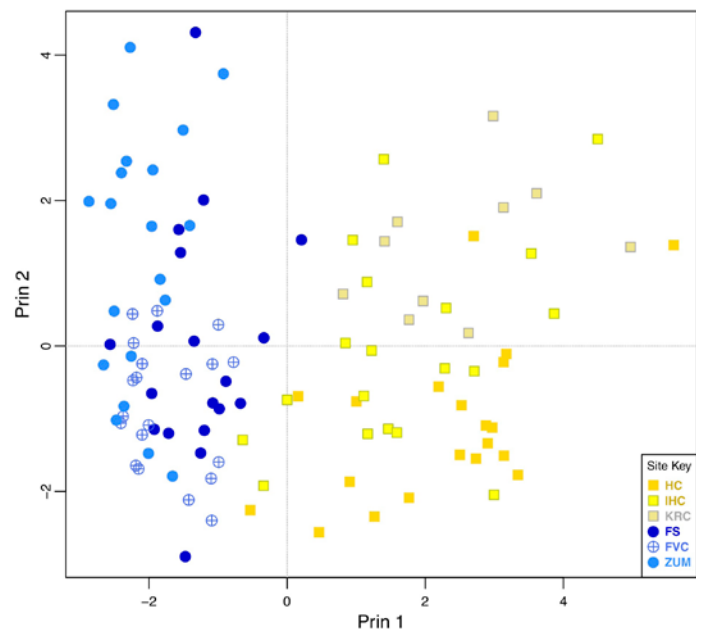
Cusick's camas at KRC occurs over 200 air miles from the closest known population in Oregon. This large

disjunction, far outside the core range of Cusick's camas, is still an enigma as to how the plants arrived at KRC, or how long they have been there. Both the Snake and the Klickitat rivers flow into the Columbia and although Cusick's camas seeds can germinate after immersion, in this case, the seeds would have to travel upstream! This suggests that birds or humans may have carried seeds or bulbs, or that older geological events may play a role that we have not yet explored. We welcome your ideas!

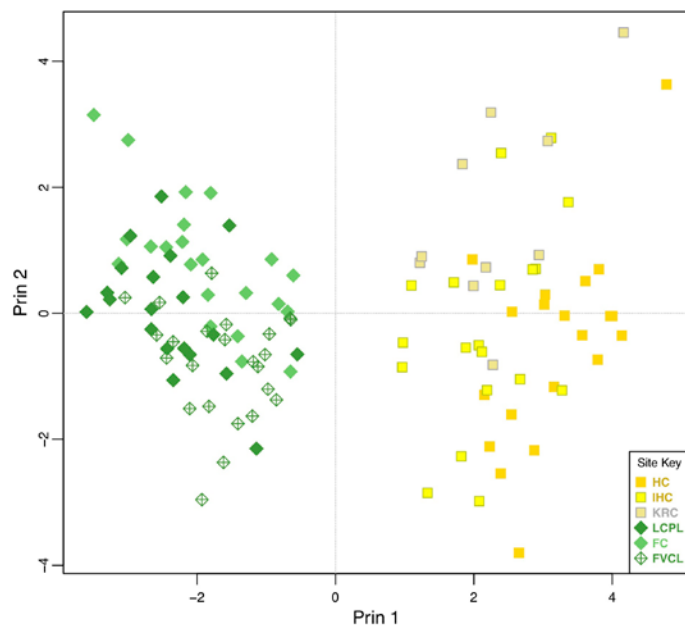
Available data from the Washington Natural Heritage Program website (<https://www.dnr.wa.gov/NHPlists>) suggest that



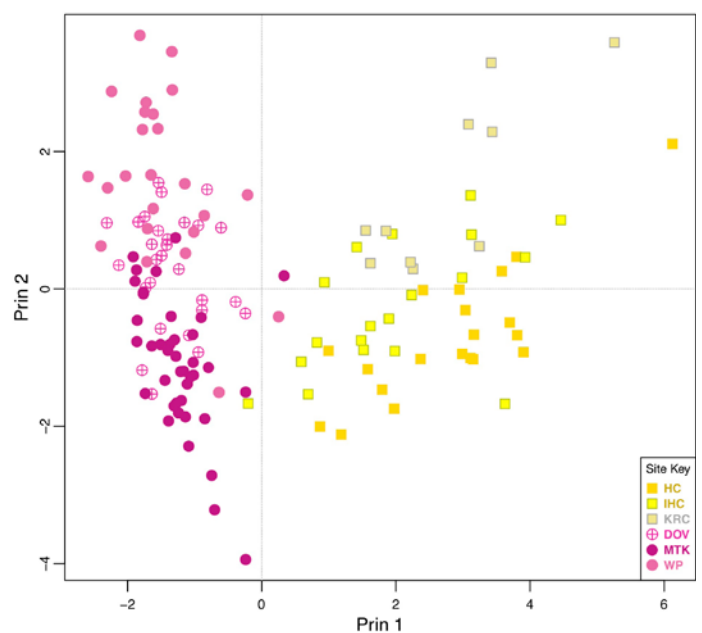
Graphical displays of Principal Component Analyses depicting the first two components on the X and Y axes for 10-20 individuals of *C. cusickii* at Hells Canyon (HC) Overlook in OR, Idaho Hells Canyon (IDH), and along cliffs of the Klickitat River Trail (KRC) in WA.



C. cusickii compared with *C. quamash* ssp. *breviflora* at Falcon Valley (FVC), Field Springs roadside (FS) in WA, and Zumwalt Prairie (ZUM in OR).



C. cusickii compared with *C. leichtlinii* ssp. *suksdorfii* at Falcon Valley (FVCL) and LaCamas Prairie (LCPL) in Camas, WA, and Fruitland Creek (FC in Salem, OR).



C. cusickii compared with *C. quamash* ssp. *quamash* at Dover, ID (DOV), Pattee Canyon near Missoula, MT (MTE), and Weippe Prairie (WP), the type locality for *C. quamash*.

“rare or at risk” populations include about 13% of vascular plant species in Washington. Floristic quality assessments (FQAs) further identify at least 2025–2794 native plant species comprising 74% and 81% of the total plants in western and eastern Washington, respectively (Rocchio and Crawford 2013). Such assessments on both sides of the Cascades can help us locate important remnants of communities that may be either more vulnerable or better able to withstand disturbance while still retaining their historical, or “natural,” vegetational characteristics and functions.

As foundation plants, both rare and common species of camas lilies may be valuable in addressing how populations respond to climate change and other human-induced disturbances. More research is needed on the genetic relationship between present day camas populations and important traditional sites of First Peoples. Such genetic signatures, while not always detectable (Tomimatsu et al. 2009), would have cultural as well as botanical value.

Finally, creating useful keys and stable classifications is challenging for species whose morphological traits are difficult

to distinguish. However, such taxonomies allow us to make informed predictions and decisions that we apply daily in agriculture, conservation, and medicine. First-hand field observations are essential for accurate assessments of plants. Even with new genomic tools, species distinctions can be contentious because the traits that define them vary spatially and temporally as environmental contexts change. It is precisely such changes that make plants, including camas, so fascinating to explore in their natural habitats.

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Acknowledgements

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Rone's Biscuitroot (*Lomatium roneorum*): A New-to-Science Endemic of the Wenatchee Mountains

by Connie McCauley

It is not often that a species of native plant is recognized as new to science, especially when it is found in an area that is hiked and biked with some regularity and, in this case, is located on National Forest land near the Leavenworth Ranger District office and the Leavenworth Ski Hill. I first became aware of this *Lomatium* (biscuitroot) species several years ago when my friend Mall Boyd and I were hiking in the area. When we spotted this beautiful plant, we knew we were looking at a *Lomatium*, but this was not a *Lomatium* we had seen in our area before.

Wenatchee Valley Chapter member Ted Alway had introduced us to the endemic Wenatchee Mt. *lomatium* (*L. cuspidatum*) on a Wedge Mountain hike some years earlier. Wedge Mountain is just a few miles away as the crow flies from “our biscuitroot.” At the time, we thought this plant appeared to be a possible variant of *L. cuspidatum*. Both species have umbels



Rone's biscuitroot (*Lomatium roneorum*). PHOTO: CONNIE McCAULEY

typical of plants in the Apiaceae (Parsley Family); they have fine, rather dense foliage and they are found in open, exposed, rocky habitat. But rather than the maroon flowers of the Wenatchee Mt. *lomatium*, this plant has what *Lomatium* expert Mark Darrach calls “brassy yellow flowers,” and the foliage is noticeably more blue-grey or sage colored than other species we see regularly. So, when we heard rumors of a new, as yet unnamed, species of *Lomatium* in the Ski Hill area, we quickly realized it had to be “our special” *Lomatium*.

In January, when our WNPS Wenatchee Valley Chapter President, Emily Orling, asked for nominations for the 2017

Chapter Plant of the Year, this *Lomatium* seemed the logical choice — even if it remained “nameless.” Apparently, those attending our annual February social agreed, as they chose this plant over two other nominations.

First spotted and collected by an individual named G. Patrick nearly thirty years ago, a specimen of this *Lomatium* has apparently been sitting unnamed in the basement of the University of Washington’s Hitchcock Hall since 1987. Only recently has this plant jumped into the spotlight when it became the focus of a news article about research botanist Mark Darrach’s non-profit auction of the naming rights for the species (Schwing, E. 2017). Though the auction took place in late fall of 2017, the names of the auction winner(s) and their choice of a name were not known until March of 2018. I can’t call it the “nameless” *Lomatium* any longer, Rone’s biscuitroot (*Lomatium roneorum*) is now the official name. The auction winners are a Wenatchee couple, and the name honors the wife, whose maiden name is Rone.



Rone’s biscuitroot (*Lomatium roneorum*) foliage. PHOTO: CONNIE McCaULEY

I recently called Lauri Malmquist, long-time Leavenworth Ranger District botanist, and asked her if she knew the history of how this plant was first recognized as a unique species. According to Lauri, about 10 years ago Thayne Tuason, a seasonal botanist with the Leavenworth Ranger District, noticed this plant on the steep ridge above the Ski Hill. A visit to the site by Lauri, Joan Frazee, and Don Knoke confirmed that it was likely an undescribed species. I asked Lauri why formal identification, classification, and naming had taken so long. She called the process a “species novum,” explaining that to publish information related to a species can be a very time consuming and expensive process. At some point Mark Darrach, likely because of his expertise with plants of the genus *Lomatium*, was alerted to the possible new species by Joan Frazee.

After visitations to see *Lomatium roneorum* in the wild, collecting specimens, and researching the relationship of this plant to other members of the genus (using molecular techniques - DNA), Mark has determined that this is a separate

and unique species, related to but clearly separate from, *L. cuspidatum* (Darrach, M.E. 2018). He reports that the genetic analysis was not particularly conclusive, but the determination was clear based upon distinctive morphological, ecological, and geographic differences.

Lomatium roneorum is found growing on Chumstick Formation sandstones and metamorphic rocks of similar overall chemistry, rather than the serpentine substrate where *L. cuspidatum* is found. It is also found at lower elevations (1,500 to 2,000 feet). *Lomatium cuspidatum* is typically found between 3,000 and 8,000 feet. These differences, in addition to the morphological (flower color and leaf structure) differences, separate the two species. Mark believes that there may be as few as 1000 plants of this new species, all located within a small area with just three known locations, all near Leavenworth. That makes it not only “new” but also very rare. Mark calls it a “narrow endemic,” and that makes it one more of a number of endemic plant species found only in the Wenatchee Mountains.

As I remember the location where we first spotted these special plants clinging to the exposed, dry ridgeline, my thought is that this is a “tough little plant” — but its future is not necessarily rosy. Invasive plants, especially cheatgrass (*Bromus tectorum*) and Dalmatian toadflax (*Linaria dalmatica*), along with human impacts are threats to its survival. Though wildfires are a potential concern, Mark reminded me that *Lomatium* species tend to recover from fire given their deep roots. Whether this species is tough enough to survive these threats, along with the ever-increasing presence of people, their pets, and changes to our environment, remains to be seen. Perhaps Mark Darrach’s efforts to classify, name, and increase awareness of this special new species will be its best hope of continuing to cling to the ridgelines above Leavenworth.

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Connie McCauley is a self-taught botanist and long-time member of the Wenatchee Valley Chapter WNPS; and is a locally known expert on the flora of the Leavenworth Ski Hill.



Preventing the Introduction of Noxious Weeds

by Wendy DesCamp, Washington State Noxious Weed Control Board

Noxious weeds can cause many detrimental ecological and economic impacts when they invade our diverse landscapes in Washington. Preventing their introduction should be a high priority for all Washingtonians — gardeners, homeowners, outdoor enthusiasts, farmers, and public land managers — as their impacts can affect all of us. Garlic mustard, spurge flax, and European coltsfoot are a few of Washington's noxious weeds that can be used to provide examples of how to prevent the spread of noxious weeds to new locations. Currently, these species have fairly limited distribution state-wide, and preventing their introduction to new areas is a high priority for County and State Noxious Weed Control Boards.

Garlic mustard, *Alliaria petiolata* (M. Bieb.) Cavara & Grande — Brassicaceae (Mustard Family)

This Class A noxious weed in the mustard family has been aggressively controlled in Washington since its first discovery in 1999 and its listing as a noxious weed in 2000. Until 2012, garlic mustard was only known to grow in western Washington, at that time occurring in five counties. That year, two eastern Washington counties, Okanogan and Spokane, discovered garlic mustard populations, and since then plants have also been discovered in Grant County. Though County Noxious Weed Boards and land managers highly prioritize garlic mustard control, in some areas such as in Spokane County, populations are persisting and expanding.

Garlic mustard is a difficult plant to control due to its high seed production, its ability to self-fertilize, and the long-term viability of its seeds in the soil. Commonly found in forested

areas, garlic mustard seeds can be easily spread by passing hikers, animals, and equipment used in the area. It is important to clean soil and weed seeds from shoes and equipment when leaving a forested area — even if garlic mustard is not known to be in the area. More trailheads are being equipped with boot brush stations, allowing hikers to clean off their shoes before and after they hike to prevent introducing weed seeds into natural areas or spreading them to other locations. You can also carry cleaning equipment, such as a brush with stiff bristle, so you are prepared in case no cleaning equipment is available. Additionally, make sure to check and clean animals such as horses and dogs that are taken on trails, to prevent them from spreading weed seeds.

Spurge flax, *Thymelaea passerina* (L.) Coss. & Germ. — Thymelaeaceae (Mezereum Family)

This Class B noxious weed, known so far to occur only in Okanogan County, is a wiry annual that spreads by seed and is difficult to see, making surveying a challenge. Seeds appear to spread readily on wildlife, all-terrain vehicles, and other equipment passing through populations. In recent years, with wildfires burning in the area, larger numbers of off-road and fire suppression vehicles have been traveling through the county and infested areas. Setting up washing stations for vehicles traveling in and out of areas of infestation can reduce the possibility of spreading plants to other areas.



Off road activity through a site of spurge flax during the fall of 2016.
PHOTO: OKANOGAN COUNTY NOXIOUS WEED CONTROL BOARD



Cleaning shoes with a scrub brush after visiting the garlic mustard infestation in Okanogan County to prevent spreading seeds to new locations. PHOTO: WSNWCB

Spurge flax is thought to have been introduced into Okanogan County in the 1990s from hay contaminated with its seeds. In order to combat this type of seed introduction (since 2009) commercially processed feed pellets and/or certified weed-free straw and feed are required for all USDA Forest Service lands in Pacific Northwest National Forests. This requirement, along

with other requests for certified weed-free forage, helped to create the Washington Wilderness Hay & Mulch Management (WWHAM) Program, administered through the Washington State Department of Agriculture (WSDA). Information about the program can be found on WSDA's website: <https://agr.wa.gov/PlantsInsects/WWHAM/WWHAM.aspx> or by contacting PlantServices@agr.wa.gov or (360) 902-1874.

European coltsfoot, *Tussilago farfara* L. — Asteraceae (Composite Family)

This new Class B noxious weed, listed in 2018, is a rhizomatous perennial that sends up its flowering stems in the early spring, followed soon after by larger, basal leaves growing from its rhizomes. Populations are known to occur in western Washington, with plants thriving on disturbed soil and in riparian areas. Besides seeds and rhizomes being spread via rivers and streams, plants have also been found growing in aggregate piles, such as gravel, where they can thrive and be easily introduced to new locations wherever the infested product is introduced.

Washington State does not have a weed-free gravel and aggregate program, but a number of County Noxious Weed Control Boards do work with local purveyors of aggregates to inspect and provide guidance on weed control. The State Weed Board encourages the voluntary use of the North American Invasive Species Management Association's Weed Free Gravel Standards, which can be found on their website: <http://www.naisma.org/weed-free-gravel>.



European coltsfoot growing throughout a gravel pile prior to control in King County. PHOTO: TRICIA MACLAREN, KING COUNTY NOXIOUS WEED CONTROL BOARD

Another potential threat — Online plant sales

A potential new avenue of noxious weed introduction into Washington State is through online plant sales. The Washington State noxious weed list and the Washington State quarantine list are two separate lists, and many but not all of our noxious weeds are included on the quarantine list. As written in the noxious weed seed and plant quarantine law, WAC 16-752-600, "It is prohibited to transport, buy, sell, offer for sale, or distribute plants or plant parts of the regulated species listed

here into or within the state of Washington or to sell, offer for sale, or distribute seed packets of seed, flower seed blends, or wildflower mixes of these regulated species into or within the state of Washington."

While local nurseries are aware of and follow the quarantine law about not selling plants on the quarantine list, this may not be the case with online retailers. WSDA's Plant Services Program has increased its communication with online retailers, notifying them of the quarantine list when these noxious weeds appear to be available for purchase in Washington. They have also worked with Amazon to provide Washington State quarantine information for online retailers. Further information about the quarantine list can be found WSDA's website: <https://agr.wa.gov/PlantsInsects/NurseryInspection/NurseryInspection.aspx>. Reports of quarantined noxious weeds suspected of being sold in Washington can be made to the plant services program at nursery@agr.wa.gov.

While this information may not be new to some, it is important as ever to remind ourselves and to teach others. Clean your shoes, equipment, and vehicles before leaving weedy sites to prevent spreading seeds. Clean off boats, trailers and other aquatic equipment to prevent spreading invasive plants as well as other aquatic invasive species, following the principles of clean/drain/dry. Find out additional information on the Washington Department of Fish and Wildlife website: <https://wdfw.wa.gov/ais/>. When possible, buy weed-free forage and inspect other items such as soils, gravel and other aggregates for weeds before purchasing. Be careful of online plant sales; identify or ask for help in identifying unknown plants to see if they are noxious weeds or other invasive plants before planting in your garden.

Additional information about noxious weeds can be found on our website, www.nwcb.wa.gov, and please contact me with questions at wdescamp@agr.wa.gov and 360-725-5764.



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Botanizing 243

Along the Columbia

by Mark Turner

Although I live near the coast, I love visiting the warm, dry country of eastern Washington in the spring. Flowers bloom earlier, and there's a great deal of species diversity that we just don't have in west-side forests. One of my favorite places, along Washington Route 243 in Grant County, doesn't even require much hiking — it's roadside botanizing at its best.

I was first introduced to the area around Vantage in the early 1990s when I was an active rock climber, and I've been visiting the area most years ever since. But it wasn't until 2003 that I really began exploring for flowers in the area. That spring Don Knoke took me to a special place that many botanists call the basalt garden. The plant list for the area (available on the WNPS website at https://www.wnps.org/plant-lists/list?Basalt_Gardens) was originated by Art Kruckeberg in 1986 and was later updated by Don in 2004 and 2006.



Aerial view of the basalt garden in autumn. PHOTO: MARK TURNER

The first few times I visited the basalt garden, which is on the uphill side of the highway at MP 26 about five miles south of the Vantage bridge, you could drive right in. There was an unmarked pull-off that looked like the off-road vehicle folks were using the place for a playground. And they were. There were also piles of junked appliances among the wildflowers. The place has since been cleaned up, and the last time I visited the US Bureau of Reclamation had constructed a wooden fence across the entrance to prevent vehicle access. That's a good thing, because there are many species that grow in the sandy soil there. In fact, I photographed 15 of the plants that appear in *Wildflowers of the Pacific Northwest* at the basalt garden.

There are no trails at basalt garden, but there is a network of old roads across the sand. Wander at will across the area, always mindful of where you put your feet. Some plants, like the tiny

shy gilia (*Gilia sinuata*), white-stemmed stickleaf (*Mentzelia albicaulis*), or low pussytoes (*Antennaria dimorpha*) are easy to miss.

Some of my favorites from the area are much showier. Pale evening primrose (*Oenothera pallida*) forms large patches, as does white sand verbenas (*Abronia mellifera*). On rockier areas look for Gairdner's penstemon (*Penstemon gairdneri*) or round-headed desert buckwheat (*Eriogonum sphaerocephalum*). The common Carey's balsamroot (*Balsamorhiza careyana*) is abundant among the sagebrush (*Artemisia tridentata*) at the base of the basalt cliffs. I'm not a grass expert, but even I could easily recognize clumps of bluebunch wheatgrass (*Pseudoroegneria spicata*) and Indian ricegrass (*Achnatherum hymenoides*).

I could spend the better part of a day botanizing in the basalt garden, but there are other interesting places along Route 243 as you head south toward Vernita Bridge.



An unusually large clump of the tiny shy gilia (*Gilia sinuata*), photographed in the wet spring of 2006. PHOTO: MARK TURNER



Pale evening primrose (*Oenothera pallida*). PHOTO: MARK TURNER

***Asarum caudatum*: Our Wild Ginger (Well, Not Really a True Ginger)**

by David Giblin, Ph.D. University of Washington
Herbarium, Burke Museum

The use of common names in the study and appreciation of natural history lowers the barrier to learning by avoiding unfamiliar word combinations from a dead language (i.e., scientific names often based in Latin or ancient Greek). However, common names do carry with them the potential to confuse evolutionary relationships. For example, here in Washington we have the flying squirrel (*Glaucomys sabrinus*) and western gray squirrel (*Sciurus griseus*), the orange-crowned warbler (*Oreothlypis cellata*) and the yellow warbler (*Dendroica petechia*), and the cutthroat trout (*Oncorhynchus clarkii*) and brook trout (*Salvelinus fontinalis*). In each instance the genus name differs for each common name pair, therefore indicating no close evolutionary relationship. This phenomenon of common names shared by unrelated species at the level of genus is worse for plants because there are so many more of them than mammals (about 80x more), birds (about 40x more), and fish (about 10x more).

A case in point from our own flora is what we call “wild ginger” (*Asarum caudatum*). Many people know edible ginger, *Zingiber officinale*, a rhizome (modified stem and not a root) commonly used to season dishes. *Zingiber* belongs to the monocot family Zingiberaceae (Ginger Family) and is native to tropical and subtropical forests of Southeast Asia. Edible ginger was well-known nearly worldwide long before John Lindley described *Asarum caudatum* in 1831.

Wild ginger is native from coastal areas of British Columbia to central California, and inland from southeastern British Columbia to northeastern Oregon, northern Idaho, and western Montana. It belongs to the Aristolochiaceae (Dutchman’s-pipe family), a dicot family mostly native to subtropical and tropical areas worldwide. About the only thing that the genus *Asarum* and *Zingiber* have in common is the aroma produced by breaking or scratching the rhizomes. While this chemical conver-



Veiny dock (*Rumex venosus*). PHOTO: MARK TURNER

Keep your eyes open as you drive past the Priest Rapids dam for large patches of veiny dock (*Rumex venosus*), with its bright red bracts and even larger expanses of round-headed desert buckwheat (*Eriogonum sphaerocephalum*) with mounds of golden blossoms.

Another of my favorite stopping points is at the junction of 243 and Road L SW, just before you get to Vernita Bridge. Here, on what looks like pure sand, I’ve found tidytips (*Layia glandulosa*), the diminutive cushion cryptantha (*Greeneocharis circumscissa*), Franklin’s sandwort (*Eremogone franklinii*), and Columbia cut-leaf (*Hymenopappus filifolius*). Park along the roadside and meander across the sandy soil, keeping your eyes open for plants. There are certainly other places to botanize along this stretch of the Columbia, including Gingko Petrified Forest State Park on the Kittitas County side of the river and Frenchman Coulee, a few miles north of the Vantage bridge. Those are the first two places I explored in the area and I keep going back to both of them, too.



Wild ginger (*Asarum caudatum*). PHOTO: MARK TURNER

gence is interesting, it is of no taxonomic significance, but could explain the origins of the common name wild ginger.

Though not a true ginger, *Asarum caudatum* is nevertheless a fascinating plant. Here in Washington it is a common understory species in forested areas across the state. Due to its rhizomatous nature, the plants tend to form somewhat loose mats. The simple, somewhat-glossy, palmately-veined leaves are distinctively kidney- (reniform) to cordate-shaped (heart-like) and arise from subterranean rhizomes. While the rhizomes are not useful for culinary purposes, some Native American tribes used the plant for treating headaches, intestinal pain, knee pain, indigestion, boils, tuberculosis, and colic, and as a general tonic (Moerman, 1998). To me, the most striking elements of this species are the distinctive morphology and color of its flowers.

Each flower is urn-shaped with three narrow appendages spreading horizontally and radially from the top of the urn. Note that these appendages are actually sepal lobes and not petals. In the genus *Asarum* the petals are absent or barely visible as scales. Inside the urn-shaped, basally fused portion of the sepals is a white background often with purple striping. Note that there are 12 anthers crammed in here as well. Finally, the flowers are typically hidden beneath the foliage, so you'll have to push aside the leaves to see all of this. "Hidden" flowers are not a typical presentation style by plants, so there must be an interesting reason for this type of evolutionary adaptation.

It was long-thought that wild ginger flowers were fly-pollinated because the flowers have the color patterning of flowers imitating or smelling like rotten flesh (carrion). However, field research has shown that most flowers are almost exclusively self-pollinated (Lu, 1982). Additionally, wild ginger flowers also exhibit a timing of pistil versus pollen maturation that is common among "selfing" species. Most plant species that are out-



Wild ginger flower. Note the white pollen atop the anthers and the white interior coloration of the urn with purple markings. PHOTO: WALTER SIEGMUND. CC BY-SA 3.0

crossing (i.e., pollen fertilizes the ovules of different plants in the population) have the pollen mature first so that it does not fertilize flowers on the same plant. In the case of wild ginger, the female flower parts mature first (protogyny) so that when the pollen is mature each flower can receive its own pollen.

Perhaps another reason why wild ginger flowers are held close to the ground is because the seeds are dispersed by ants (myrmecochory). Wild ginger produces fruits in the form of dry capsules, and if you open one up you will find small brown seeds, each with a fleshy appendage. This appendage provides nutrition to the ants that drag the seeds away from the plant and cache them in their underground colony — a convenient way for seeds to be dispersed and "sown."

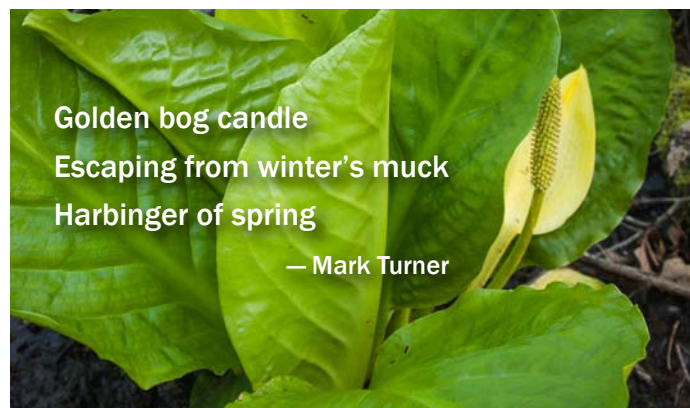
Despite not being a true ginger, *Asarum caudatum* is a most remarkable member of our native flora that deserves close inspection on any forest walk.

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Leaves and growth habit of wild ginger. PHOTO: ROBERT FLOGAUS-FAUST. CC BY 4.0



Golden bog candle
Escaping from winter's muck
Harbinger of spring
— Mark Turner

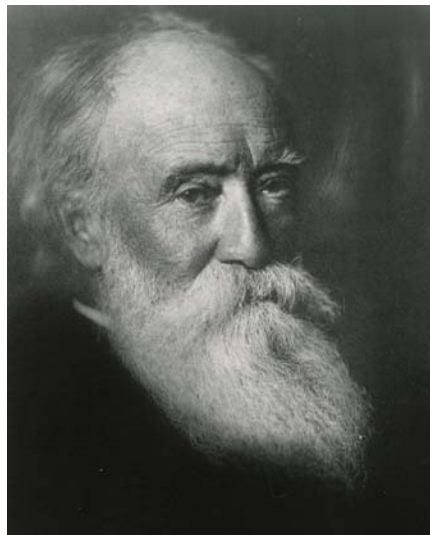
John Burroughs: Father of American Wildflower Guides

by Frank Knight

Farm Boy to School Master to Literary Naturalist

John Burroughs (JB) is widely acknowledged as the Father of the American Nature Essay. It is less well-known that JB also inspired popular American wildflower guides, soon emulated by field guide authors for most groups of plants and animals. These many guides from several publishers far exceed all of Burroughs' own writings. Here is the account of JB's wildflower guide fatherhood.

Son of a dairy farmer, John Burroughs (1837-1921) attended a one room school in rural Delaware Co., NY; the only of his siblings with the spark of genius. A voracious reader, young Burroughs' real teacher was books purchased with any money earned. Attending a teacher training institute became a compelling goal, so at age 17, JB found a teaching position nearby; the



John Burroughs. PHOTO: COURTESY AMNH

first of nine school master positions he held between 1854 and 1863. Fifty dollars earned from teaching paid for a term of study at the Hedding Literary Academy, and another at the Cooperstown Seminary – the total of his formal education.

Natural history was not on the curriculum of these institutions. Ironically, JB's lack of formal science training likely spurred his success as the foremost naturalist of his time. In the 19th century, natural science was lifelessly taught from texts, prompting Louis Agassiz' famous quote, "Study nature, not books." Studying nature, Burroughs discovered the beauty and wonder that would soon so endear him to his readers. At age 26, while teaching near West Point, JB rekindled his childhood passions for observing nature. On spring walks in the woods and a Military Academy campus walk with visiting lecturer Ralph Waldo Emerson, JB soon thought himself a naturalist. Giving up teaching, JB moved to the nation's capital in 1863 to start writing.

In Washington, JB met and befriended Walt Whitman, who was there to comfort the war wounded. Whitman suggested the title *Wake-Robin* for Burroughs' first volume of essays. Taking a position in a vault of the U.S. Treasury, Burroughs began writing the more than 400 essays published in 23 volumes by

Houghton Mifflin from 1871 until after his death in 1921. These essays on plants, animals, farm life, and later literary criticism and philosophy, often first appeared in popular periodicals. Burroughs left D.C. in 1872 to build his home for wife Ursula beside the Hudson River near Poughkeepsie, NY. By 1885 he was a full-time table grape farmer and writer; his fame growing with each new volume.

Trying to identify new plant finds in woods and fields, JB was frustrated with the sparsely illustrated, very technical botany manuals then available. He proposed a starkly simpler alternative:

One of these days some one will give us a hand-book of our wild flowers, by the aid of which we shall all be able to name those we gather in our walks without the trouble of analyzing them. In this book we shall have a list of all our flowers arranged according to color, as white flowers, blue flowers, yellow flowers, pink flowers, etc., with place of growth and time of blooming.

Mrs. William Starr Dana – Guides East Coast Origins

New York socialite Frances Theodora Dana (née Smith) (1861-1952), read Burroughs' plea in an 1887 essay "Among the Wild Flowers" in *Century* magazine (later published in Vol. 9: Riverby [1894] of his collected essays); and would grant his wish with *How to Know the Wild Flowers*, (Scribner's 1893).

Educated at a girls' finishing school, Francis married Navy Commander William Starr Dana in 1884. Dana perished in a flu epidemic while posted in Paris in 1890. Clothed in mourning black with restricted social contacts, Frances was enticed by her friend Marion Satterlee to join her on country walks; reawakening Frances' childhood wildflower interests. This inspired Frances' first book under, as was then the custom, her husband's name. With no formal botany training, but with great organizational skills, her field guide was a big success, helped by Satterlee's excellent pen-and-ink drawings.

Frances' book inspired many other popular guides over the years (see Chronology below) that would have more and better color plates as printing techniques became less expensive. Despite the competition, *How to Know the Wild Flowers: A Guide to the Names, Haunts, and Habits of our Common Wild Flowers*, would remain in print into the 21st century.

In 1896, Frances married Prof. James Russell Parsons, Jr., educator, politician, and finally Counsel General to Mexico under Pres. Theodore Roosevelt. Parsons' financial problems early in their marriage spurred Frances Parsons to write *How to Know the Ferns* (Scribner's 1899), another great success. James was tragically killed in a trolley – carriage crash in Mexico City in 1905. Again a widow, Frances would not write more until her privately published autobiography, *Perchance Some Day*, which barely mentioned her two famous guides, appeared after her death at age 90.

Mary Elizabeth Parsons – The California Wildflower Guide

Mary Elizabeth Parsons (1859-1947) – no kin of Frances Theodora – moved to California in 1883 and was well-tutored in botany by Alice Eastwood, Curator of Botany at the California Academy of Sciences. Parsons' *The Wild Flowers of California: their names, haunts and habits* was first published in 1897. [My 1914 edition includes the Preface to the never-published 1906 edition, its plates destroyed by the San Francisco Earthquake.] Her scholarship is evident with an extensive introduction that includes keys based on Linnaeus' stamen number system.

Burroughs' periodical essays and books were widely read in the West, and Mary Elizabeth used a JB quote in her introduction:

Most young people find botany a dull study. So it is, as taught from the text-books in the schools; but study it yourself in the fields and woods, and you will find it a source of perennial delight.

Ms. Parsons credited Mrs. Dana and not JB for inspiring her book, and also thanked the Southern and Northern Pacific Railroads for reduced travel rates to explore then highway-sparse California with her illustrator Margaret Warriner Buck, whose pen-and-inks were drawn from life. While Parson's *The Wildflowers of California* included plants from further north, a Washington State native in a few decades would address the Pacific Northwest.

Helen Margaret Gilkey – The Oregon Story

Dr. Helen Margaret Gilkey (1896-1972) was born to a farm family in Montesano, WA. One spring, young Helen observed a couple digging violets and placing them in a container. Asking her mother why anyone would collect such common plants, she learned that they were likely botanists collecting for later study. Coincidentally, some thirty years later, while studying for a year at the Gray Herbarium in Cambridge, MA, Helen found a sheet of violets that, by location and date, were those she saw being collected back home. She earned both Bachelors and Masters Degrees at Oregon State College (OSC) before entering the University of California where she became the first woman to earn a PhD in science.



H.M. Gilkey

She spent the remainder of her career as faculty at OSC (now OR State University) where she taught, authored books, and became a leading authority on truffle fungi. Her modest *A Spring Flora of Northwestern Oregon* (1929) and her later floras

were written for botany students; not as popular field guides. As a student, Helen had earned her living doing scientific art, and drew illustrations for a number of works. Like many teachers before and since, Dr. Gilkey knew that detailed line art was essential for accurate plant study and identification.

Written for gardeners, orchardists, farmers, and ranchers rather than students, *Weeds of the Pacific Northwest* (1957) was closer to a popular field guide than any other written by Dr. Gilkey. With simple, non-technical keys arranged by plant families and using common names, each species was accompanied with a precise line drawing to aid identification. It even had a dozen full-page color plates. *Weeds* was primarily for identification but also included weed origin, habitat, and noxious properties. She referred readers to frequently updated state and USDA bulletins for specific weed controls. *Weeds* included a JB quote, 36 years after his death:

Our Worst Tramp

Weeds are great travelers; they are indeed the tramps of the agricultural world. They are going east, west, north, south; they walk, they fly, by flood, by wind; they go underground and they go above, across lots and by highways. But, like other tramps, they find it safest by the highway. In the fields, they are intercepted and cut off; but on the public road every boy, every passing herd of sheep or cows gives them a lift.

from "Weeds," Vol. 5, *Pepacton*, 1881

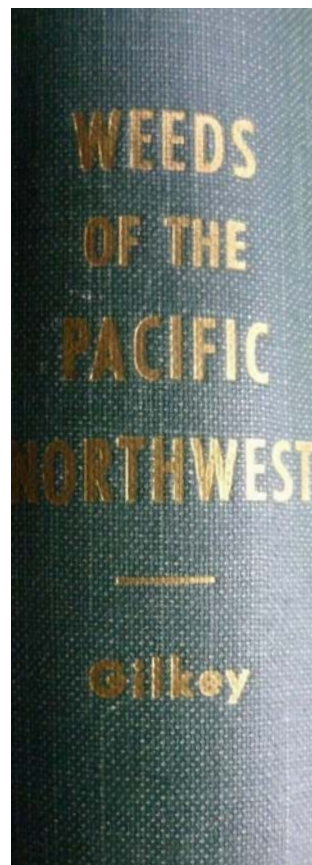
Now difficult to find, *Weeds of the Pacific Northwest* is a fascinating precursor to contemporary noxious weed control publications.

Field guides have contributed immeasurably to our outdoor awareness and appreciation of plants and animals. Twenty-first century digital guides with public-demanded high-resolution photo illustrations will continue honoring Burroughs' 130-year-old plea to find in wildflowers afield "a source of perennial delight" "without the trouble of analyzing them."

A Selected Chronology of Wildflower Guides

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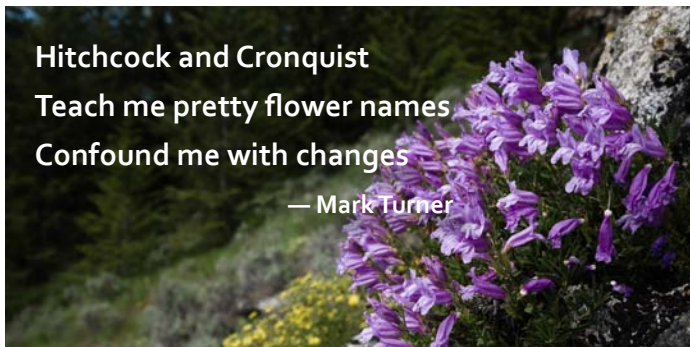
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Hitchcock and Cronquist
Teach me pretty flower names
Confound me with changes

— Mark Turner



Saddle Rock Demonstration Garden

by Sandy Letzing

The Saddle Rock Natural Area in south Wenatchee is a heavily-used, 325-acre community landmark visited by over 10,000 people each year. Activities range from snowshoeing to horseback riding to educational classes and school field trips. Currently, Saddle Rock is the primary environmental education destination in the valley, used regularly by Wenatchee High School, Wenatchee Valley College, and by every Wenatchee School District 2nd and 5th grader (1,385 students) for an annual outdoor educational field trip.



Saddle Rock Demonstration Garden. PHOTO: SANDY LETZING

In fall of 2018, Cascadia Conservation District collaborated with several partners to install an 1,800ft² xeriscape and native plant educational garden at Saddle Rock. Over 90 locally-sourced native plants and shrubs were planted in the garden to showcase the surrounding shrub-steppe landscape. The demonstration garden sits directly in front of a covered shelter classroom, amphitheater, and five bilingual interpretive signs. We believe this garden will enhance the educational potential in a location accessible to all socio-economic demographics.

This project aligns with our vision to impart the importance of conservation of intact upland habitat through education and demonstration. The long-term goal of the garden is to teach the students and public about the role that preserving and maintaining Wenatchee's native shrub-steppe plays in sustaining a healthy ecosystem through soil stabilization, weed suppression, reducing wildfire intensity and providing habitat. Next spring we will complete the fencing around the garden, label each plant, and install a garden interpretive sign. This project would not be possible without the help from volunteers from the Wenatchee Valley Chapter of the Washington Native Plant Society (WNPS), Chelan Douglas Lands Trust, and through funding from WNPS Conservation Committee grant.



Recreational Use and Pasayten Wilderness Ecosystems: Know Where You Step

by Therese Ohlson

Before one can talk about current effects of habitat disturbance in the Pasayten Wilderness, we need to take a look back a hundred years when white settlers started grazing livestock. Thousands of sheep traveled from Horseshoe Basin to the crest of the Cascades every season beginning in the early 1900s. Peak numbers reached five bands (5000 ewes with lambs) around 1912. By 1921, sheep numbers began to decline, and by the mid 1900s most of the sheep grazing was converted to cattle. Livestock grazing was eliminated in the Pasayten between 1994 and 1997. To this day, in some places you can still see evidence of this past history. Parallel trails traversing a hillside or high knobs that are less diverse than the surrounding often indicate old sheep beds, and many of the old sheep camps are popular campsites with today's visitors.



Stock and packer trails through *Danthonia* meadow after 6 years of recovery. PHOTO: THERESE OHLSON

Today, the Pasayten is one of the most popular destinations within the Pacific Northwest Region for those who enjoy the backcountry on horseback. Despite its current popularity, stock use now is much less than in the past, and the landscape is healing from nearly 100 years of seasonal livestock use. However, we humans still love the Pasayten Wilderness. And because of this, we should be aware of how our activities might impact this place we love.

In order to minimize future damage, one needs to understand how the type of recreational traffic influences the resiliency of a plant or plant community. Horses, given their size, weight, and iron clad feet are six to 10 times more likely to cause vegetation cover loss than a hiker or llama given the same number of passes across an area. Llamas, with their padded feet, are similar to hikers in their trampling effect on vegetative cover (Cole and Spildie 1998).



Horse travel through hummocks. One pass. PHOTO: THERESE OHLSON

The ability of vegetation to tolerate recurrent trampling is likely more a function of its ability to recover (resiliency) than its ability to resist being damaged. Moist forb communities, dominated by erect herbs like Sitka valerian (*Valeriana sitchensis*) are ten times more vulnerable than a red mountainheath (*Phyllodoce empetrifomis*) meadow to immediate cover loss caused by trampling. But recovery to pre-disturbance levels is significantly higher for moist forb communities. Trampling damage to shrub communities is by far longer lasting. Sod forming grass and/or sedge communities are the most tolerant and resilient of any community types to trampling.

Moist forb meadow communities are found throughout the Pasayten, but are particularly abundant in the Spanish Camp area. They show little tolerance to trampling and are easily crushed, leaving moist mineral soils exposed. Most damage to moist forb meadows occurs within a few passes in a given season. But these communities are highly resilient and will recover quickly, in most cases. A moist, deep organic soil layer helps give these communities their resiliency to disturbance. In many cases they have demonstrated nearly full recovery one year after disturbance at low to moderate levels of trampling (25 to 200 passes by humans across the same spot). Horses and mules, given their weight, sink into the soil deeper with each step and can quickly churn up a moist forb meadow community leaving it more vulnerable to erosion.

Increasing trampling passes across moist forb meadows showed successively less damage than what occurred with

the first few passes. In other words, it takes very few boots or hooves to reduce the vegetative cover and expose the mineral soil. Even in the most heavily trampled areas, one year after the disturbance nearly 75% of the vegetation had recovered (Cole 1995a, 1995b). These moist forb meadows will appear more heavily used or damaged in terms of the visual effects; even though one year later most visitors would not be able to detect any disturbance, if the disturbance was eliminated for at least one season. Of course, consecutive years of disturbance over a long period reduces the resiliency of these communities too.



Healthy *Phyllodoce* and *Cassiope* meadow. PHOTO: THERESE OHLSON

Communities intolerant of trampling are less resilient, especially those in colder environments subject to frequent frost and typically in the low shrub dominated communities. Examples of the shrubs that make up these communities are grouse whortleberry (*Vaccinium scoparium*), thin leaf huckleberry (*V. membranaceum*), red mountainheath (*Phyllodoce empetriformis*), western moss heather (*Cassiope mertensiana*) and white arctic mountain heather (*C. tetragona*); they are the least able to recover and are intolerant of even moderate levels of trampling. *Phyllodoce empetriformis* developed obvious trails after only 25 passes by humans. *Vaccinium scoparium* shows a similar response to trampling. One year later the initial trampling damage to these shrub communities was still unchanged and the trails still obvious (Cole 1995a, 1995b, 1987).

The ability of these communities to recover decreases with increasing years of trampling. It has also been documented that *V. scoparium* communities can continue to lose additional cover even one year after the initial disturbance. This evidence of

delayed damage is most pronounced in areas that are subject to cold air drainage and frequent frosts where low shrub communities are dominant. The cumulative effect of multiple seasons of use appears to be more important than the number of days within the season trampling occurs. Even in the most resilient communities, the greater the number of years of use the less resilient is the community.



Trampled *Phyllodoce empetriformis*. PHOTO: THERESE OHLSON

The two primary grass meadow communities found in the Pasayten are green fescue (*Festuca viridula*) and timber oatgrass (*Danthonia intermedia*). *Festuca viridula* meadows are more often associated with mid slopes or flats and concave microtopography on upper slopes where finer textured soils accumulated. Overgrazing was common during the sheep era in the Wallowa Mountains and likely in the Pasayten as well. Where soils remained intact, these communities quickly recovered (13–20 years) in this 50-year study in the Wallowa Mountains. Where topsoil had eroded, little recovery was documented 50 years post grazing (Reid and others 1991).

Danthonia intermedia meadows are typically found on the shallow coarser textured soils on the upper slopes and ridges, and often grade into the alpine fellfield communities. *D. intermedia* meadows will be slower to recover from any trampling due to the harsher sites where they are found. Fellfield communities, with their thin soil, abundance of cushion plants, cryptograms, and lichens are likely the most fragile and least resilient of all.

In the Pasayten, the little arctic tundra plant, glaucous gentian (*Gentiana glauca*) is most often associated with a type of patterned ground that occurs in subarctic and alpine environments. These hummocks are very rare in the Okanogan-Wenatchee National Forest, except in the northern-most portions of the Pasayten Wilderness between Cathedral Pass and the Ashnola River. They are formed in areas with fine-grained frost susceptible lacustrine soils, where annual seasonal frost heaving processes form and maintain them.

It is not clear exactly how these hummocks formed but there are several theories. Hummocks are often associated with



Little arctic tundra plant *Gentiana glauca*. PHOTO: THERESE OHLSON

permafrost in the northern latitudes. But in the Pasayten, there is no permafrost layer driving this frost heaving process. These hummocks are either actively forming as a result of seasonal frost heaving or they were formed immediately following the retreat of the glaciers when permafrost was likely present and are now being maintained by seasonal freeze thaw cycles. In either case this patterned ground is very old. And very sensitive to trampling damage. Radiocarbon dating of the lower stable layer of a hummock was found to be about 3000 years and the active frost heave layers to be between 1580 and 2500 years



Hummock pattern ground with damaged hummock lower right. PHOTO: THERESE OHLSON

in one study (Washburn 1956, Zoltai and Scotter 1982). This patterned ground is very susceptible to any type of trampling damage and it will likely never recover, especially in the face of global warming.

So no matter what your favorite mode of travel through the wilderness is, using established trails and campsites is important. If you do wander off trail, disperse across an area when hiking with others to avoid creating single-file tracks and minimize damage to fragile habitats..

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Support Our Work

Make a Planned Gift

Making a gift through your estate is a powerful way to express your values, care for the earth, and ensure a lasting impact. *"One generation plants the trees, another gets the shade."*—Chinese Proverb

Here are examples of how to make a planned gift: name the Washington Native Plant Society in your will, as a beneficiary to your IRA or life insurance policy, or as the beneficiary of a charitable remainder trust.

There are many other ways you can make a charitable gift through estate planning—consult your lawyer or financial planner. For more information, call the WNPS office: 206-527-3210.

Using Artificial Intelligence to Identify Herbarium Specimens

by David Giblin, Ph.D. University of Washington Herbarium, Burke Museum

In the Fall 2018 issue of *Douglasia*, I wrote about how scientists are developing the capacity to use DNA barcoding to identify plants in the field. Along the lines of this exciting breakthrough is a similar effort to identify herbarium specimens from their digital image. A little background is in order to fully appreciate this development.

Starting in the late 1990s, the National Science Foundation (NSF) began awarding grants to herbaria around the U.S. to “digitize” vascular plant specimens. At that time, digitize basically meant keystroking label data into a relational database application so that the label text could be published online for free, public access. It is important to remember that the World Wide Web (the graphical interface to the internet) only really came into being around 1993, and websites and browsers (think Mosaic) were quite basic compared to what we know today. Moreover, digital cameras were in their infancy and very expensive, computer server space was expensive, and there really was no “cloud” for storing images.

Fast forward to the mid-late 2000s when both digital cameras and server space became relatively cheap. Now NSF was funding herbaria to not only keystroke the label data, but to also image each specimen and assign geocoordinates (latitude/longitude) using georeferencing software. The results of NSF funding in our region can best be seen by visiting the Consortium of Pacific Northwest Herbaria database (www.pnwherbaria.org/data/search.php), where there are nearly a million vascular plant images resulting primarily from NSF-funded projects.

Most major herbaria today, including the University of Washington Herbarium, are imaging all new specimens added to the collections. Additionally, when external funding is secured, herbaria are digitizing as many legacy (i.e., already in the collections) specimens as possible. The collective

result of these efforts is that more than 300 million herbarium specimens worldwide have been imaged and made available through online databases. This has facilitated the remote identification of misidentified or previously unidentified specimens by amateur and professional botanists. However, with over 300 million plant specimens to be examined, there simply are not enough knowledgeable botanists to review everything. Time to call in artificial intelligence technology.

Research teams in North America, Europe, and Asia have developed artificial intelligence protocols that are now identifying imaged herbarium specimens with high levels of accuracy (80% in one study — a better percentage than humans). Should working botanists be concerned that they will be replaced by computers? For the moment, no. Artificial intelligence and machine learning applied to herbarium specimen identification points out misidentifications that allow botanists to revise biodiversity analyses, develop more accurate distribution maps, and identify potential species new to science. There are literally thousands of new species sitting in herbaria worldwide because there are not enough experts, or enough experts with time, to find new species by plowing through hundreds or thousands of specimens in collections that they will never visit.

To get an appreciation for what is being done I encourage you to visit the following online article in the journal *Nature* from 2017: “Artificial intelligence identifies plant species for science”. You can find the article here: www.nature.com/news/artificial-intelligence-identifies-plant-species-for-science-1.22442.

The application of computer science tools to field and collections-based botany strikes me as an unplanned encounter of the 18th and 21st centuries (Linnaeus made herbarium specimens in the mid-1700s). The upshot of this serendipitous confluence should result in better understanding of plant diversity patterns on both local and global scales, as well as the discovery of new species that very well may have never occurred or were literally decades in the offing. Considering the threats to plant diversity worldwide, I’d rather have that information sooner rather than later, even if it means that such discoveries are credited to computers.



Herbarium vascular plant specimen image available through the Consortium of Pacific Northwest Herbaria online database. Photo provided by permission from the University of Washington, Burke Museum.

Growing Natives from Seed: Simple Seed Propagation Methods for Native Plants

Part 4: Seed Dormancy Special Situations and How to Determine Dormancy Type

by Bridget McNassar

Growing natives from seed and the word daunting often go hand-in-hand; once you start learning about dormancy, it's easy to see why. In the previous article of this series (*Douglasia* Fall/Winter 2018), I introduced seed dormancy by simply comparing external vs internal dormancy and treatments to use for each. However, the plot thickens: there are multiple types of internal dormancy, combinations of dormancies, variations in dormancy deepness, and the techniques to break a dormancy type can vary from species to species. To top it off, it is possible that dormancy type and deepness can even vary *within* a species, at different locations, seasons, or even different spots on the same plant!

While it might all seem hopelessly inscrutable, I hope the complexities lead you to a sincere appreciation of the genius of the plant world. The diversity that exists both between and within species allows native plants to continue to exist on the landscape over a wide range of seasonal conditions, with some easily germinating quickly after dispersal and others biding their time for multiple seasons. As a propagator, I also find that this gives me hope, not despair. I can try one or two basic methods with any new seed, and it is likely that I will at least get some germination, bringing me further enough down the path to take a few more educated steps in the next season. The chance to know something deeper, only through spending more time and attention with it, is welcome to me in today's world of quick and shallow interactions—and I hope you, too will be motivated to form such relationships with your favorite plants.

Special Dormancy Situations

In my previous article, *scarification* and *stratification* of seeds were described as dormancy breaking methods for *external* and *physiological* dormancy, the more common situations you will run into in our region. As mentioned above, there are other types, combinations and nuances of dormancy to be considered, a few of which I'll introduce here.

Warm Treatment

At the time of seed ripeness, many seeds have embryos that need further time to develop before germination can occur, referred to as having *morphological* dormancy. Often the seed needs a warm, moist period to allow the embryo to finish growing. This can be accomplished using any of the methods described for cold stratification, but keeping the seed closer to room temperature (70°F) for the suggested length of time, usually somewhere

between 1-2 months. More often than not, a species will then need a cold/moist stratification period immediately following (you might see this referred to as *morpho-physiological* dormancy). Wild ginger (*Asarum caudatum*) and Oregon iris (*Iris tenax*), are two examples of species that we treat this way for germination in the nursery at Oxbow Farm & Conservation Center.



Wild ginger (*Asarum caudatum*) seed should be sown soon after collection in order to get a warm and then cold period before germinating the following spring. PHOTO: BRIDGET MCNASSAR

Another form of a warm treatment you might see when researching a species is called *afterripening* (or *aging*). This occurs when *dry* seed is allowed to sit at room temperature for up to 3 or 4 months before beginning any moist stratification treatments. In some species, a warm, dry period can give an embryo more time to develop, and is also thought to lessen the degree of dormancy in some species. I often find that I unintentionally give many of my seeds this treatment as they sit around a month or more waiting to be cleaned. Keep your afterripening seeds as you would when initially drying them; somewhere with good air circulation, protected from extreme weather and animal damage.

Multiple Cycles of Treatment

Some species of natives play the long game in the germination process; once they take in water, they require multiple cycles of warm and then cold treatment before emerging. The treatments can be done artificially with room and fridge temperatures, or seeds can be sown in a protected location and allowed to



Snowberry (*Symphoricarpos albus*) seedlings emerging, which typically requires two seasons after seed is sown. PHOTO: BRIDGET MCNASSAR

naturally experience winter and summer temperatures for two seasons, as long as they remain moist throughout. Snowberry (*Symphoricarpus albus*) is an example of a local species that usually requires two warm-cold cycles to germinate. Additionally, I find some species will have a number of seeds germinate after one cycle, but if I hold onto the trays another year, an additional flush of germination will happen the second year: dull Oregon grape (*Mahonia nervosa*) consistently does this for me.

In a slightly different situation, some species exhibit what is called double, or two-step, dormancy. For these seeds some type of dormancy treatment (perhaps a warm-cold cycle) initiates their radicle (embryonic root) to emerge, but another treatment (likely another warm-cold cycle) needs to happen before their above-ground growth appears. This often means the radicle comes out the first year and, the first leaves appear the second year. This type of germination is found in pacific trillium (*Trillium ovatum*) and plumed Solomon's seal (*Maianthemum racemosum*). Both instances are good reason to keep your trays of sown seeds for more than one year, especially when you are unsure of what type of dormancy they may have.

Oscillating Temperatures

There is evidence that some species germinate best when they are experiencing fluctuating day/night temperatures, and may germinate best if fall sown and allowed to experience outside temperatures throughout the winter and spring. This may be the case with many of our spring ephemeral bulbs.



Plumed Solomon's seal (*Maianthemum racemosum*) has two-step dormancy, with radicles emerging after one year, and first leaves typically emerging in a second season. PHOTO: BRIDGET MCNASSAR

Determining Seed Treatments on Your Own

Often, I encounter a species that has no published information indicating dormancy type or treatments. When this occurs, there are ways to make some good guesses. Search around a bit first and see if you can find information about any similar plants (those in the same genus). It is possible they may have similar requirements for germination, especially if they exist in similar ecologies. Second, learn all you can about the life history and ecology of your species of interest. For example, spring blooming bulbs (such as *Camassia* spp. and *Fritillaria* spp.) often germi-

nate/emerge very early in the spring and produce seed in early summer. You could infer from this life cycle that the seed will germinate in cold temperatures and should be sown in late winter (or back in the fall), and also that its seed might benefit from an afterripening period-since it is produced at the onset of our summer drought, likely remaining warm and dry all summer. In contrast, you might look at wetland species that produce seed later in the fall when rains have returned, such as tule (*Schoenoplectus tabernaemontani*), and assume that this seed may be best sown immediately and not dried out before sowing. While these are not foolproof methods, they are good ways to start.

If you have a variety of spaces to test seed treatments at home, you can try a more formal experiment, moving your seed through a series of temperature treatments to simulate cycles of the seasons and see which brings your seeds to germinate. This is outlined in an article by Baskin and Baskin listed below.

As ever, I encourage you to persevere with difficult species, keep good records, and share what you find out when you can. Next up in Part 5, we'll explore considerations around sowing seeds, such as timing, temperatures, containers and soils.

Resources with more information about seed dormancy and treatment methods:

- Bonner, Franklin, and Robert Karrfalt (Eds). 2008. *The Woody Plant Seed Manual*. Agriculture Handbook 727. Washington, D.C.: U.S. Department of Agriculture, Forest Service. Available online: <https://rngr.net/publications/wpsm>
- Royal Holloway University of London. Website Gerhard Leubner Lab. "The Seed Biology Place" Accessed August 15, 2018. <http://www.seedbiology.de/index.html>
- Luna, Tara; Wilkinson, Kim M; and Dumroese, K. 2009. 8: Seed Germination and Sowing Options. In: Dumroese, R. Kasten; Luna, Tara; Landis, Thomas D., editors. *Nursery manual for native plants: A guide for tribal nurseries - Volume 1: Nursery management*. Agriculture Handbook 730. Washington, D.C.: U.S. Department of Agriculture, Forest Service. p. 133-151. Available online: <https://rngr.net/publications/tribal-nursery-manual>

A more in-depth look at determining dormancy type when unknown for a plant species:

- Baskin, C and J Baskin. 2003. When breaking seed dormancy is a problem, try a move-along experiment. *Native Plants Journal* 4 (1): 17-21. Available online: <https://rngr.net/npn/journal/articles/when-breaking-seed-dormancy-is-a-problem-try-a-move-along-experiment>

Bridget McNassar is the manager of the native plant nursery at Oxbow Farm & Conservation Center (www.oxbow.org) in Carnation, WA. You can contact her at bridget@oxbow.org.



Natural History of the Pacific Northwest Mountains

by Daniel Mathews
Timber Press, 2017
Flexibound, 584 pages,
\$27.95

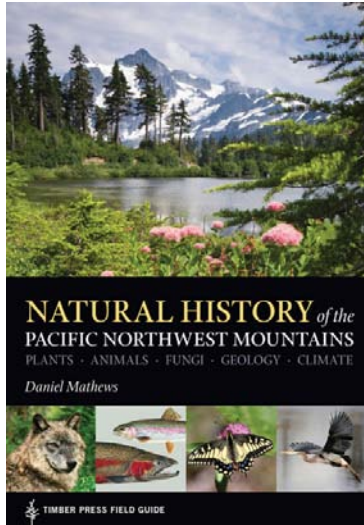
reviewed by Saul Weisberg

Many years ago, sitting in a subalpine meadow below Slate Peak in the North Cascades, Art Kruckeberg told me “a naturalist is an ecologist in short pants.” That began a long, rambling discussion about natural history, field ecology, trail snacks, Methow Valley place names, simple tools for the complete naturalist, and ultimately, what books are worth carrying in your pack. Daniel Mathews’ *Natural History of the Pacific Northwest Mountains* is one of those books.

Mathews’ magnum opus is a love poem to the creatures that inhabit the mountains and rivers of Washington, coastal Oregon, and southwestern British Columbia. This book is much more than just a field guide; it’s a series of lessons in how to pay attention to the amazing diversity of the natural world. I’ve pulled it out of my pack on a misty summit and read it by headlamp in my tent.

This unique volume is a much expanded and updated third edition of *Cascade-Olympic Natural History* first published in 1992. The geographic range has been expanded to include the mountains of Vancouver Island, the British Columbia Coast Range, and Northwest Oregon, as well as the Olympics, North Cascades, and southern Cascades in Washington. While these ranges have different geologic stories, the rich species diversity they share links them well in this field guide.

Dan Mathews shares tips for finding and identifying over 950 species, while describing the landscapes they inhabit from the mountains to the sea. Striking photographs combine with excellent descriptions and compelling sidebar stories that bring these wild mountains alive. From rich evocations of the land, to life histories of early naturalists, to musings about slug sex, and the impacts of climate change, each page of this book drew me deeper in. In one pack-



able volume, it’s both an introduction and a graduate course in Northwest natural history.

This book stretches far beyond the usual field guide material to include a broad and surprisingly deep swath of natural history: plants, animals, fungi and geology, with additional sections on climate (and climate impacts on Northwest species) and naming (including recent taxonomic upheaval in our favorite plant families). It includes over 60 fascinating mini-essays on everything from historical Northwest naturalists to alpine landforms, plant succession, timberline, gopher teeth, weeds, coprophagy, animal sonar, torpor and hibernation, pheromones, and the sweet aromas of cedar.

Over half the book is devoted to plants, with broad coverage and excellent descriptions, natural history notes, and photographs of conifers, flowering trees, shrubs and herbs, ferns, clubmosses, horsetails, mosses, and liverworts. The coverage of macrofungi and lichens is good, but more limited. Mammals and birds are well treated, with an excellent selection of our most common and interesting species. The selections of reptiles, amphibians, and fish are again more limited, but adequate for the amateur naturalist. Insects are much more fully treated than in the earlier editions, and dragonflies are now well represented. The geology section is particularly well done, with a well-written and understandable description of the past 250 million years of mountain forming, geomorphology, terranes, volcanoes, and rock types of our wild neighborhood.

Natural History of the Pacific Northwest Mountains is well designed for the field with 800 color photos, 215 illustrations, and 4 maps wrapped in a tough water-resistant cover. The only downside, and it’s to be expected in a book this thorough, is its rather hefty mass. At just over two pounds it’s a weighty addition to a pack that might also contain Pojar, Sibley, Pyle, and Paulson.

I commend Timber Press for actively pursuing their mission to share the wonders of the natural world by adding *Natural History of the Pacific Northwest Mountains* to their Field Guide Series which now includes Birds, Trees and Shrubs, Mushrooms, Insects, Wildlife Tracking, and Medicinal Plants.

Pick up a copy today at your local independent bookstore or help support youth education in the North Cascades by ordering from North Cascades Institute’s new online store: www.ncascades.org/shop. And then get outside and explore our wild mountains!

Saul Weisberg is the executive director of the North Cascades Institute.



Books for the Pack

Before our journey into mountains we choose by size and weight the books that we place in our packs.

I pick four, and wedge them tight between climbing gear and cook pots: Basho’s *Haiku*, Mathews’ *Natural History*, Sund’s *Ish River*, Pyle’s *Butterflies*.

What rests on the pages is weightless.

— Saul Weisberg
Headwaters: Poems & Field Notes. Pleasure Boat Studio, 2015

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Deadline extended to March 15 – <https://wnps.org/conservation-grants>

Education Grants

Upcoming Grant cycle applications due May 15 – <https://wnps.org/education-grants>

Research and Plant Inventory Grants

Applications are due by January 15, now closed for 2019.

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Contents

About This Issue, *David Giblin*Inside Front Cover

President’s Message: The View from Here, *Van Bobbitt* 1

Big Genera: Why are Some Genera So Much Bigger than Others?, *Walter Fertig*2

Botanizing from Mt. Adams to the Klickitat River: The Search for New and Historical Camas Lilies,
 Susan Kephart, Jim Kephart, and Barbara Robinson5

Rone’s Biscuitroot (*Lomatium roneorum*):
 A New-to-Science Endemic of the Wenatchee Mountains, *Connie McCauley* 10

Preventing the Introduction of Noxious Weeds, *Wendy DesCamp* 12

Botanizing 243 Along the Columbia, *Mark Turner* 14

Asarum caudatum: Our Wild Ginger (Well, Not Really a True Ginger), *David Giblin* 15

John Burroughs: Father of American Wildflower Guides, *Frank Knight*..... 17

Saddle Rock Demonstration Garden, *Sandy Letzing* 19

Recreational Use and Pasayten Wilderness Ecosystems: Know Where You Step, *Therese Ohlson*20

Using Artificial Intelligence to Identify Herbarium Specimens, *David Giblin*23

Growing Natives from Seed:
 Simple Seed Propagation Methods for Native Plants, *Bridget McNassar*24

Book Review: *Natural History of the Pacific Northwest Mountains*, *Saul Weisberg*.....26

WNPS 2018 Donor List27

Washington Native Plant Society State Board Directory29



Arrow-leaved balsamroot (*Balsamorhiza sagittata*) and showy phlox (*Phlox speciosa*)
on Hayward Hill in Kittitas County. PHOTO: MARK TURNER