# Kalmiopsis

Journal of the Native Plant Society of Oregon

Jewel milkweed (*Asclepias cryptoceras*) growing on barren clay soil that was actively slipping down the steep slope.

ISSN 1055-419X

Volume 23, 2020

# Kalmiopsis

Journal of the Native Plant Society of Oregon, ©2020





## Editorial

What a year 2020 has been. Our Annual Meeting was cancelled, as were most chapter meetings, programs, and field hikes. We've learned to "zoom," wear masks, and "social distance," among other things. Without face-to-face interactions, our publications—the eBulletin and *Kalmiopsis*—take on new importance as a means to communicate and connect with each other in the Society. This year I'm pleased to offer a selection of articles that span Oregon from east (Leslie Gulch) to west (Coos Bay) and view our native plants and habitats from the perspective of Native Americans (*Abronia*), monarch butterflies (*Asclepias*), and greater sage-grouse (sagebrush steppe). In addition, this is the first time that *Kalmiopsis* has published a reprint from another source. However, the new species of *Monardella* described from Oregon in the Idaho Native Plant Society's *Sage Notes* by Don Mansfield was one that needed to be shared with NPSO members. In an article on milkweeds in Oregon, including two not yet in the new Oregon Flora, the authors introduce you to the amazing complexity of milkweed (*Asclepias*) flowers. Don't worry about the multitude of new vocabulary words. The floral structures are all illustrated, and you will marvel at the diversity of species that grow in Oregon.

Two new Fellows have been initiated into the select group of honored members: Lisa Blackburn and Dave Wagner. Be sure to read the stories of their lives and contributions to the Society.

The Native Plant Society of Oregon is dedicated to the enjoyment, conservation, and study of Oregon's native plants and habitats. Conservation is the common thread for the four articles in this issue and spans both rare plants (*Abronia*, *Monardella angustifolia*, and some *Asclepias* species) and the importance of more common plant species for imperiled insects (*Asclepias* for monarch butterflies) and animals (sagebrush steppe wildflowers for greater sage-grouse). I hope that NPSO's "phytocurious" members enjoy this issue and learn from it as well.—*Cindy Roché, Editor*.

Cover photo: Jewel milkweed (*Asclepias cryptoceras*) in Crook County, Oregon. Photo by Robert Korfhage



Kalmiopsis: ISSN 1055-419X. Volume 23, 2020. Published annually.
Native Plant Society of Oregon • General business address: PO Box 902, Eugene, OR 97440-0902 • NPSO Website: http://www.NPSOregon.org

# Yellow Sandverbena
# (*Abronia latifolia* Eschsch.)

Patricia Whereat-Phillips
Sonoma, California

I grew up near the southern edge of the Coos Bay dune sheet. There are many green "old friends" I love to meet while hiking in the *ta'an* (a Hanis Coos word for dunes): a Port Orford cedar (*Chamaecyparis lawsoniana*) growing above a dune lake, purple flowered seashore lupines (*Lupinus littoralis*), wild strawberries (*Fragaria chiloensis*), among many others. But one beach-hugging plant has stood out for me, not only for its bright yellow flowers, but especially for its strong sweet smell: the yellow sandverbena. I can't recall any other native beach or dune plant that has such strongly scented flowers.

Flowers of yellow sandverbena at Crissey Field Beach at the welcome center near the Oregon-California border. Photo by the author.

Yellow sandverbena grows from British Columbia to the central California coast and is usually found above the high tide line beaches and in coastal sand dunes. A ground-hugging perennial, yellow sandverbena sprawls across the sand with stems up to a meter long and opposite oval leaves that are somewhat sticky, thick and fleshy, and often covered in sand. The plants are anchored in the sand by a large, thick taproot. The flowers are a bright yellow. Numerous small (8 to 10 mm long), five-lobed flowers are grouped in an eye-catching round inflorescence of up to 34 flowers.

But to me this plant's most striking characteristic is its scent. It is unusual among native northwest beach and dune plants to have a strong, sweet fragrance. Scents are notoriously difficult to describe, but to me it smells both sweet and spicy, with hints of something that reminds me of cardamom and ginger, but not quite like either. Indeed, it is this feature that inspired its name in the Hanis and Miluk languages of Coos Bay: *tɬəmqá'yawa*, which translates roughly "the scented one."

Yellow sandverbena is not a true verbana (Verbenaceae). The genus *Abronia* is a member of the four o'clock family (Nyctaginaceae). This family is represented in Oregon by just four species of *Abronia* and three species of *Mirabilis* (four o'clock). In the genus *Abronia,* there are two species on the Oregon coast, yellow sandverbena (*A. latifolia*) and pink sandverbena (*A. umbellata*). Pink sandverbena resembles the yellow-flowering species, but its leaves are longer and narrower, and the flowers are a vivid pink with white centers. Some report pink sandverbena has no scent; others report it has a scent, but is lighter than its yellow cousin. Both species have declined, but pink sandverbena has nearly disappeared from its northern habitat in British Columbia and Washington and is now listed as an endangered species. Today, most pink sandverbena is found in southern Oregon and northern California. The two species can hybridize, but rarely do. In recent years a few hybrids have been reported from the Port Orford region. These hybrids have pale pink flowers, are scented, and the fruit is usually seedless.

For many Indigenous people, yellow sandverbena's most important characteristic was not its odor or showy flowers, but its root, which was used as a food. Some people harvested them in fall, some in early summer. Most traditional Indigenous root foods had to be cooked to make them digestible or palatable, but yellow sandverbena roots

Exposed root of yellow sandverbena in the dunes at Abbott lagoon, Pt. Reyes, California. Photo by the author.

were unusual in that they were eaten raw. Erna Gunther, in her classic survey of western Washington ethnobotany, said that a Klallam informant compared the taste and sweetness to sugar beets.

I have not yet tried to eat this root myself; the plant is not common outside parks in California where I have been living for the last 20 years, and the parks here discourage most kinds of harvest. However, Canadian ethnobotanist T. Abe Lloyd tried some last year. He found that "Raw, the root has a very firm texture and a subtle smell of cucumber. It is softer than a parsnip and drier than a potato, with flavor somewhere in between the two. Boiling for five minutes did little to change the root's character; it softened to that of a cooked parsnip and tasted more like a potato with a hint of sweetness and a mild peppery after taste. I fried a couple thin slices of the root for 10 minutes and these had a more peppery, though not dissagreable [*sic*], taste. Perhaps boiling leaches out some of the peppery constituent. In any case, I think Sand Verbena root would serve well as a base carbohydrate for a meal and easily take on added flavoring."

Though known to Native People for millennia, it was not described and named in western science until 1826 in a publication by German naturalist Johan Friedrich Gustave von Eschscholtz. Nearly ninety years later, a New York botanist named Homer House came west to visit a friend, medical doctor and amateur botanist, Dr. Walton Haydon. Haydon and House travelled around the Coos Bay region botanizing. House's observations of the Coos Bay dune field are especially interesting because the dunes and its plant communities have changed considerably over the last century. Today, introduced plants such as European beachgrass (*Ammophila arenaria*), scotch broom (*Cytisus scoparius*) and gorse (*Ulex europaeus*) have radically changed dune ecology and have caused the decline or extirpation of some native plant species. A century ago these invasive plants had a much smaller foothold in the dunes. House noted that yellow sandverbena was an important sand binder in the dunes, and created hummocks. "The *Abronia* seems to be especially effective as a sand binder, growing in large colonies and with a gigantic, deep going root, retaining the soil so firmly that the surrounding sand may be blown away for several feet below the colony, resulting in the production of curious green capped mounds..." Today, yellow sandverbena is not often seen in

Pink sandverbena resembles the yellow-flowering species, but its leaves are longer and narrower, and the flowers are a vivid pink with white centers. Photo from near Coos Bay by Lisa Schomaker.

A ground-hugging perennial, yellow sandverbena sprawls across the sand near Waldport, Oregon. Photo by Lisa Schomaker.

the Oregon dunes, but tends to be found along beach margins.

Yellow sandverbena is the host plant for the caterpillars of the sandverbena spotted moth *(Copablepharon fuscum*) in British Columbia and Washington. Because populations of its host plant have become uncommon and fragmentary, Canada has declared this moth an endangered species. Other moths that use this plant as a host are the sand dune moth (*Euxoa wilsoni*), spotted moth (*Euphyia implicata*) and the yellow woolly bear moth (*Spilosoma virginica*). Yellow sandverbena and silver beachweed (*Ambrosia chamissonis*) are host plants for the Oregon plant bug (*Lygus oregonae*), an insect of concern to the Xerces society as a species on the decline in some areas, again because of the declining numbers of *Abronia.*

Populations of both species of *Abronia* would probably increase if habitats were protected from coastal development and invasive species were controlled. Controlling vigorous invaders like European beachgrass is difficult, but there have been a few trials along the Oregon coast to remove it and plant seeds or seedlings of pink sandverbena. These trials were done not just for the plants, but also to increase nesting habitat for the endangered Western Snowy Plover (*Charadrius nivosus*), which also thrives in the same kind of habitat as *Abronia* does.

**Further Reading**


Gunther E. 1973. Ethnobotany of Western Washington: The Knowledge and Use of Indigenous Plants by Native Americans. Seattle: Univ. Washington Press.

House HD. 1914. "Vegetation of the Coos Bay Region, Oregon." Muhlenbergia. 9:81-100.

House HD. 1914. The Sand Dunes of Coos Bay, Oregon. The Plant World. 17:238-243.

http://arcadianabe.blogspot.com/2019/07/sand-verbena-mana-of-sand.html

http://en.hortipedia.com/Abronia_latifolia

https://esc-sec.ca/2016/01/26/the-sand-verbena-moth/

https://www.fs.fed.us/psw/publications/beyers/psw_2010_beyers(montalvo)_NativePlantRecomm.Abronia.maritima.pdf

Kozloff EN. 1983. Seashore Life of the Northern Pacific Coast: An Illustrated Guide to Northern California, Oregon, Washington, and British Columbia. Seattle, Washington: Univ. Washington Press.

Peterson ER, Powers A. 1952. A Century of Coos and Curry. Portland, Oregon: Binford and Mort.

Phillips PW. 2016. Ethnobotany of the Coos, Lower Umpqua, and Siuslaw Indians. Corvallis, Oregon: Oregon State University Press.

Yellow sandverbena from Crissey Field Beach near Brookings-Harbor, below the Oregon welcome center. Photo by the author.


Poinar Jr. G. 2016. A Naturalist's Guide to the Hidden World of Pacific Northwest Dunes. Corvallis, Oregon: Oregon State University Press.

Pojar J, McKinnon A. 1994. Plants of the Pacific Northwest Coast: Washington, Oregon, British Columbia, and Alaska. Redmond, Washington: Lone Pine Press.

Stein M. 2015. Survey for sand dune endemic species in the Oregon Dunes National Recreation Area. Unpublished report.

USDA Siuslaw National Forest and USDI Bureau of Land Management, Coos Bay District. 2006. Conservation Strategy for Pink Sand-Verbena (*Abronia umbellata* ssp. *breviflora*). (https://www.fs.fed.us/r6/sfpnw/issssp/documents/planning-docs/cs-va-abronia-umbellata-ssp-breviflora-2006-07.pdf.)

Wiedemann AM, Dennis LJ, Smith FH. 1999. Plants of the Oregon Coastal Dunes. Corvallis, Oregon: Oregon State University Press.



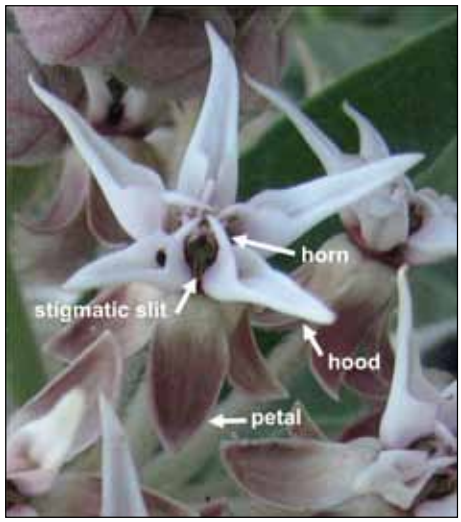
Patricia Whereat-Phillips holds a BS in Biology from Oregon State University and a MA in Linguistics from the University of Oregon, where her studies focused on the Hanis Coos language. She has worked with the US Forest Service in the Oregon Dunes National Recreation Area and Mt. Hood National Forest, and served as the Cultural Resources Director for the Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians from 1997 to 2001. Subsequently she has worked as a consultant to the Tribes on traditional language, storytelling and ethnobotany. Her book, *Ethnobotany of the Coos, Lower Umpqua, and Siuslaw Indians*, was published by OSU Press in 2016. She lives in Sonoma, California.

# Milkweeds Are NOT Weeds

Cindy Roché and Frank Callahan
Bend and Central Point, Oregon

Milkweeds are species of the genus *Asclepias*. Botanists of a certain age learned that *Asclepias* were members of their own family, Asclepiadaceae. Now the genus has been folded into the dogbane family, Apocynaceae, which is represented in Oregon by four genera: *Apocynum, Asclepias, Cycladenia,* and *Vinca*. Linnaeus named the genus *Asclepias* in 1753, honoring Asklepios, legendary Greek physician and god of medicine.

The "milk" part of the name derives from their milky sap. The "weed" part of the name probably derives from the old English term used to denote grasses and herbs. It might also refer to the more recent meaning of weed, "toxic plants or plants having no useful value." If we had it to do over again, perhaps we would call our *Asclepias* species "milkplants." To those of us who appreciate native species, milkweeds are not weeds. Although they serve many useful purposes, they are valuable in their own right as part of the complex ecosystem on planet earth. Their biology and ecology are fascinating. Milkweeds are beautiful natives, important for pollinators, especially for monarch migration, and popular with gardeners. Historically, they've been used by Indigenous people for fiber and medicine. Milkweed occurrence has decreased due to habitat degradation, pesticide use, intensive agriculture, and climate change. This trajectory needs to be reversed. We hope to stimulate your interest in native milkweeds in Oregon and encourage you to take action to protect or restore milkweed habitat critical for monarch migration.

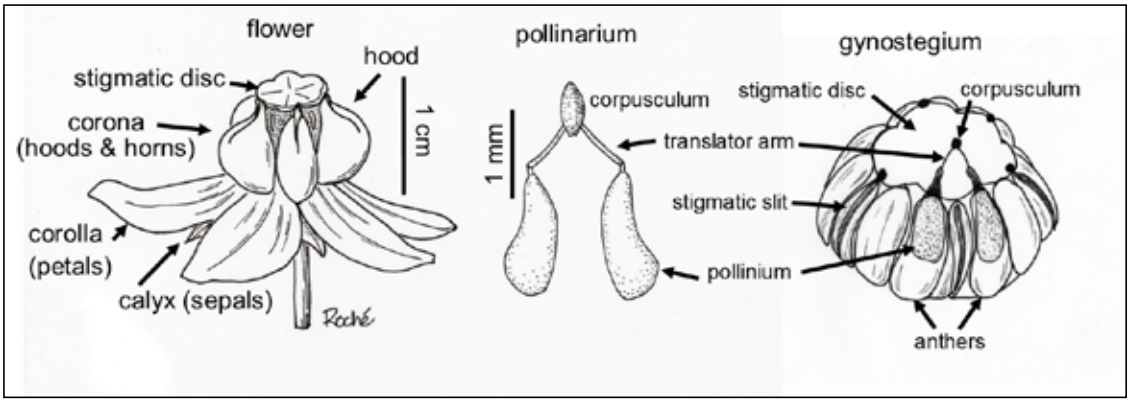



Individual flower of showy milkweed (*Asclepias speciosa*), showing petals, hoods, horns and stigmatic slit. Photo by Frank Callahan.

## The structure of *Asclepias* flowers and pollination

Milkweeds have whorled or opposite leaves and flowers borne in umbels, either terminal or arising from upper leaf axils. The fruit is a follicle: a single-chambered pod that splits longitudinally. Seeds are flat and borne away on wind or water by silky parachutes.

Milkweed flowers have a morphology all their own with an extraordinary pollination mechanism. The flowers have three floral whorls around a central structure called a gynostegium (see illustrations of flower parts). Starting at the base, the first two whorls are like other flowers: the calyx (five sepals) and the corolla (five petals that are generally reflexed or spreading). The third and fourth whorls of a typical flower (stamens and pistil) are no longer easily recognized: they have been transformed into the corona and the gynostegium. The corona is made from the filaments of the stamens and the anthers are fused to the stigma and style to form the gynostegium. The corona is made up of five hoods, each of which usually has an elongate, inwardly curved appendage called a horn. The horn is fastened near the base of the hood and is either included within it or exserted from it. Horns of some species are long, while in others they are barely visible. The stigmatic disk forms the top of the gynostegium and the modified anthers form the sidewalls.




Flower parts of *Asclepias*. In *Asclepias cryptoceras*, hoods are rounded and horns are hidden inside. Illustration by Cindy Roché.

Between the anthers are the stigmatic slits where the pollen enters. Milkweeds achieve cross-pollination by means of a pollinarium that comprises pollinia from two adjacent stamens. The two pollinia are connected by a translator arm to a corpusculum, a sticky gland that aids in the transport of the pollinia. When an insect – primarily Lepidoptera (butterflies and moths) and Hymenoptera (bees, wasps, ants) – lands on the horn or disc, its leg often slips into the groove below it (the stigmatic slit). This allows the corpusculum or translator arms of the pollinarium to catch in the hairs or the tarsi of the insect's leg. The insect moves to another flower, carrying the pollinia like saddlebags. As the translator arms of the pollinia dry, they re-orient the pollinia to be deposited in the stigmatic slit of the next flower the insect lands on. Smaller insects are not strong enough to pull their feet out of the slits and are often trapped there and die.

Nectar has two primary roles. First, as its carbohydrate composition is nearly 100% sucrose, it is the primary reward for insect visitors. Nectar flows from the stigmatic chambers into the cupped hoods of the flower, where it is available to insects. Second, nectar is the primary germination medium for milkweed pollen. The pollen falls through the stigmatic slits into a nourishing nectar bath, which stimulates it to germinate and grow pollen tubes to the ovules (Broyles and Stoj 2019). All of the seeds in a follicle share a single father (from one pollinarium), which means that seeds within a given follicle have less genetic diversity than in most other plants, where pollen derives from various fathers.

### Native milkweeds in Oregon

Oregon hosts seven species of *Asclepias*, all of them native. Volume 2 of the Oregon Flora online (https://oregonflora.org/taxa/index.php?taxon=442) shows only five species, but two more have been recently discovered. The species will be presented in this order: first, the five included in the Oregon Flora, starting with the most abundant and working to the rarest, and second, the two newest discoveries. Distribution maps for the first five species are also available in the online flora (link above).

### Showy milkweed (*Asclepias speciosa* Torr.)

John Torrey named this species in 1828 using a specimen collected by Edwin James in 1820 "on the Canadian [River]" (Ann. Lyceum Nat. Hist. New York 2:218). Showy milkweed is indeed showy, with *speciosa* meaning "beautiful" in Latin. It could be argued, however, that our other species are just as beautiful. Showy milkweed is the most widely distributed species in Oregon, occurring at least sparingly across most of the state, except along the coast north of Gold Beach.

Showy milkweed is a robust perennial from spreading rhizomes, growing to 5 feet tall. Its opposite leaves are

Flower cluster of showy milkweed (*Asclepias speciosa*). Photo by Frank Callahan.

Immature follicle of showy milkweed. Photo by Cindy Roché.

gray-green, covered in velvety hairs. From May to September it bears clusters of flowers in umbels from the upper axils of the stem. Flower petals are pink to rose, with pink hoods that are considerably longer than the petals, and somewhat divergent. The horns curve strongly inward toward the disc. The thick, leathery, one-chambered follicles are 3 to 5 inches long, with densely woolly surfaces that are rough with short, soft, horn- or wart-like projections.

*Habitat*

Showy milkweed grows in well-drained soil in full or nearly full sun, in pastures, meadows, forest clearings, untilled fields, roadsides, and ditch banks. Adapted to either wet or dry sites with deep, well-drained, sandy or loamy soils, it is commonly found in somewhat disturbed habitats, such as along the banks of irrigation or road ditches or untilled areas adjacent to cultivated fields.

*Cultivation*

Showy milkweed is the most popular milkweed species in cultivation in Oregon. Both seeds and plants are readily available for establishing pollinator gardens or restoring native habitats. For those planning to introduce it in a garden, be forewarned that it grows into a robust plant and spreads vigorously by rhizomes, so allow adequate space.

Narrowleaf milkweed (*Asclepias fascicularis*) grows in colonies from rhizomes. Photo by Frank Callahan near Jacksonville, Oregon, June 24, 2020.

**Narrowleaf milkweed**
**(*Asclepias fascicularis* Decne.)**

French botanist Joseph Decaisne named *Asclepias fascicularis* in 1844 from a specimen collected by David Douglas in California (*Prodromus systematis naturalis regni vegetabilis* 8:569). Narrowleaf milkweed is exceptionally common in the Rogue Valley (Jackson County). It occurs less frequently in the Willamette Valley and the Columbia Gorge. It also appears in lowlands of the Wallowa and Blue mountains. It is not a montane species and is seldom found above 5,000 feet elevation. It is rare in southeastern Oregon and absent along the Oregon coast. I (Callahan) have never come across this species in all my searches in southeastern Oregon and only a few voucher specimens are known from this area.

Flower cluster of narrowleaf milkweed. Photo by Frank Callahan near Jacksonville.

Narrowleaf milkweed is strongly rhizomatous, spreading to form small colonies. It is generally shorter than showy milkweed, growing as an erect perennial, 1 to 2.5 feet tall. In contrast to opposite leaves found in most milkweeds, narrowleaf milkweed leaves (except the uppermost ones) are in whorls of 3 to 6. The reflexed petals are a pale soft pink to darker rose, often with a white margin. The cupped hoods are creamy white, surrounding a pale pink to white disc. The horns are incurved. Mature follicles are ½ inch in diameter by 3 inches long.

*Habitat*

This species prefers full sun in dryland habitats, such as grasslands, oak savannas, and openings in pine or oak woodlands. Soils range from clay loams to sandy loams, but they must be well-drained. It spreads abundantly in disturbed soils, especially along roadsides.

*Cultivation*

Seeds are readily available for this species. It can also be propagated by rhizome cuttings. Native plant nurseries in the Rogue Valley offer plants for sale and claim that narrow-leaf milkweed is one of the easiest milkweeds to grow, tolerating heat, drought, and a fair amount of disturbance. Its vigorous rhizomes may cause problems if the gardener has limited space and prefers well-mannered perennials.

Narrowleaf milkweed follicles releasing seeds. Photo by Frank Callahan.

**Heartleaf milkweed**
**(*Asclepias cordifolia* (Benth.) Jeps.)**

Willis L. Jepson named this species in 1901 (Fl. W. Calif. [Jepson] 384) from an 1836 collection by German botanist Karl Theodor Hartweg in California. Although the Oregon Flora shows a second common name, purple milkweed, for this species, that name is also used for *Asclepias purpurascens*, which is native to the eastern, southern and midwestern US. Because *purpurascens* refers to purple and *cordifolia* refers to "heart-shaped leaf," we prefer the name heart-leaf milkweed.

The center of the distribution of this species is California's Sierra Nevada and Coast Ranges. From the Sierra Nevada it extends east into Nevada; from the California Coast Ranges it extends north into southwestern Oregon where it is commonly found on serpentine substrates. There are outlier records in eastern Douglas and Lane

Flower cluster of heart-leaf milkweed (*Asclepias cordifolia*), photographed by Frank Callahan on the west-facing slope of Blackwell Hill on May 26, 2020.

counties and a population reported in Lake County, south of Lakeview.

Heart-leaf milkweed is a perennial that grows to a height 1 to 2 feet, more or less erect. Its large opposite leaves are cordate (heart-shaped). Its flowers have dark

Habit of heart-leaf milkweed (*Asclepias cordifolia*). Photo by Frank Callahan.

red-purple petals and cupped hoods of pale pink surrounding a creamy white center. The horns are inconspicuous. The oblong follicles are large (3 to 5 inches long) and tapering to a point. They are lighter green than the leaves, with a purplish tinge and are usually erect on the plant.

*Habitat*

In Jackson County, this species is abundant on open exposures on both granodiorite (Blackwell Hill) and gabbro parent material (Gold Hill). It has been reported on soils derived from ultramafic, limestone, and volcanic substrates. In California it grows in open or shaded woodland, often on rocky slopes and in mixed coniferous forest.

*Cultivation*

Propagation is by seed. It thrives in full sun or partial shade and is drought tolerant. It does well in medium to coarse soil, or rocky soil; it needs good drainage. Seeds are available online.

**Jewel milkweed**
**(*Asclepias cryptoceras* S. Watson**
**ssp. *davisii* (Woodson) Woodson)**

Other common names for this small milkweed are pallid milkweed or Davis milkweed. *Cryptoceras* means "hidden horn," referring to the inconspicuous horn in the corona of this species. Sereno Watson added this species in 1871, based on a specimen collected by Thomas Nuttall near the Green River in 1834. Previously, in 1845, Torrey and Fremont named an 1844 collection by Fremont (also on the Green River) *Acerates latifolia*, a name no longer considered valid when it was recognized that the species belonged to the genus *Asclepias*.

The center of its range is the Great Basin and it is widely distributed in the Intermountain region. It grows in seven eastern Oregon counties: Baker, Crook, Grant, Harney, Malheur, Wallowa, and Wheeler, but it is uncommon in all of them.

Jewel milkweed grows as a perennial from an enlarged, woody, often fusiform root that is fleshy when young. This is one of the sprawling milkweeds, lying on the ground (prostrate) or with drooping stems (decumbent). The thick, waxy, blue-green leaves are broadly ovate and opposite on short stems. The umbels are usually terminal, bearing 5 to 10 flowers. The striking flowers have pale chartreuse-green, reflexed petals, magenta hoods, and a pale creamy center. The two lobes of the saccate hoods project at the top into two short teeth that completely enclose the short horn. The ovoid follicles are held erect, about 1 to 2 inches long.

*Habitat*

Its preferred habitat in Oregon appears to be sparsely vegetated, heavy clay soils, often on steep slopes. Descriptions include the phrases "barren clay with spiny hopsage and bitterbrush," "occasional on barren lens of cherty soil in sagebrush steppe," and "heavy clay soil subject to slipping down a steep slope." Some references say it grows in sandy soils, but the herbarium sheets from Oregon collections indicate a clear preference for clay soils.

*Cultivation*

This species is rare. Seeds, when available, are expensive (one vendor offered 15 seeds for $40 with a limit of 2 packets, but they were sold out). Do not dig plants from the wild (refer to the NPSO Ethical Guidelines for Collecting Plants at https://www.npsoregon.org/documents/ethics.pdf). If you find a population large enough to safely collect a few seeds, be prepared to replicate the soils and other habitat conditions when trying to grow them.

Habit of jewel milkweed (*Asclepias cryptoceras*). Photo by Robert Korfhage in Crook County. May 2020.

## Serpentine milkweed (*Asclepias solanoana* Woodson)

Serpentine or Solanoa milkweed in honor of Solano, chief of the Suisunes. The type specimen was collected by C.B. Towle in Lake County, California: "on bare summit of a mountain … not far from the Geysers." First described by Asa Gray in 1874 as *Gomphocarpus purpurascens*, the name was changed to *Solanoa purpurascens* by Greene in 1890. Finally, Robert E. Woodson published the currently accepted name, *Asclepias solanoana,* in 1941 (Ann. Missouri Bot. Gard. 28(2): 207). I (Callahan) have visited the type location near the Geysers, and it is a barren serpentine habitat typical for the species. Until recently, serpentine milkweed was considered a California endemic, a rare species growing only in the North Coast Ranges north of San Francisco. Serpentine milkweed is known from one location in Oregon. The northernmost known population of this species is in Josephine County in the upper reaches of the Rough and Ready Creek drainage. It consists of only a few plants. I (Callahan) discovered the Oregon plants in late May 2014, after fording the creek and hiking four steep, rugged miles up the canyon without a trail.

Serpentine milkweed is one of the sprawling milkweeds, growing as a prostrate perennial. Leathery, heart-shaped or ovate leaves on short petioles attached opposite each other on smooth purple stems. The spherical inflorescences are at the end of the stems, a heavy ball of lovely rose-purple to pink flowers. Each flower has five reflexed to spreading, pink to dark rose petals below a ring of pale pink rounded hoods without horns. Follicles are up to 2 inches long and 3/8-inch thick.

Flowers of serpentine milkweed (*Asclepias solanoana*). Photo by Frank Callahan.

Serpentine milkweed (*Asclepias solanoana*) from Rough and Ready Creek. Note the serpentine scree and Jeffrey pine needles. Photo by Frank Callahan, May 26, 2014.

### *Habitat*

The habitat in Oregon is similar to that in California, a steep slope with Jeffrey (*Pinus jeffreyi*) and knobcone (*P. attenuata*) pines growing over unweathered serpentine shards and scree. In California this species is limited to ultramafic soils of serpentine outcrops and is found in chaparral, foothill woodland and yellow pine forests.

### *Cultivation*

Serpentine milkweed is a rare species and not available in the native plant trade. Wild plants should not be dug up. Collect seeds only in locations where it would not diminish the native population. It is not expected to grow well in gardens because it appears to be adapted to a specialized habitat of ultramafic soils.

Creamy flowers of woollypod milkweed (*Asclepias eriocarpa*). Photo by Frank Callahan, 2016.

**Woollypod milkweed, Kotolo**
**(*Asclepias eriocarpa* Benth.)**

George Bentham published the name in 1849 using a specimen collected by Hartweg in 1835 in California: "In collibus siccis juxta praedium Tularcitos in vicinibus Monterey" (Plantas Hartwegianas imprimis Mexicanas 323). The specific epithet of this species comes from the Greek words, *erion*, meaning wool and *carpos*, fruit. Woollypod milkweed is a new discovery in Oregon. In July 2016, I (Callahan) found a small population of it along the Rogue River just downstream from Bear Creek in Jackson County. It was previously known only from northern California, adjacent parts of Nevada, and Baja California. In California, it is found primarily in the Coast Ranges from Mendocino County southward into Mexico, in the Sierra foothills and in the northern part of the Central Valley.

Woollypod milkweed is an erect, single to multiple-stemmed perennial, only a bit smaller than showy milkweed. On fertile, grassy sites, it grows to a maximum of about 4 feet tall; plants on open, sun-baked soils may reach only 2 feet tall. All parts of the plant are covered with smooth, dense, white hairs. The large leaves are lance-shaped to oval, 2.5 inches wide by 8 inches long, rippled. Leaves tend to be at a 90-degree angle from the stem, either as opposites or in whorls of 3 or 4 leaves. The flower cluster is a large umbel-like cluster of flowers. Each flower is creamy white to cream colored, often tinged with bright pink. It has a central array of rounded hoods with short horns that curve toward, but don't reach, the disc. The corolla is reflexed against the stalk. The fruit is a large, woolly follicle.

*Habitat*

The small population in Oregon was growing on a steep eroding bank covered with weedy grasses along the Rogue River. After the Gold Ray Dam was removed, the river is cutting the rich soils on the south side of the river and this farmland is washing away. In California it is reported to grow in yellow pine, red fir, and lodgepole pine forests, foothill woodlands, chaparral and Central Valley grasslands.

*Cultivation*

In the garden it makes a striking specimen, especially when massed (https://calscape.org/Asclepias-eriocarpa-(Kotolo-milkweed)). Seeds are available from a variety of sources online.

Woollypod milkweed (*Asclepias eriocarpa*) fruits and leaves covered with short fuzz. Photographed by Frank Callahan in Jackson County, Oregon

**Swamp milkweed**
**(*Asclepias incarnata* L.)**

This species was named by Linnaeus in 1753, apparently using specimens from Canada and Virginia. The specific epithet for this species *incarnata*, is from the Latin *carn*, meaning flesh and *atus*, meaning "like," because its hue is sometimes like flesh, or it may be dusty rose in color.

Previously unknown in Oregon, this species was known to grow in eastern Canada and the US, extending as far west as Idaho (Kinter 2019) and Nevada. I (Callahan) reasoned that if it grows in Idaho, it might be found in Oregon as well. So, on September 1, 2020, Tom Fealy and I, using a boat christened the Monarch, surveyed along the Snake River in eastern Malheur County. We surveyed from the Oregon-Idaho border at State Line Road to Nyssa (about 20 miles) then north to Ontario, another 10 miles. We found a few, highly scattered populations,

Swamp milkweed (*Asclepias incarnata*) with follicles in a bullrush marsh habitat with *Schoenoplectus acutus* along the Snake River. Photo by Frank Callahan, Malheur County, September 1, 2020.

including a plant over 5 feet tall in a tule marsh. However, plants were difficult to see because most of the flowers had matured into fruits, which blended into the massive tule populations. Tom and I also explored the Fort Boise Wildlife Management Area (1,630 acres) in Idaho, just across the Snake River from Oregon. We found plants at the mouth of the Boise River where it joins the Snake River. Some of the Oregon plants were directly across the Snake River from the Idaho populations. We did not have time to explore the mouth of the Malheur River (just south of the Wildlife area), but that is definitely prime habitat. The highest concentrations were to the south of Nyssa in Oregon, ranging from 10 to 30 plants per site.

Swamp milkweed is an erect perennial, reaching five feet tall in favorable conditions. Its smooth, narrow leaves are lance-shaped with sharp tips and occur in pairs. Sometimes the leaf edges turn inward and upward suggesting the prow of a ship. Swamp milkweed produces almost no

Swamp milkweed (*Asclepias incarnata*) flowers and leaves. September 1, 2020. Malheur County, Oregon. Along the Snake River.

milky substance. The fragrant clusters of flowers range in color from soft mauve to pink to reddish-violet. Within each small cup-shaped hood is an upward curving horn that reaches to the center of the disc. Follicles are narrow and held erect.

*Habitat*

In its native habitat it grows in sunny openings of wet habitats: swamps, marshes, ditches, wet meadows, along streams and lakes. In Oregon it grows in marshy zones along the Snake River.

*Cultivation*

Swamp milkweed is reported to thrive in average garden soil as long as it does not dry out completely, especially in the spring. It tolerates heavy clay soils and can be grown in full sun to partial shade. As you would expect by its name, it requires more water than other milkweeds. It is a good choice for wetland pollinator gardens. Seeds are readily available but are likely to be from populations quite distant from Oregon. This widespread species is frequently cultivated, and a number of cultivars have been developed. This species is also sold as fresh cut flowers, mostly because the flowers are long lasting, but sometimes for the distinctive seed pods.

The Monarch botanical exploration boat. Photo by Frank Callahan.

Monarch caterpillar feeding on woollypod milkweed (*Asclepias eriocarpa*) leaves. Photo by Frank Callahan.

### Milkweeds and monarchs

Monarch butterflies depend on *Asclepias* species: without their obligate milkweed host, monarchs will disappear. But the reverse is not true: milkweeds do not depend on monarchs for pollination, which is done, mostly, by other insects. Although monarch butterflies pollinate milkweeds as they draw nectar, they mostly need milkweed as a host plant for their caterpillars. The sap that lends milkweed its name ends up protecting the monarchs as well. The toxic compounds, a distasteful mix of resinoids, glycosides, and alkaloids, can cause nausea and vomiting in low doses, and death in high doses. But not for monarch larvae. When monarch larvae feed on milkweed, they sequester the toxins, so instead of making the larvae sick, they make them and the adult butterflies undesirable as food for potential predators. Monarch adult and larval coloration provides a warning that vertebrate predators learn to recognize after sampling monarch larvae or adults and finding that they taste bad and/or cause vomiting. The concentration of alkaloids varies considerably among the 73 *Asclepias* species in North America. Generally, milkweeds with narrow leaves have higher concentrations, but one broad-leaved species, woollypod milkweed, is considered to be one of the most toxic species (Panter *et al*. 2011).

### Fiber, floss, and flower gardens

In addition to serving as a critical food source for Monarch butterfly caterpillars and nectar as a reward for many other pollinators, the plant's fibers have been used for a variety of purposes.

The tough fibers of many species are useful for making ropes and string, thus the common name "Indian Hemp." For example, heart-leaf milkweed was valued by the Native American Miwok tribe for its stems, which they dried and processed into string and rope. Woollypod milkweed was used as a source of fiber and medicine by several California Indigenous peoples, including the Ohlone and Luiseno. The tuft of white, silky, filament-like hairs on the tip of milkweed seeds is known as the coma but is often referred to by other names: pappus, floss, plume, silk. The filaments are hollow and are coated with wax to allow it to float on water. The coma has been reported to be six times more buoyant that cork and five times warmer than wool; large quantities of milkweed were grown for use as stuffing in pillows and lifejackets during World War II (Kirk and Belt 2011). Apparently, it is better for insulating clothing than for pillow stuffing, lacking in fluffiness for comfort. Coma is also good for absorbing oil, with the potential for remediation of oil spills in waterways (https://empressofdirt.net/growing-milkweed-seed/).

More recently, milkweeds have enjoyed an unprecedented popularity among gardeners. This is not surprising, given the spectacular beauty of their flowers and their power to attract butterflies and other insects with their nectar. Milkweed is almost an obligate component of pollinator gardens and monarch advocacy groups offer seeds of almost any species of *Asclepias* (http://www.xerces.org/milkweed/milkweed-seed-finder). Conservation of wild habitat is critical, but garden and restoration plantings are needed to provide pathways for monarchs to access milkweeds along their migration routes when native habitats have been degraded. We have touched only briefly on cultivating milkweeds; those without experience in growing native milkweeds should consult the Xerces Society's publication: *Milkweeds, A Conservation Practitioner's Guide* (Borders and Lee-Mäder 2014). This publication covers almost everything one might need to know about collecting seeds and growing milkweeds. As tempting as exotic *Asclepias* species may be, please plant only the ones native in Oregon. There is a report that common milkweed (*Asclepias syriaca*), which is native to eastern North America, has naturalized in Oregon and also hybridizes in the wild with showy milkweed (Savonen 2016). A bright red and yellow milkweed (*Asclepias curassavica*), native to tropical America, is planted in gardens in western Oregon. Even though it is apparently staying in cultivation in Oregon, it has naturalized in California. In addition, butterfly scientists say to avoid planting this non-native because it disrupts the relationship between monarchs and a protozoan parasite, *Ophryocystis elektroscirrha.* The parasite is deposited on the leaves and caterpillars ingest the parasite as they feed. The host and parasite evolved together, so as long as parasite levels remain low, butterflies are not harmed. However, high levels of the parasite in adult monarchs lower migration success, as well as reduce body mass, lifespan, mating success, and flight ability. When native milkweeds die back after blooming, the parasite dies along with them so that each summer's monarch population feeds on fresh, parasite-free foliage. In contrast, tropical milkweed remains green through winter, allowing parasite levels to build up, so successive generations of monarch caterpillars feeding on the plant can be exposed to

dangerous levels of the parasite (https://xerces.org/blog/tropical-milkweed-a-no-grow). Anyone truly interested in doing the best for Oregon's native plant and monarch conservation will grow a species native to the area.

**Acknowledgements**

We thank Cecilia Lynn Kinter, Idaho Dept. of Fish & Game, Boise, and Donald H. Mansfield, College of Idaho, for their assistance. Kareen Sturgeon edited several iterations of the manuscript. Aaron Liston reviewed the manuscript and offered many constructive comments that improved our understanding of milkweed floral morphology. Aaron recommends Anurag Agrawal's book, *Monarchs and Milkweed: A Migrating Butterfly, a Poisonous Plant, and Their Remarkable Story of Coevolution* for further reading on this subject. We also recognize botanist and chemist Dr. Steve Northway, who co-founded Cascadia Monarchs, an organization for growing and distributing milkweed seedlings in the Willamette Valley and beyond.

**References**

Borders B, Lee-Mäder E. 2014. Milkweeds, a Conservation Practitioner's Guide. The Xerces Society for Invertebrate Conservation (www.xerces.org).

Broyles SB, Stoj KR. 2019. Patterns of nectar production in *Asclepias curassavica* (Apocynaceae). J. Pollination Ecology 25(8):78-88.

Holmes FR. USDA Forest Service Plant of the Week: Swamp Milkweed (*Asclepias incarnata* L.). (https://www.fs.fed.us/wildflowers/plant-of-the-week/asclepias_incarnata.shtml).

Kinter CL. 2019. A Guide to the Native Milkweeds of Idaho. (https://idfg.idaho.gov/species/sites/default/files/Idaho%20Milkweed%20Guide%2C%20Kinter%202019-07-16.pdf)

Kirk S, Belt S. 2011. Plant fact sheet for swamp milkweed (*Asclepias incarnata)*. USDA-Natural Resources Conservation Service, Norman A. Berg National Plant Materials Center. Beltsville, MD 20705.

Panter KE, Ralphs MH, Pfister JA, Gardner DR, Stegelmeier BL, Lee ST, Welch KD, Green BT, Davis TZ, Cook D. 2011. Plants Poisonous to Livestock in the Western United States. (Agriculture Information Bulletin No. 415). Logan UT: USDA ARS Poisonous Plant Research Laboratory. 107 pp.

Pocius VM, Pleasants JM, Debinski DM, Bidne KG, Hellmich RL, Bradbury SP, Blodgett SL. 2018. Monarch butterflies show differential utilization of nine midwestern milkweed species. Front. Ecol. Evol., 25 October 2018. (https://doi.org/10.3389/fevo.2018.00169)

Savonen C. 2016. Got milkweed? Native showy version is best. Statesman Journal. July 13, 2016. (https://www.statesmanjournal.com/story/life/2016/07/13/got-milkweed-native-showy-version-best/86965492/).

Woodson RE. 1941. The North American Asclepiadaceae. I. Perspective of the Genera. Ann. Mo. Bot. Gard. 28: 207.

Xerces Society. 2012. The Native Milkweeds of Oregon. (https://xerces.org/sites/default/files/2018-05/12-023_05_XercesSoc_NativeMilkweeds_Oregon_web.pdf)

---

Roché has edited *Kalmiopsis* since 2001 and is always on the lookout for botanical subjects to share with NPSO members. She clearly remembers her first milkweed encounter: it was *Asclepias speciosa* in the summer of 1979 in the Colville River Valley between Colville and Kettle Falls in northeastern Washington. Four decades passed and nothing noteworthy happened with milkweeds until the summer of 2019. A botanist friend in Bend showed her a picture on her smartphone of *Asclepias cryptoceras*. Going to visit the site in 2020 sparked a new interest in milkweeds which burst into flame when her longtime friend from the Rogue Valley (Frank Callahan) sent pictures of his discoveries of other rare milkweeds in Oregon. Thus began the collaboration that resulted in this article.

---

Callahan is a veteran author for *Kalmiopsis*, having published five previous articles: California Buckeye (2005), Hinds Walnut in Oregon (2008), Discovering Gray Pine in Oregon (2009), Botanizers in the Land of Conifers: Oliver Matthews, Al Hobart, Eugene Parker (2013), and Cypress Species in Oregon (2013). Although his passions are big trees in general and Oregon trees in particular, Callahan's motto "Never stop discovering" applies to all things botanical. His mother, Muriel Callahan, introduced him to showy milkweed growing near an irrigation canal on their property in Bend, Oregon, many years ago. As a high school student, he was dissecting everything, including flowers, and was smitten with the intricate floral structure of *Asclepias speciosa*. In 1963, his 9th grade teacher, Dr. Gettman, introduced him to a microscope, which became an addiction leading to illustrating many flowers. This year, intrigued by the image of *Asclepias cryptoceras*, a plant that he has never seen in the wild, he accepted the offer to share his experiences with *Asclepias* species in Oregon.

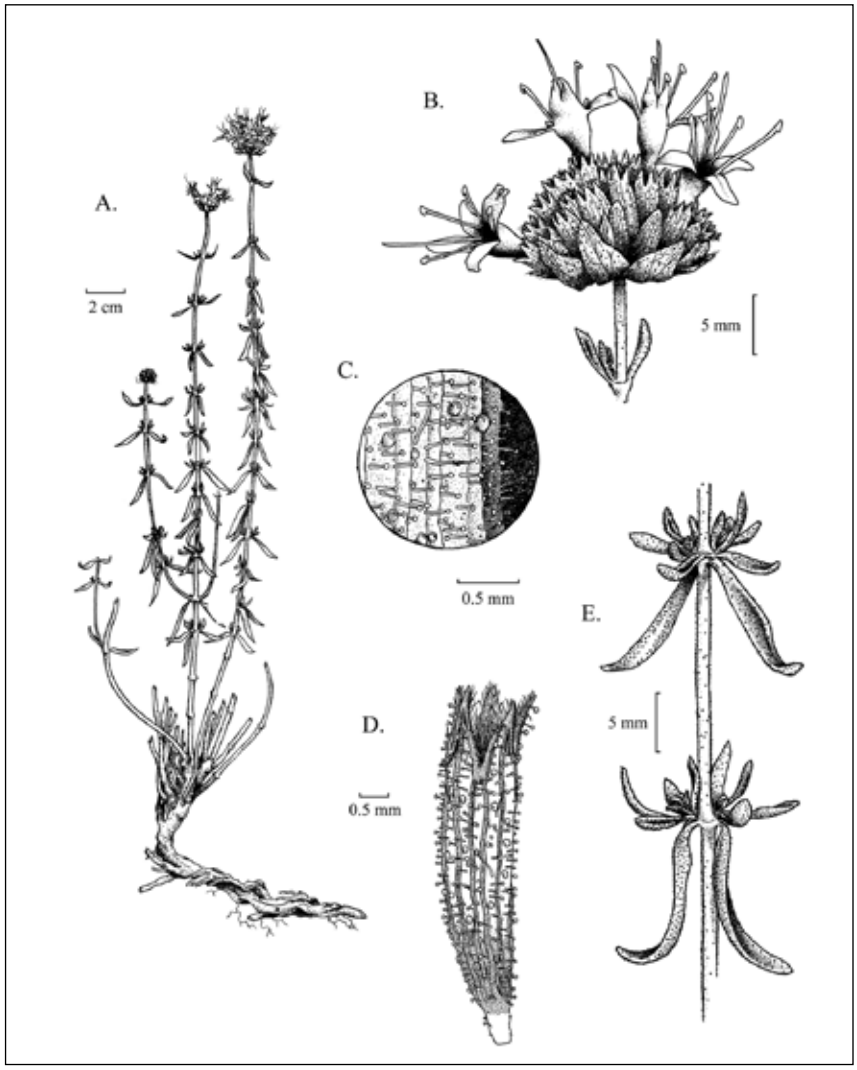

---

# The Discovery of *Monardella angustifolia* at Leslie Gulch

Don Mansfield, The College of Idaho
Reprinted from *Sage Notes* Vol. 38 (4) December 2016, pages 6-7

Leslie Gulch in southeastern Oregon has been a source of botanical curiosity for decades—ever since the new road was punched down Runaway Gulch from the vicinity of Succor Creek in the early 1970s, replacing the old wagon road from Rockville to Watson. Leslie Gulch is a caldera (an old collapsed volcanic eruptive center) containing outcrops of volcanic ash-tuff of assorted colors and is home to several endemic plant species. And just in the past few years, Mark Elvin, Barbara Ertter and I described another new species endemic to Leslie Gulch—*Monardella angustifolia*, narrow-leaved monardella (Elvin et al. 2014). It is reasonable to ask: how can new species still be found? I shall attempt to answer that question in this article by describing the process by which this new species came to our attention and how it came to be described.

The first botanical collection of this plant was made in 1973 by Pat Packard, former College of Idaho biology professor and long-time Idaho/Oregon botanist. It had been collected in nearly every decade since then, too. The plant, in the mint family (Lamiaceae), looks and smells like mountain monardella *(Monardella odoratissima)*. Mountain monardella is a common subshrub throughout our region with oval leaves, pink-purple to whitish flowers, and a wonderful fragrance. The Leslie Gulch plants have been included under that species by the authors of the Intermountain Flora, an authoritative treatment whose coverage includes the Leslie Gulch area (Cronquist et al. 1984). That is, the Leslie Gulch plants were considered just an extreme form of that well-known, highly variable species. In variable species like mountain monardella, it is often hard to determine whether certain combinations of characteristics are discrete, that is, with several characteristics all being similar together in only certain locations or habitats, or whether the characteristics vary in the manner of a "smear" (continuous), with no obvious corresponding association with geography or ecology. In the case of the Leslie Gulch plants, do monardellas with narrow, reflexed, and bundled leaves all occur together in a certain area or in particular habitats, or are they just spread throughout the range of the species, gradually changing from one form to another? If the former, then this may be a new species, isolated from other species and likely breeding only among themselves in a particular place or habitat. If the latter, then these variations are among the many that are just remixing as plants interbreed and make new forms through sexual recombination. Barbara and I had both thought, from the time of




*Monardella angustifolia*—narrowleaved monardella. A. Habit sketch. B. Inflorescence. C. Glandular hairs on the stem. D. Calyx of the flower showing glandular hairs. E. The opposite leaves, characteristic of the mint family, are narrow, folded, and bundled. Artwork by Alexa DiNicola.

*Monardella angustifolia*, narrowleaved monardella on Leslie Gulch ashtuff. Photo by Alexa DiNicola.

our earliest conversations about this Leslie Gulch plant in the mid-1990s, that this was probably a new species. But without a study of the variation throughout the whole range of mountain monardella from Utah and California up into southern British Columbia, there would be no way to test that hypothesis. And neither of us had the time or inclination to undertake such a study.

Like so many "new" species that are described, there is a long lag between when botanists become aware of some unusual forms and the time that such forms may be described and named as new to science. In fact, the average lag time between first collection of a new plant species and when that species is first described is 24 years (Bebber et al. 2010). In the case of narrow-leaved monardella, the lag time was a bit over 40 years. Specimens of this lovely Leslie Gulch endemic were included under the name *M. odoratissima* between 1973 and 2013 when Mark Elvin, living in southern California, contacted Barbara and me asking about these plants while he was working on the treatment of species in the genus *Monardella* for the new *Flora of Oregon*. In his study of the variation in this genus, he had come to suspect that the Leslie Gulch plants might be distinctive. So Barbara and I, with others, sought new specimens, researched various aspects of the distribution, and corresponded about everything from habitat, location of collections, and associated plant species, to minute glandular hairs on the calyx.

After observing the morphologies of more than 30 *Monardella* species throughout western North America, Mark realized that not only did the narrow, bundled and folded leaves of the Leslie Gulch plants (see Figure 1) distinguish them from mountain monardella, so too did the size of the aromatic glands on the calyx of the flowers and the presence of some additional layers of bracts in the inflorescence. In fact, the plants most similar to our Leslie Gulch populations (a species called *M. eplingii*) occur in the Mojave Desert over 900 km to the south. And that Mojave species, like the new Leslie Gulch species, is restricted to volcanic ash-tuff outcrops! Is that because they both evolved similar morphologies in parallel on similar substrates in distant locations? Resolving one question seems to just lead to more and more interesting questions.

So, like the discovery of so many new plant species, the "new" species was under our noses for decades. It just took a keen eye and careful examination of all related specimens to finally realize that a certain, odd-looking form was instead a new Leslie Gulch endemic, joining the group of other Leslie Gulch endemic species including Ertter's butterweed *(Senecio ertterae)*, Packard's blazingstar *(Mentzelia packardiae)*, Owyhee clover *(Trifolium owyheense)*, yellow phacelia *(Phacelia lutea* var. *mackenzieorum)*, and Grime's ivesia *(Ivesia rhypara* var. *rhypara)*.

While looking for populations of this plant over a larger geographic area, up into the Succor Creek drainage,

*Monardella angustifolia* flower head. Photo by Gerald Carr, June 4, 2016, in Malheur County, Oregon.

Stems and leaves of *Monardella angustifolia*. Photo by Gerald Carr.

the College of Idaho Field Botany class of 2013, Alexa DiNicola, Beth Corbin, and I found some additional populations. In the Succor Creek drainage of both Oregon and Idaho there are a few scattered outcrops of the same tan, volcanic ash-tuff that is found in Leslie Gulch. Some of those outcrops support populations of narrow-leaved monardella, just as one might expect of a substrate-limited endemic species. A third metapopulation of narrowleaved monardella is known from Chalk Basin, along the west side of the Owyhee River north of Rome, Oregon, with plants found on the same tan, volcanic ash-tuff outcrops.

There are other more widespread species that occur on these same relatively barren outcrops in all of these locations, including woolly sunflower *(Eriophyllum lanatum)*, snakeweed *(Gutierrezia sarothrae)*, narrowleaf wirelettuce *(Stephanomeria minor)*, silverleaf phacelia *(Phacelia hastata)*, Chambers' twinpod *(Physaria chambersii)*, desert princesplume *(Stanleya pinnata)*, Nuttall's sandwort *(Minuartia nuttallii* var. *nuttallii)*, few-flower pea *(Lathyrus pauciflorus* var. *pauciflorus)* which also appears to have a slightly atypical morphology than other populations of this taxon, blue flax *(Linum lewisii)*, whitestem blazingstar *(Mentzelia albicaulis)*, northern Indian paintbrush *(Castilleja angustifolia)*, bitterbrush *(Purshia tridentata)*, and Indian ricegrass *(Achnatherum hymenoides)*.

Although it is easy to find narrow-leaved monardella on a trip to Leslie Gulch, the limited distribution of this new species puts it in the Critically Endangered category according to criteria of the International Union for the Conservation of Nature (IUCN). Only two locations are known for Idaho. The easiest place to see and smell this plant is along the roadcut 7.3 miles southwest of the Oregon/Idaho border on Hwy 95 between Marsing and Jordan Valley, in the tan-colored outcrop on the east side of the highway. For further reading on the unique botanical curiosities of Leslie Gulch, I recommend Findley (2004).

**References**


Bebber D, Carine MA, Wood JR, Wortley AH, Harris DJ, Prance GT, Davidse G, Paige J, Pennington TD, Robson NK, Scotland RW. 2010. Herbaria are a major frontier for species discovery. Proc. National Academy of Sciences, 107(51):22169-22171.

Cronquist A., Holmgren AH, Holmgren NH, Reveal JL, Holmgren PK. 1984. Intermountain flora. Vascular Plants of the Intermountain West, U.S.A. Vol. 4. Subclass Asteridae (except Asteraceae). New York Botanical Garden. Bronx, New York.

Elvin MA, Mansfield DH, Ertter B. 2014. A new species of *Monardella* (Lamiaceae) from southeastern Oregon and adjacent Idaho, U.S.A. Novon 23:268-274.

Findley J. 2004. Leslie Gulch. Kalmiopsis 11:3-9.


Don was born in Salem, Oregon, and grew up all over the US. He took his first biology class from Dr. Martha Springer at Willamette University and transferred to Colorado College where he completed a BA in biology in 1973, discovering field botany in his senior year studying under Dr. Jack L. Carter. After completing his MSc in botany at University of British Columbia, working with Dr. Iain E.P. Taylor on a biochemical problem, but also studying with Dr. Wilf Schofield and others, Don decided that he loved both teaching and botanical research. He earned his Doctor of Arts degree in biology at Idaho State University (1979) working with Dr. Jay Anderson. There he began studying the botany of Steens Mountain in eastern Oregon, often studying with Dr. Karl Holte. After brief postdoctoral employment at University of California, Davis, where he worked on post-harvest physiology while spending weekends studying vernal ponds of northern California, he taught botany and physiology at Colorado College (1981-1984). While Assistant Professor of Biology at Rollins College in Florida (1984-1989), Don returned each summer to Steens Mountain and Colorado to pursue his growing love of floristics. In 1989 he took a faculty position at The College of Idaho in Caldwell, where he teaches field botany and a variety of biology courses and serves as Curator of the Harold M. Tucker Herbarium. His floristic research resulted in the *Flora of Steens Mountain* (2000), and he continues to study the floristics of SE Oregon, SW Idaho, and N Nevada. His work has turned up many interesting problems, such as the one described in this article, which he continues to pursue with his wonderful and talented undergraduate students.

# How Wildflowers Could Help Save Sage-Grouse

Cindy Roché and Stu Garrett
Bend, Oregon

Sagebrush (*Artemisia*[1]) steppe once covered about 170 million acres across the western United States. In western North America, this habitat supported populations of greater sage-grouse[2] (*Centrocercus urophasianus*) estimated as high as 14 million birds (Dumroese 2020). The arrival of Euro-Americans began a saga of unmitigated disaster for the greater sage-grouse. Half of the sagebrush steppe habitat has been lost entirely. The process started with conversion to agricultural uses, primarily a combination of domestic livestock grazing and irrigation projects. More recently, losses are primarily due to urban sprawl, energy projects, infrastructure, and wildfires. As a consequence, the total number of greater sage-grouse in the US has declined by 97 percent, to only 400,000 birds. The entire population in Oregon is estimated at only 14,200 birds (Foster and Vold 2020).

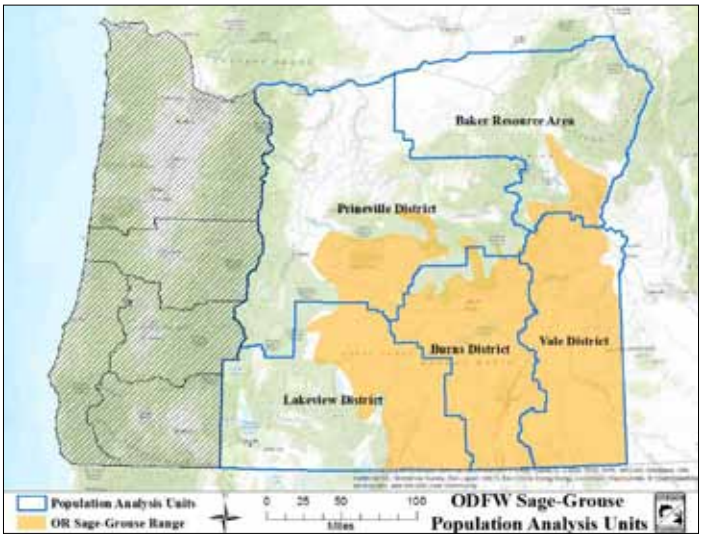
In Oregon, most of the primary negative impacts on sage-grouse are related to human actions. (See sidebar) Thus, human intervention to preserve existing sagebrush steppe and restore degraded habitat is crucial for survival of sage-grouse populations. In this article we describe the relationship between sage-grouse and their sagebrush habitat and discuss ways that this habitat might be restored.

## A year in the life of sage-grouse

Sage-grouse are the ultimate sagebrush steppe specialists, requiring sagebrush habitat year-round.

### *Spring*

Each spring sage-grouse return to their breeding grounds, called leks, to perform an elaborate courtship. This ritual of male dancing ranks as one of the top wildlife "wonders of the world." From March through May, males gather as the sun rises to strut for female attention and vie for dominance. Males inflate and deflate two bright yellow throat




Sage-grouse habitat in Oregon is the northern extension of the Great Basin. Map from the Oregon Greater Sage-grouse Population Monitoring: 2020 Annual Report.

sacs to make a strange popping sound, like champagne bottles opening. As they strut, they fan their spiky tails, occasionally sparring with each other with their wings. Females[3] watch from the cover of nearby sagebrush. This waiting and watching lasts for many mornings before the hens choose their mates. It appears that a few dominant males receive almost all the attention from the females. After a hen mates with her chosen cock, she flies off in search of the ideal sagebrush shrub under which to make her nest on the ground. Sagebrush with a spreading growth form provide more secure nesting conditions than plants with columnar growth form because the spreading branches provide additional screening from predators. Hens usually fly no more than three to four miles from the lek. The males play no part in the raising of the young. Hens choose nest sites that not only provide hiding cover from predators but are also surrounded by forbs and insects. Before and after breeding, hens require increased levels of calcium, protein and fat-soluble vitamins (A, E, $D_3$ and K) to produce eggs (Barnett and

[1] When we use the name sagebrush without a modifier, it means collectively the woody *Artemisia* species found in the Great Basin steppes, including the various hybrids between them: *Artemisia tridentata* (ssps. *tridentata*, *vaseyana*, and *wyomingensis*), *A. arbuscula* (ssps. *arbuscula and longiloba*), *A. cana, A. nova, A. papposa* and *A. rigida.*

[2] There are two species of sage-grouse: greater sage-grouse and Gunnison sage-grouse (*Centrocercus minimus*). In Oregon we have only greater sage-grouse, which we will, for convenience, refer to simply as sage-grouse in this paper.

[3] Females are about half the size of males. Both sexes have small heads and long tails with black bellies and clean white underwings, easily spotted in flight. The female has a mottled breast and neck, while the males sport a white breast and white neck feathers above a black neck ring.

## The Saga of Resource Development in Oregon

Much of the shrub steppe in Oregon has been lost to large wildfires, developed for other uses or severely degraded by improper grazing. Energy development and urban expansion are huge threats outside of Oregon, but those threats are fairly negligible here compared to invasive annual grasses and conifer encroachment. Eighty percent of the remaining sagebrush steppe is estimated to be so degraded that it does not meet the needs of sage-grouse. Many of the factors that eliminate or degrade sagebrush habitat interact with each other and have a compounding effect on the birds. Wildfires, annual weed invasion, conifer encroachment, lax enforcement of grazing regulations as well as range "improvement" projects such as seeding with crested wheatgrass all contribute. Some of the remaining sagebrush steppe is so fragmented, without connections to larger areas, that it is unavailable as suitable habitat.

More frequent and prolonged droughts contribute to large wildfires, which have replaced vast areas of sagebrush with exotic annual weeds that spread rapidly on bulldozed fire breaks. Fire is now particularly devastating to sage-grouse habitat in lower elevation (Wyoming big sagebrush) sites. Historically, distribution of the vegetation (fuel) was patchy with bare soil or rocks between the clusters. Frequent fires ignited by lightning or by native people resulted in a highly heterogenous landscape, both spatially and temporally (through varying stages of post-fire succession), which was perfect for providing all of the habitat requirements for sage-grouse at all life stages. Now, exotic annual grasses create a continuous fuelbed, and the climatic trend is toward more episodes of extreme fire weather, a combination that yields the current "megafires." Megafires leave large areas of annual grass monocultures in their wake that are vulnerable to very frequent fire return intervals, effectively preventing the reestablishment of any perennial vegetation. Rabbitbrush often replaces sagebrush by quickly recolonizing after fire by re-sprouting and widespread dispersal of copious quantities of seed. In contrast, it can take 20 to 50 years for big sagebrush to recolonize a site without replanting by humans.

Conifer encroachment is another primary threat to sage-grouse habitat, particularly in the higher elevation (mountain big sage) sites. Western juniper (*Juniperus occidentalis*) may occupy as much as 150% more area than it did pre-European settlement. In Oregon, conifer encroachment has made a substantial amount of historical sage-grouse habitat unsuitable. Sage-grouse tend to actively avoid sagebrush steppe habitats with conifers, where they experience higher predator mortality. Juniper encroachment of the uplands also affects the hydrologic conditions of the surrounding areas by reducing the amount of water that uplands contribute to surrounding areas. Less water in the lower areas results in increased shrub mortality and formerly mesic habitats fail to sustain the forbs and insects that are critical for sage-grouse.

In the early years, large bands of sheep "stripped the desert clean" of all forage. Historical photo from the Bowman Museum, Prineville.

### *Historic overgrazing*

Where sagebrush remains, the legacy of historic overgrazing is the primary cause of the loss of native wildflowers and grasses in the understory. During the early decades of western range use, domestic livestock grazing eliminated the diverse array of forbs and grasses that are characteristic of steppe communities, leaving a depauperate shrub steppe. Because sheep show a higher preference for forbs, they were often blamed for the destruction of rangeland. Reub Long described the situation: "When the grass belonged to no one, the sheepherders knew that if they didn't get the last spear of grass, that someone else would. There was no point in grazing lightly" (Jackman and Long 1967). In those early decades, the rangelands were stripped bare, whether by sheep, cattle, or horses. Large bands of 2,000 to 3,000 ewes (with lambs) could remove all the forage in a single pass, but they did not necessarily cause more damage than cattle and horses. Sheep were herded across the landscape in mass and then were gone, while horses and cattle tended to remain in a location, grazing any regrowth the plants could muster to produce flowers or seeds. They grazed the seedlings too, thus ensuring the demise both of existing plants and their potential replacements.

Excessive grazing left native species less resistant to drought: depleted reserves in the roots led to smaller root systems and feeble regrowth when water became available. Essentially all of eastern Oregon was subjected to unregulated livestock grazing in the late 1800s and early 1900s. That said, given the opportunity, many plant communities recovered if the overuse was stopped soon enough, that is, before the plants were dead, the seedbank was depleted, and before invasive species occupied the site and changed the frequency and intensity of wildfire.

Sage-grouse hens feed on tender leaves and buds of composites with milky sap. Photo by Tom Koerner.

Day-old sage-grouse chicks have their eyes open and are covered in downy feathers. Photo by USFWS.

Crawford 1994). Viable eggs depend on quality forbs[4] in the hen's diet. Nutritive food is also needed during the incubation period. Hens usually lay 6 to 10 eggs over a period of about 10 days. The chicks hatch after about 4 weeks, covered in down and with their eyes open. In Oregon, hatching begins in late April and lasts through nearly the end of June (Foster and Vold 2020). By the time they are five weeks old, chicks are relatively good flyers. The broods will stay together for nearly three months. The chicks are voracious eaters, following their mother out of the nest in search of insects and wildflowers.

Survival rates for sage-grouse chicks vary, but typically fewer than half will make it to winter. A large number of predators seek out sage-grouse eggs and chicks for a delicious meal: ravens, ground squirrels, coyotes, snakes, eagles, hawks, owls, badgers, and bobcats. Considering the variety and resourcefulness of the cadre of predators, the survival of any chicks is a credit to a sage-grouse hen's dedication and shrewdness.

*Summer*

From May through July sage-grouse hens need a site with sagebrush canopy cover between 15 and 25 percent. Excessive canopy coverage (>40 percent) for brood rearing habitat is just as undesirable as inadequate canopy coverage (<10 percent). As upland sagebrush habitats dry out over the summer, broods are drawn to riparian areas, springs, wet meadows, irrigated fields and other moist, green spots where they can feed on wildflowers, ants, beetles, grasshoppers, and succulent leaves and later-blooming flowers (especially legumes). During summer days, hens and their broods forage for tender flowers and leaves in the early morning, rest during the heat of the day, then resume foraging until twilight when they seek a safe place to roost on the ground. By the end of summer sage-grouse juveniles are about two-thirds the size of adults and can follow the hen for long distances.

*Fall*

Fall is a time of transition, both for diet and physical location. Although sage-grouse continue to stock up on protein-rich foods found near mesic habitats they begin eating more sagebrush through the fall. Sagebrush is the species that sustains them through winter. Most birds have left their summer ranges by late October and make their way to winter range. The distances that birds migrate vary and some do not migrate at all.

*Winter*

During the winter, sage-grouse shelter under sagebrush and are often covered by the snow. Preferred winter habitat

In winter, sage-grouse use sagebrush as a source of food and cover. Photo by Tom Koerner.

[4] Biologists use the term "forb" as a collective term for herbaceous, non-graminoid flowering plants. We might think of them as wildflowers that aren't shrubs.

is 10 to 30 percent canopy cover of sagebrush that extends 10 to 14 inches above the snow. They are able to burrow in the snow for warmth and ingest snow instead of seeking out liquid water to drink. They feed exclusively on sagebrush leaves, which are rich in oils and protein and provide adequate energy for survival. In fact, male sage-grouse often gain weight over the winter and most are in their best physical condition as the spring mating season approaches. While nutritious for sage-grouse, sagebrush leaves are not suitable for many other animals because they contain toxic terpenoids (the same chemicals found in turpentine). Sage-grouse are able to sequester these chemicals during digestion and excrete them separately as a "cecal dropping," which looks like a silver-dollar-sized drop of tar. This may remind you of the way monarch larvae ingest toxic compounds in milkweeds, except that the sage-grouse eliminate the toxins while the monarchs retain them for protection from predators. Just as milk becomes flavored by particular plants a cow consumes, it appears that sage-grouse may take on the flavor of sagebrush. In his narrative of 1838, John Kirk Townsend reported that he and other early explorers couldn't resist shooting the "cock of the plains" but found them "so strong and bitter as not to be eatable" (Townsend 1999).

### Sagebrush steppe as habitat

Wildlife habitat must provide cover, food, and water, as well as sites for breeding. Eastern Oregon hosts a variety of sagebrush steppe habitats (Shultz 2012). The three subspecies of *Artemisia tridentata* grow in on different sites. Basin big sagebrush (*A. tridentata* ssp. *tridentata*) is found on deep well-drained soils in cool valleys; Wyoming big sagebrush (*A. tridentata* ssp. *wyomingensis*) grows on harsh, dry sites from the lowest elevations in the valleys to mountain slopes, and mountain big sagebrush (*A. tridentata* ssp. *vaseyana*) is generally found at the higher elevations on mountain slopes. Three-tip sagebrush (*A. tripartita*) is occasionally found on sandy, gravelly or ashy ridgetops and slopes. Silver sagebrush (*A. cana* ssp. *bolanderi*) grows in the playas, preferring poorly drained clay soils. Low sagebrush (*A. arbuscula* ssp. *arbuscula*) is usually found in islands of rocky soil amid large stands of big sagebrush. Early sagebrush (*A. arbuscula* ssp. *longiloba*) is the most valuable sagebrush species for sage-grouse (Rosentreter 2005). As its common name suggests, it flowers earlier than the other low sagebrush subspecies and grows in alkaline clay soils with poor drainage, from low to high elevations. On basalt soils in extreme southeastern Oregon, low and early sagebrush are more common, and Owyhee sagebrush (*A. papposa*) extends into Oregon from adjacent Idaho.

Because sage-grouse depend on sagebrush steppe for all of their needs, their populations are at risk. During 200 years of Euro-American development of the West, the sagebrush steppe has been radically altered toward two extremes: too little or too much sagebrush. In the former case, a diverse sagebrush community has been replaced by a relatively simple community of annual weeds, usually dominated by cheatgrass; if there is an overstory it is most often rabbitbrush or western juniper. At the other extreme, what remains is a dense canopy of sagebrush with a severely depleted (or missing) herbaceous understory. Dense sagebrush can lack the herbaceous component that provides food; sparse sagebrush provides too little hiding cover. Whether there is too much or too little sagebrush,

Ideal sagebrush steppe for sage-grouse has open sagebrush, some bunchgrasses and a diverse mix of forbs. Photo by Stu Garrett.

Degraded sagebrush steppe has dense sagebrush and bare soil. Photo by Stu Garrett.

degraded habitat lacks the native wildflowers that were once part of the steppe community. While biologists formerly considered that the right sagebrush species, condition, and amount of *Artemisia* was *the* crucial factor for sage-grouse habitat, they now agree that having an adequate component of the right species of forbs is equally important (Dumroese *et al.* 2015, Luna *et al.* 2018, Pennington *et al.* 2016, Walker and Shaw 2005). Without both, greater sage-grouse will not survive. Grass is not a component of sage-grouse diets but it provides important hiding cover and nesting material.

The open sites in sagebrush steppe called playas were especially important to sage-grouse. Playas are flat-bottom depressions found in interior basins in arid and semi-arid regions that periodically fill with water that slowly infiltrates into the ground water system or evaporates, causing the deposition of salt, sand or mud around the edges of the depression. Sage-grouse leks can occur in playas, but more importantly the playas served as mesic refuges of forbs and insects for the sage-grouse. In southeastern Oregon most of the playas have been dug out to create spring-summer livestock watering holes. Livestock congregate in these areas, which become overgrazed, trampled and dry out earlier than undisturbed playas. Thus, they no longer function as mesic refuges.

*Why are forbs important to sage-grouse?*

Forbs are crucial for nutrition in two ways: they are eaten directly by the birds and they also attract insects that the birds eat. Sage-grouse have a crop[5] but not a muscular gizzard, and must eat soft plant parts that can be digested without grinding. Only adult sage-grouse can eat sagebrush leaves[6] and then only during the winter. The rest of the year they eat juicy leaves, buds, flowers, and immature seeds, but not hard, dry seeds or coarse cellulose. Not only are the softer foods more digestible, but they are more nutritious, with a concentration of protein, fat, and essential minerals, including calcium and phosphorus not found in more fibrous foods.

Chicks require digestible food with the necessary protein and amino acids for development. Flower petals are made of hemi-cellulose which is easier to digest than the stiffer cellulose of stems and branches. The best parts of all are the anthers: they are little nutritional pollen bombs, packed with protein and lipids (Rosentreter 2005).

Flowers attract insects that feed on leaves, pollen, nectar, or seeds. For about three weeks after the chicks hatch, insects are a critical food for both chicks and adults

[5] The crop is a muscular pouch located in a bird's neck above the top of the chest or sternum. As an enlargement of the esophagus, the crop functions as a storage place for food and is where digestion starts. In birds whose diet focuses on seeds, the food is pushed through a narrow passage called the gizzard, which is a muscular organ that uses grit to grind the food.

[6] The juveniles cannot digest sagebrush at all until they are over six weeks old.

Anthers are packed with pollen: "little pellets of nutritive power." Bitterroot (*Lewisia rediviva*) photo by Robert Korfhage.

Some flowers have value for the insects they attract. *Cryptanthus celosioides* photo by Robert Korfhage.

Sage-grouse like to eat leaves, buds, and flowers of sunflower family species with milky juice. Western hawksbeard (*Crepis occidentalis*) is a favorite. Photo by Paul Slichter.

Sagebrush false dandelion (*Nothocalais troximoides*) is not a showy wildflower but sage-grouse seek out its leaves, buds and flowers. Photo by Paul Slichter.

*Agoseris* is one of the most important genera for sage-grouse as they eat the leaves during brood rearing. As an early successional species that tolerates disturbance, annual agoseris (*Agoseris heterophylla*) is a good candidate for restoration projects.

(Johnson and Boyce 1991). Although forbs contain higher levels of calcium and ascorbic acid (Vitamin C), invertebrates provide more protein than plant materials (Smith *et al.* 2019). In a dietary study of sage-grouse chicks, Johnson and Boyce (1990) found that newly hatched chicks fed only plant material died within 10 days. Those fed insects and vegetation survived, and the ones given extra insects gained more weight and were healthier than birds fed the standard number of insects. During the summer, insects become especially important if the sage-grouse have to survive without mesic areas; their crops have been found to be full of grasshoppers. Many types of insects, in all stages from larvae to adults, help sustain sage-grouse: moths, flies, beetles, ants, grasshoppers.

## Favorite wildflowers of sage-grouse

Not all forbs are equal in the eyes of sage-grouse. Roger Rosentreter (2016), using his extensive knowledge of sage-grouse and the literature on sage-grouse diets, has created three categories for forbs: most preferred, fair, and poor or least preferred. Sage-grouse favorite wildflowers are yellow composites with milky sap and tender forbs, especially non-toxic legumes. Intermediate in preference are composites without milky sap, lilies, desert parsley, penstemons, paintbrushes, and buckwheats. The least beneficial ones include gummy yellow and coarse composites, other coarse forbs, and toxic legumes. As important as leaves and flowers are to sage-grouse, the value of some species is how they attract insects. Even toxic legumes like lupines have value because they attract insects and fix nitrogen that benefits other plants. As described above, providing a diversity and abundance of arthropods is a key component of recovery of sage-grouse populations. Plant phenology and cycles of abundance or scarcity of annuals also play a role. In springs with above average rainfall, flushes of small tender annuals like annual agoseris (*Agoseris heterophylla*), narrowleaf collomia (*Collomia linearis*), and annual phlox (*Microsteris gracilis*) augment the populations of perennial forbs.

Leaves of woolly groundsel (*Packera cana*) are likely a bit coarse, but the flowers are eaten and also support invertebrates consumed by the birds. Photo by Cindy Roché.

Table 1. Forb preference categories and food value for sage-grouse. Adapted from Roger Rosentreter (2016). **Bold** indicates the most preferred category.

| Species group | Examples | Leaves | Flower parts | Immature or soft seeds | A magnet for diverse & abundant insects |
|---|---|---|---|---|---|
| **Yellow composites with milky sap (Lactuceae)** | *Agoseris, Crepis, Hieracium, Microseris, Nothocalais Packera, Senecio, Taraxacum* | good | good | good | good |
| **Composites with nonmilky sap** | *Balsamorhiza, Blepharipappus, Chaenactis, Erigeron, Townsendia* | fair | good | good | good |
| **Tender legumes (Fabaceae)** | *Astragalus, Trifolium, Vicia* | good | good | good | good |
| **Desert and spring parsleys (Apiaceae)** | *Lomatium, Cymopterus* | fair | good | fair | good |
| **Lilies (Liliaceae)** | *Calochortus, Fritillaria* | good | good | good | good |
| **Penstemons (Plantaginaceae)** | *Penstemon* | good | fair | fair | good |
| **Paintbrushes (Orobanchaceae)** | *Castilleja Orthocarpus* | good | fair | fair | good |
| **Other small tender forbs** | *Cerastium, Lithophragma, Mentzelia* | good | good | fair | good |
| Buckwheats (Polygonaceae) | *Eriogonum* | fair | good | good | good |
| Toxic legumes | *Lupinus* | poor | poor | poor | good |
| Coarse composites (incl. all thistles) | *Cirsium, Dieteria, Layia* | poor | poor | fair | good |
| Oily, hairy and gummy composites | *Achillea, Ambrosia, Anthemis, Grindelia, Madia* | poor | poor | fair | fair |
| Coarse borages & mustards | *Amsinckia, Cryptantha, Sisymbrium, Lepidium* | poor | poor | fair | good |
| Blue flax | *Linum* | poor | poor | poor | fair |

### Restoration and saving the sage-grouse

The objectives for habitat management to benefit sage-grouse (Walker and Shaw 2005) recommend prioritizing sites already used by sage-grouse: first, protect high quality sagebrush steppe; second, enhance slightly degraded habitat; third, restore degraded habitats that still receive some sage-grouse use. It is extremely difficult and expensive to restore severely altered sagebrush habitat to its original state; in most cases, it is probably impossible to do more than relatively minor mitigation. In nesting locations that satisfy a minimum level of habitat requirement livestock grazing should never occur in the spring-early summer period in direct competition with the sage-grouse for succulent forbs. There is already plenty of competition for forbs from pronghorn antelope, deer, rabbits, mice, and any number of insect larvae and adults. Grazing in spring and early summer also inhibits seed set by forbs and reduces seedling replacement. Sometimes well-intentioned efforts hurt greater sage-grouse populations, such as when water developments designed to improve livestock distribution simply expand habitat destruction by introducing livestock grazing and weeds to previously undisturbed areas.

In a dense stand of sagebrush, some of the shrubs may need to be removed to free up resources for forb establishment (*e.g.,* light, space, nutrients, and water). Removing sagebrush may be done by various mechanical means, or very carefully by fire, but any disturbance may stimulate an increase in weeds that prevent establishment of native forbs. A seed source must be present for the native forbs, and grazing must be controlled so the desired species have a chance to grow. Choice of species among those adapted to the site should consider, first, the value on the species for sage-grouse, and second, the ease of establishment of that species. For example, milky-sapped composites like

Threadleaf phacelia (*Phacelis linearis*) leaves are too glandular and hairy to be eaten, but the flowers are eaten and support invertebrates. Photo by Stu Garrett.

*Lomatium* flowers are good forage and also attract insects. Photo by Robert Korfhage.

*Agoseris* and *Crepis* are on the "best foods" list and are ecologically early successional species, making them prime candidates for restoration projects.

The East Cascade Audubon Society (ECAS, Bend Chapter of the National Audubon Society) is joining forces with the Oregon Desert Land Trust (ODLT) to begin research on how to restore forbs to sagebrush steppe in central Oregon. The goal is to increase the number of forbs and consequently the number of insects in an area that is currently used by sage-grouse. A series of plots will be set up on ODLT land where conditions range from overly dense sagebrush to areas needing only more forbs and grasses. The goal is to learn how to restore degraded sagebrush steppe habitat over a wider region in central Oregon. The project will focus on seeding with native forbs, reducing overly dense sagebrush, and determining the timing and amount of grazing that can occur without hindering restoration. The property includes both sagebrush steppe and a mesic site. While research or demonstration plots are part of the project, the emphasis remains on restoring the ODLT site while gathering information to scale the methods to restoring public and private lands in central Oregon. ECAS has received a grant from Deschutes County to begin the project on 320 acres owned by ODLT near Brothers, Oregon. The Institute for Applied Ecology (Corvallis) and the USDA Great Basin Native Plant Project are also partners. Native Plant Society of Oregon volunteers will assist with on-the-ground projects. The ECAS-ODLT partnership is an exciting and much needed project that has the potential to take sage-grouse conservation to a new level.

## Acknowledgements

We thank Kareen Sturgeon, editor extraordinaire, whose suggestions on multiple iterations of this article improved it in so many ways. We thank our reviewers, Roger Rosentreter and Nick Vora, for their insightful comments, particularly on important points we needed to clarify or had neglected to mention.

## References

Barnett JK, Crawford JA. 1994. Pre-laying nutrition of sage-grouse hens in Oregon. J. Range Manage. 47:114-118.

Dumroese RK. 2020. Sagebrush Rangelands and Greater Sage-grouse in Northeastern California. Chapter 4.3 *In* USDA Forest Service RMRS-GTR-409.

Dumroese RK, Luna T, Richardson BA, Kilkenny FF, Runyon JB. 2015. Conserving and restoring habitat for Greater Sage-Grouse and other sagebrush-obligate wildlife: the crucial link of forbs and sagebrush diversity. Nativeplants 16(3):277-299.

Foster L, Vold S. 2020. Oregon Greater Sage-grouse Population Monitoring: 2020 Annual Report. Oregon Department of Fish and Wildlife. 112 pp.

Jackman ER, Long RA. 1964. The Oregon Desert. The Caxton Printers, Ltd., Caldwell, Idaho. 407 pp.

Johnson GD, Boyce MS. 1990. Feeding Trials with Insects in the Diet of Sage Grouse Chicks. J. Wildlife Manage. 54(1):89-91.

Johnson GD, Boyce MS. 1991. Survival, growth and reproduction of captive-reared sage grouse. Wildlife Soc. Bull. 19(1): 88-93.

Luna T, Mousseaux MR, Dumroese RK. 2018. Common native forbs of the northern Great Basin important for Greater Sage-grouse. Gen. Tech. Rep. RMRS-GTR-387. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station; Portland, OR: U.S. Department of the Interior, Bureau of Land Management, Oregon–Washington Region. 76p.

Pennington VE, Schlaepfer DR, Beck JL, Bradford JB, Palmquist KA, Lauenroth WK. 2016. Sagebrush, Greater Sage-Grouse, and the occurrence and importance of forbs. Western North American Naturalist 76(3):298-312.

Rosentreter R. 2005. Sagebrush identification, ecology, and palatability relative to sage-grouse. *In* Shaw NL, Pellant M, Monsen SB, comps. Sagegrouse Habitat Restoration Symposium Proceedings, June 4-7, Boise ID. Proc. RMRS-P-38. Fort Collins, CO: USDA Forest Service, Rocky Mountain Research Station. pp. 3-16.

Rosentreter R. 2016. Sage-grouse forb preference by 12 plant categories. Great Basin Fire Science Exchange webinar. (https://greatbasinfirescience.org/event/sage-grouse-forb-preference-by-12-plant-categories/).

Shultz, L. 2012. Pocket Guide to Sagebrush. (http://www.sagegrouseinitiative.com/wp-content/uploads/2013/07/SGI_Sagebrush_PocketGuide_Nov12.pdf)

Smith KT, Pratt AC, LeVan JR, Rhea AM, Beck JL. 2019. Reconstructing Greater Sage-Grouse chick diets: Diet selection, body condition, and food availability at brood-rearing sites. The Condor. 121:1-12.

Townsend JK. 1999. (reprint from original publication in 1839). Narrative of a Journey across the Rocky Mountains, to the Columbia River, and a Visit to the Sandwich Island, Chili, Etc., with a Scientific Appendix. OSU Press, Corvallis. 290 pp.

Walker SC, Shaw NL. 2005. Current and Potential Use of Broadleaf Herbs for Reestablishing Native Communities. pp. 56-61 *In* Shaw NL, Pellant M, Monsen SB, eds. Sage-grouse habitat restoration symposium proceedings; 2001 June 4–7, Boise, ID. Proc. RMRS-P-38. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 130 pp.

Cindy Roché was raised on a farm in northeastern Washington. She earned a BS in Forest Management and MS in Rangeland Ecology from Washington State University (WSU) and a PhD in Plant Science (University of Idaho). She has worked as a range conservationist with the US Forest Service and with WSU Cooperative Extension in rangeland weeds. She moved to central Oregon from the Rogue Valley five years ago and enjoys exploring the High Lava Plains as well as the Cascade Mountains. Roché has assisted with sage-grouse lek counts, sagebrush planting, and raven surveys in nesting areas. After hearing Stu's talk on sage-grouse for the High Desert Chapter, she wanted his message to reach a larger audience. Photo inside front cover.

Dr. Stu Garrett has a long-standing interest in natural history, particularly local botany and geology and is active in the protection of Oregon's special places. He practiced family medicine in Bend from 1978 to 2012. He co-founded the local chapter of the Native Plant Society of Oregon and served as president of both the local and statewide NPSO organizations. His fascination with the ecology of Oregon's sagebrush steppe includes the animals that dwell there, especially the greater sage-grouse. He has noted the dramatic decrease in local grouse numbers and is concerned that more is not being done to correct problems in its habitat. Leks that hosted bird numbers in the dozens east of Bend are now abandoned. He feels that local residents, particularly bird-lovers and botanists, should step up and do more locally to save this remarkable species. As a consequence, five years ago he took on the job of coordinating sage-grouse activities for the local Audubon chapter (ECAS). Through ECAS he has worked closely with ODFW, USFWS, Deschutes NF, Deschutes County, and BLM on various projects to help the sage-grouse. Projects have included putting up wire fence markers, monitoring for predators, trapping mosquitos for West Nile virus, removing young conifers, restoring damaged sagebrush steppe with native plantings, assisting private landowners with restoration and research activities, coordinating with National Audubon, leading field trips in greater sage-grouse habitat, and developing a local research study to look at ways to improve habitat in eastern Deschutes County. The local greater sage-grouse population is in a precarious position and it has a viable future only if we step up and restore their habitat.

## Lisa Blackburn

Lisa Blackburn was born and raised in southern California. As a child, she enjoyed numerous camping vacations with her family all over the western United States. These trips and her mother's interest in gardening sparked her interest in botany and geology. When Lisa attended the University of California, Davis, her broad interests led her to enroll in a variety of environmental science classes. She graduated in 1974 with a Bachelor of Science in Renewable Natural Resources.

Lisa found herself interested in soils and botany, recognizing that soils are key to the vegetation they support. She took classes in soils, botany, and range management, completing an MS in Range Management from UC Davis in 1975. This qualified her for federal government positions in range conservation and soil science. Lisa started her career as a Range Conservationist in the Plumas National Forest in Milford, California. In 1976, she moved to Burns, Oregon, to work with the Bureau of Land Management. As a Range Conservationist in California and Oregon, she monitored vegetation conditions and trends by measuring and photographing trend plots, developed grazing rotation plans, and participated in plant association surveys and mapping projects. She did wild horse counts from helicopters and airplanes. Her work took her to the BLM office in Portland in 1978, where she became an Environmental Protection Specialist, serving on a team that wrote the Environmental Impact Statements for grazing management plans in eastern Oregon. She was responsible for the vegetation, soils, water, climate, and wild horse sections. For the next 25 years, Lisa continued to work in the BLM state office in Portland as a computer specialist and Freedom of Information Act (FOIA) and Privacy Act records specialist, providing program leadership, policy guidance, technical assistance, program monitoring, and training. After her retirement in 2007, she continued to work on contract in BLM offices in Oregon, California, and Arizona.

In 2009 Lisa joined the Native Plant Society of Oregon (Cheahmill Chapter, McMinnville). She immediately assumed a leadership role in the chapter serving, first, as the Secretary (2009-2011), then as Chapter President for the next two years (2012-2014). She served for another two years as Vice President for Programs, identifying speakers who could engage both Chapter members and the public in learning more about native plants. In 2016 Lisa started another two-year term as President and is, once again, in 2020, serving as President for the Chapter. She served on the planning committee and assumed responsibility for registration at the State Annual Meeting sponsored by the Cheahmill Chapter in Cannon Beach in 2014. She served on the planning committee for the 2020 Annual Meeting (cancelled due to Covid-19). Lisa has given presentations to the Newberg and McMinnville garden clubs, with a focus on gardening with native plants and has staffed NPSO tables at various businesses for workplace funding campaigns. Lisa has helped coordinate and manage the annual Cheahmill Chapter wildflower show since 2010 and has helped maintain the native plant garden around the McMinnville Library, pruning and weeding with the monthly garden work parties.

At the state level, Lisa served as the NPSO EarthShare Oregon liaison for two years. She started as a director-at-large on the State Board from 2010-2011, then served as Secretary for three years, vice president for a year, and president until 2020, adding a third year to her tenure when no one responded to the call for nominations for president in 2019. During her term as president, she supported a number of transitions relating to electronic communications, including development of a NPSO Facebook page, updating the NPSO website, replacing the print Bulletin with an email version, amending the bylaws to facilitate electronic voting, and offering membership renewal by PayPal. The significant conservation issue of her term was the Oregon Department of Agriculture's Native Plant Conservation Program for listing the status of plant species that are considered threatened or endangered, for which she advocated for financial support of the program during the 2019 Legislative session.

Lisa lives in Newberg and spends time with her son, her daughter, and five grandchildren. She has traveled extensively since her retirement from BLM, but continues volunteering with NPSO, the Newberg Food Bank, and activities to support the disadvantaged in her hometown.

Although Lisa joined the Society relatively recently, her dedication and leadership in support of the Native Plant Society of Oregon has been unflagging. She has committed much of her retirement to efforts in sharing the NPSO mission and values to the broader public.—*Michal Wert, Cheahmill Chapter.*

## David H. Wagner

As the son of missionary parents, David Wagner spent his childhood in Landour, India, in the foothills of the Himalayas. There David attended Woodstock School, exploring the mountains and collecting specimens of all kinds, including beetles, butterflies, birds, mammals, and snakes. About the age of eleven, he became particularly curious about ferns that, along with bryophytes, became a central theme throughout his life. Mosses appealed to him because they are small, often overlooked, and very much worth studying. After leaving India in 1963, David studied biology, chemistry, and geology at University of Puget Sound in Tacoma, Washington. He earned his MS and PhD in botany at Washington State University in Pullman; his doctoral dissertation focused on the genus *Polystichum* (swordferns) of western North America.

In 1976 David moved to Oregon to become curator of the University of Oregon herbarium in Eugene. In 1979 he was promoted to Director, a position he held until 1993, when the herbarium was merged with the herbarium at Oregon State University in Corvallis. As both a member of the university faculty and Director of the herbarium, David engaged with students and the general public, taught systematic botany and bryology, wrote professional publications and mentored graduate students, including NPSO members Linda Vorobik and Jennifer Lippert.

When the herbarium merger left him without employment, he established Northwest Botanical Institute, a consulting and research business with special focus on ferns and bryophytes. He conducted surveys for rare species, developed keys and study guides, and offered workshops for federal employees and contractors. Today he is a recognized expert on the bryophyte flora of our state, identifying and cataloging species from diverse habitats, ranging from Cascade fens and the deep waters of Waldo lake to Coos Bay and the Elkhorn Mountains, and to locations beyond the borders of Oregon in the Pacific Northwest. In his hometown of Eugene, he inventoried the bryophytes and lichens of Spencer Butte Park. As an active participant in rare bryophyte conservation, David described new species and created numerous guides and checklists that are used by local, state and federal agencies, NPSO, and the Oregon Biodiversity Information Center (ORBIC) as references in their work to protect and conserve rare Oregon bryophytes and their habitats.

David joined the Native Plant Society of Oregon soon after his move to Eugene (1976), so he has been contributing to the Society for over four decades. Although NPSO was founded in 1961, the process of establishing local chapters throughout the state was still underway at that time. When David helped found the Emerald Chapter it became the sixth chapter. He served as the first Emerald Chapter president (1979-1981), then as State president (1981-1982). David also served twice on annual meeting committees (1982 and 1991), coordinating logistics and soliciting speakers. He has been a frequent speaker over the years at Emerald and other NPSO chapters as well as at the Eugene Natural History Society. As a member of the Board of Directors of the Eugene Natural History Society, he brought excellent speakers to the University of Oregon for public education on topics ranging from bats to volcanoes. David has volunteered at the NPSO-sponsored Mt. Pisgah Arboretum Wildflower Festival since 1980, collecting plants, setting up the show, and staffing the botanist's table to identify plants. David published two articles in *Kalmiopsis*: History of the University of Oregon Herbarium in 1994 and Shepherd's Desert Parsley (*Lomatium pastorale*) in 2013. He reviewed books for *Kalmiopsis* on topics ranging from pitcher plants to climate change.

David advocated for conservation of rare native plants and their habitats as an appointee (1978-1985) to the Natural Areas Preserves Advisory Committee (NAPAC). With Jean Siddall from Portland Rare Plant Project and Ken Chambers at OSU, they used NAPAC as a vehicle to publish *Rare, Threatened and Endangered Plants of Oregon* in 1979. This established the basic groundwork for subsequent rare plant work in Oregon. NAPAC subsequently became the Natural Heritage Advisory Council that continues to protect representative ecosystems for research and education. David has represented NPSO on community committees to advocate for native plant conservation and volunteered for conservation projects such as rare plant surveys. He was a member of the Lane County Rare Plant Committee and Checklist Group (1995, 1998-2002), which became a valuable resource for both the Oregon Flora Project and for the second edition of the *Flora of the Pacific Northwest*.

David wrote and reviewed treatments and provided species lists for the Oregon Flora Project. He served on the Board of Directors for the *Flora of North America* (2009-2018) and wrote the treatment for *Polystichum* (Volume 2) and several genera of liverworts (Volume 29). He is an exceptional artist and has developed techniques for stunning microphotographs of diagnostic features in ferns and bryophytes. David maintains an enlightening website called "fernzenmosses," which reflects both the spiritual and aesthetic components of his appreciation for these plants and natural history. Each year he creates the Oregon Nature Calendar, which includes information on plants, animals, phases of the moon, photoperiod, soils and various aspects of natural history, illustrated with his original pen and ink drawings.

David has written numerous popular articles about the natural history of the Willamette Valley, particularly on Oregon native plants and habitats, including for the Mount Pisgah Arboretum and Eugene Natural History Society newsletters and a monthly article (It's About Time) for the *Eugene Weekly*. For 17 years (1977-1993), he led weekly spring walks in Alton Baker Park in Eugene, recording flowering phenology, which has been added to the database for a future publication own the effects of Pacific decadal oscillations and climate change on plant phenology.

The OSU Herbarium houses thousands of David's vascular plant collections, and even more nonvascular (bryophyte) collections, the latter not yet cataloged in the Consortium of Pacific Northwest Herbaria. Through his contributions to botanical knowledge in the Pacific Northwest and his life-time commitment to NPSO, David embodies the society's mission: dedicated to the enjoyment, conservation, and study of Oregon's native plants and habitats.—*Gail A. Baker and Jennifer Lippert, Emerald Chapter.*

## Winner of the Council on Botanical and Horticultural Libraries 2020 Annual Literature Award

*This is CBHL's highest award, going to a work that makes a significant contribution to the literature of botany or horticulture.*

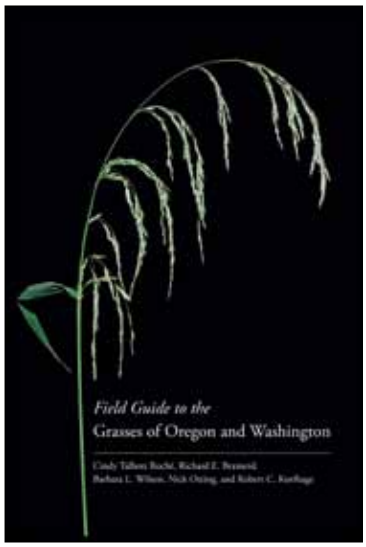
**Field Guide to the Grasses of Oregon and Washington**
Cindy Talbott Roché, Richard E. Brainerd, Barbara L. Wilson, Nick Otting, and Robert C. Korfhage. 2019. Oregon State University Press. ISBN 9780870719592. 488 pp. soft cover. $35

This is a review of the *Field Guide to the Grasses of Oregon and Washington*, a long-awaited book by a group of eminently qualified and experienced botanists and ecologists. According to the authors, this work began in 2003 as a desire to complete a definitive reference work for the grasses of Oregon. Washington state was added later. I was asked to write a review of this field guide from the perspective of a field botanist/range conservationist who has dealt with, and often struggled with, grass identification over the course of several decades.

First, reading the 14-page introduction is crucial. Here you'll find an explanation as to why grasses are important, a discussion of what constitutes a grass and a bit about grass identification in general. The bulk of the introduction consists of a section entitled "Grass Structure and Vocabulary" with the caveat "READ ME." The authors aren't kidding. Read and understand this section and you'll know enough grass anatomy to be well on your way to becoming an agrostologist. This was enjoyable, even entertaining reading, enhanced by the inclusion of appropriate line illustrations. Completing the introduction are sections on grass biology and tips on how to use the book.

Following the introduction are the "Keys to the Genera of Grasses." Starting at square one, dichotomous choices will take you first to "groups" and then to genera. Once you've determined (or guessed) a genus, the next section, "Genus Descriptions and Keys to Species" is where you need to be. Conveniently, this is organized alphabetically for all taxa. So, if you key to the genus *Hordeum*, for example, thumb through the genus descriptions to *Hordeum*, and there you'll find a key to determine species. So far, this is somewhat standard for most keys.

However, once you think you've identified your grass to species, then the next section, Species Accounts, is where this book really shines, not to slight the keys. Here you'll (typically) find a page for each species, organized alphabetically. Generally, two-thirds of each page is devoted to high quality, detailed photographs of each grass, from a general view of the plant itself all the way down to diagnostic features such as ligule size and shape, glume hairs and the like, including measurements where important. The rest of the page includes a map of the species' occurrences from the Oregon Flora Project, a technical description, a brief habitat statement, and informative comments. Each species is also tagged as to its nativity (also indicated in the species keys), and, of course, the latest nomenclature is used.




As per the authors' advice, one can either use the key, the species accounts, or both. For me, both are essential, and my preference would be to use the key first, and then the species account to validate or refine. But if you know your genus, you could thumb through the species accounts to come up with an ID.

To test the key, I found a couple of dry, weathered specimens (all I could find mid-November) and worked them through. It seemed pretty easy, but I can't wait until next field season to really give it a workout.

Following the Species Accounts is a fairly standard glossary followed by a list of references and an index. The index is where you'll find taxonomic synonyms.

What I really like about this book is that it's technically correct yet friendly. For example, in the introduction is a brief discussion about spikelets being laterally compressed, cylindrical or dorsiventrally compressed. These can be intimidating words. However, the authors suggest you simply place the spikelet on a table and depending on how it orients itself, this will tell you how it's compressed. In another case to determine if a spikelet is flat or not, it is suggested to just roll it between your fingers. These are simple "tricks" that only come with experience, and I've never encountered such helpful advice in any other key. It's as if someone was looking over your shoulder helping you make sense of it all.

About the size of half a sheet of paper and an inch thick, the book is small enough to take with you to the field, and its glossy cover should provide some protection from the elements.

If you care about grass identification, either as an amateur or professional, you need this book. From my experience, no other grass key is as useful and user friendly. Along with GPS, GIS, digital cameras and Google Earth, I wish I had this book 40 years ago.—*Ron Halvorson, High Desert Chapter*

## Winner of the Council on Botanical and Horticultural Libraries Award of Excellence in Gardening and Gardens

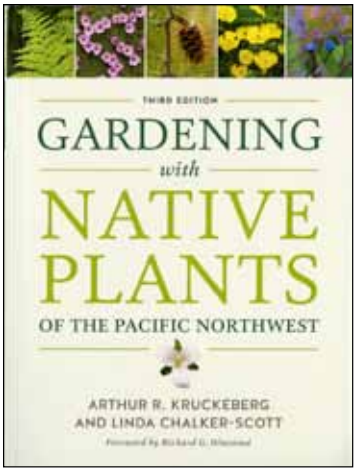
### Gardening with Native Plants of the Pacific Northwest Third Edition

Arthur Kruckeberg and Linda Chalker-Scott. 2019. University of Washington Press, Seattle, Washington. ISBN 978-0-295-74415-5 374 pp. Softcover. $35.00

Three and a half decades ago, Art Kruckeberg shared his passion for cultivating native plants in *Gardening with Native Plants of the Pacific Northwest*. At that time good references on this topic were scarce and his book filled a gap between desire to grow natives and knowledge of how to do so. Much has changed since publication of that first edition, indeed since the second edition in 1989. Interest in growing natives has grown exponentially, starting with roadside beautification and wetland restoration and expanding into home gardens, parks and street side "hell strips." Pollinator support has shifted awareness to hardy native plants that provide habitat as well as nectar and pollen for native insects. Water restrictions and wildfires have generated interest in drought-tolerant and fire-resistant natives.

The contents of this third edition are organized into seven chapters, preceded by an introduction. Sami Gray managed the layout of this edition, with the goal of illustrating every habitat and each species with a photo. She succeeded by enlisting 80 photographers from throughout the Pacific Northwest, including both of us. All references to wild collection of native plants have been removed; many species are now available as plants or seed from commercial sources. The introduction chapter discusses plant names, the options one encounters in plant nurseries (natives, varieties, cultivars and hybrids), and uses of native plants in gardens and landscapes. The icons used throughout the book for habitats are explained here, so don't skip over this chapter. Chapters two and three are new to this edition and review garden ecology and science, covering basic knowledge needed by anyone growing native plants.

Chapters three through seven introduce trees, shrubs, perennial forbs, graminoids, and annuals. The nomenclature was updated to the newly published second edition of the *Flora of the Pacific Northwest*. The original edition described about 250 species, this number was expanded to nearly 1,000. In each section, species are grouped by type (ferns, lilies and irises, etc.) then alphabetically by genus, making them easy to locate, or sorted by height, a layout that will appeal to gardeners looking for plant solutions for specific spots. Habitat icons help the reader decide which species to try, and which to avoid based on the likeliness, or not, of delivering the proper habitat conditions in one's home garden. Rock garden selections are featured in several sections. One native endemic shrub




was mentioned, queen-of-the-forest (*Filipendula occidentalis*), a lovely shrub that is often overlooked in regional field guides.

Perennial forbs (wildflowers) are allotted the most space (40 pages), while trees and shrubs share about equal coverage, 24-26 pages. Much less space is devoted to grasses and grass-like plants (13 pages) and annuals (4 pages). The latter was justified by a statement in the introduction: "unlike in California and the Southwest, there are few native annuals in the Northwest, and even fewer with any exceptional garden potential." But the light coverage of native grasses cannot be attributed to the same rationale, as the number of species offered by native plant nurseries far exceed the options mentioned in chapter six. Indeed, a major omission was a section on options for native grasses as low to no-mow turfs for replacing lawns. In the back, there is a new appendix listing plant societies and botanical gardens, along with a glossary, bibliography, index of subjects, and of common and scientific names.

There appears to be a rather heavy bias toward the west side of the Cascades, which isn't surprising since the authors and editors are all based in western Washington. It would be good if future editions created a little more balance for east and west recommendations. For example, potential problems should be mentioned when mixing native and nonnative plants in urban gardens of arid regions. Urban landscape substrates frequently have only a few inches of "topsoil" or compost added over heavily compacted fill material, forcing plants to depend on shallow roots. To compensate for the absence of deep roots, ornamentals are watered frequently, saturating the surface soil. Native plants in arid eastern Oregon often die in these conditions, either from overwatering (lack of permeability) or from drought (lack of rooting depth). In addition, recommendations for grasses east of the Cascades are less than they could be. For example, the statement "the tallest native grass in the Pacific Northwest surely must be giant rye grass (*Elymus canadensis*)" leaves me puzzled. The common name for *Elymus canadensis* is Canada wildrye; the tallest native bunchgrass is basin wildrye (*Leymus cinereus*), which is highly recommended for landscaping, but not even mentioned in the book. The most common grass referred with the common name squirreltail is *Elymus elymoides*, not *Elymus multisetus*. While both are excellent species for restoration, they are not particularly good garden plants because they readily self-seed and the awns are a nuisance for dogs. The book's roster of eastside grasses on pages 236-7 is equally misleading: *Buchloa* and *Bouteloua* are not native to eastern Oregon and Washington;

Grama (presented as a genus name) is the common name for *Bouteloua*; the genus name *Stipa* (now *Achnatherum* for our species) is listed, despite the statement in the preface that the book follows nomenclature of the *Flora of the Pacific Northwest*; *Poa* is such a large genus that is it nearly meaningless to list *Poa* spp.

Despite these criticisms, we recognize that offering plant selection advice on both sides of the Cascades, from the seashore to interior montane gardens, is a formidable challenge, given the variation in growing conditions in the Pacific Northwest. Without adding another fifty pages or so of habitat and climate details, this book provides succinct and visually gorgeous information to guide readers in growing native plants in home gardens. It's definitely worth upgrading to the new edition; it contains a wealth of recommendations. —*Kathleen Sayce, Filipendula Chapter and Cindy Roché, High Desert Chapter*

**Common Mosses of Western Oregon and Washington**
Bruce McCune and Martin Hutten. 2018. ISBN: 978-0-9987108-2-2. Wild Blueberry Media, Corvallis, Oregon, U.S.A. Paperback. $40. Available from https://www.wildblueberrymedia.net

Geared towards beginning moss enthusiasts, this luxuriantly illustrated guide to "one of the mossiest places in the world" is a great place to start for bryo-curious botanists in the Pacific Northwest. The volume is perfect for the field or lab, as it includes field-observable and microscopic photographs on nearly every page and, at only 146 pages long, it easily fits in one's backpack. The authors are both scientists who specialize on bryophytes and lichens. The first author, Bruce McCune, is a professor at Oregon State University where he has taught for over 20 years and published extensive scientific research and identification guides on lichens and bryophytes. The second author, Martin Hutten, currently works for USDA Forest Service in Alaska, and has worked for National Forests and National Parks throughout North America. Martin earned a PhD in 2014 from Oregon State University where he conducted research on lichens in Yosemite National Park. The two authors combine their wealth of knowledge on bryophytes with exceptional photography to write a book that is accessible for beginners wanting to dive into the world of mosses. I was particularly interested in writing this review for two reasons. First, I am a lichenologist who recently started to learn bryophyte identification. Second, I teach undergraduate botany at a university and was curious to see if this book would be a good educational aid.

The text is organized into three main sections: introductory material, extensive keys, and further information including a glossary and references. The introductory material begins by outlining the scope and purpose of the book and unique features of the keys. A detailed review of moss basic biology and life cycles follows with illustrations and bolded key vocabulary. The section wraps up with instructions on how to collect, preserve, and study mosses in the lab. Next, the keys comprise the bulk of the book (110 of 148 pages). The structure of the keys in this book is unique when compared to similar references. The distinguishing features for each couplet is listed first and demarcated by a semicolon. Then, descriptions are listed after the semicolon, and full illustrations are integrated onto the page where the species is listed. This layout reduces the amount of flipping back and forth between keys, descriptions, and illustrations that is inevitable in the layout of most similar books. Illustrations in the key section are extensive. The right page of each two-page spread is all photographs, and the left page is a quarter to half photographs as well. For instance, if you collected a sample of

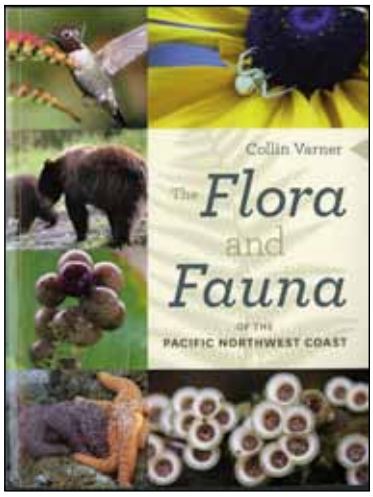

*Claopodium* you would be directed to "Key O – Pleurocarps; Costa Long and Single; Papillose Leaves." On this two-page spread, in addition to extensive discussion on the differences among the three species, on the left, you will find a photograph illustrating differences among the leaves of the three species and, on the right, macroscopic photographs of the three species, along with a micrograph of the diagnostic papillae of *Claopodium crispifolium*. After the keys, there is a short nomenclatural note on synonyms, a page illustrating the evolutionary relationships among moss genera, and my favorite part of the back material—a thoroughly illustrated glossary. Most terms are illustrated with high quality photographs, and a full-page line drawing of leaf shapes is included as well. Acknowledgements, references, and an index wrap up the very end of the book. This content is encompassed in an easy-to-pack paperback book with all glossy paper.

*Common Mosses of Western Oregon and Washington* is a great starting point for botanists interested in expanding their knowledge to moss identification from northern California to British Columbia. I also recommend it for educators who incorporate moss identification into their teaching, as I know of no better beginner's reference. —*Jessica Allen, PhD, Assistant Professor, Eastern Washington University*

**Flora and Fauna of the Pacific Northwest Coast**
Colin Varner. 2018. University of Washington Press, Seattle, Washington. ISBN 978-0-295-74464-3 464 pp. 2000 color illus. 7.5 x 10 in. Paper. $34.95

Colin Varner started his career in 1977 in the botanical garden of the University of British Columbia, where he became the university's arborist/horticulturist and also teaches native plant studies. He spent 17 years collecting information and photos for this book. Most of the photos

are by the author and most are stunning. The layout is impressive as well. In the author's definition, the Pacific Northwest coast extends from Juneau, Alaska, to San Francisco, California. As if that weren't a big enough area, he extends his coverage inland about 60 miles, so that the species in this book are "the delights that the ambler encounters from the intertidal to the subalpine areas." If one skips over this introduction, it could be confusing to encounter high elevation species in a book about the coast.




As the title indicates, there are two main divisions in the book, flora and fauna. The flora section has eight chapters: Flowering Plants, Berries, Ferns, Shrubs and Bushes, Trees, Fungi and Allies, Invasive Plants, and Marine Plants. The fauna section has six chapters: Birds, Land Mammals, Amphibians, Reptiles, Insects and Associates, and Marine Life.

The Flowering Plants chapter includes mostly forbs with showy flowers, arranged alphabetically by family name, from Asteraceae through Violaceae. Curiously, here he includes three members of the family Lycopodiaceae, which produce spores, not flowers. Goatsbeard, *Aruncus dioicus*, appears twice, once in Flowering Plants and again in Shrubs (pages 87 and 139). The only error we found here was that the photo for *Carex nigricans* on page 43 is a *Juncus* species, possibly *J. mertensianus*. Photos of the other two sedges, *Carex macrocephala* and *C. obnupta*, show the characters beautifully, and the understatement that *Carex macrocephala* is not pleasant to step on with bare feet is a nice touch. This section completely avoids grass species, possibly because the author considers them to be "more obscure species" that are not "visible to the typical viewer," and we can't argue with this.

The Berries chapter is mostly edibles; it includes two blackberries that are on several invasive species lists (*Rubus armeniacus* and *Rubus laciniatus*). The Fern chapter describes ten common ferns. In the Shrubs and Bushes chapter, photos show fruits or flowers and leaves or growth habit. Trees are also organized alphabetically by family name, which serves, conveniently, to present the hardwoods first, followed by the conifers. Fungi and Allies starts with members of the sub-family of Ericaceae (Monotropoidae) and finishes with fungi ranging from *Amanita* to dog vomit slime mold. The problem with this is that whether one defines "allies" as related species or as species that help one another, the term does not fit here. Fungi are more closely related to a human baby than they are to plants (Dan Luoma, pers. comm.); the plants described in this chapter are now considered mycotrophytes.

The final chapter in the Flora section is a thorough and comprehensive collection of non-native plants. The author's coverage is impressive and underscores the prevalence of introduced species in mild coastal environments. We are curious only about why, in the alphabetical listing of families, he chose to include wild proso millet (in the family Poaceae) in between the families Chenopodiaceae and Convolvulaceae. Compared to European beachgrass and cordgrasses, this is a relatively innocuous weedy grass. The more aggressive and easily identified genera of *Ammophila* and *Spartina* are not mentioned.

In the Marine Plants Chapter, one would be able to identify *Nereocystis* from the photo alone, but not *Macrocystis*. The rockweeds and sargassum are adequately presented; algae covered are most of the larger kelps and commonest greens and reds. Let's say this chapter serves as an introduction to the uninitiated. The remaining chapters cover the fauna, but beyond admiring the photos, we won't detail that section for this plant society review.

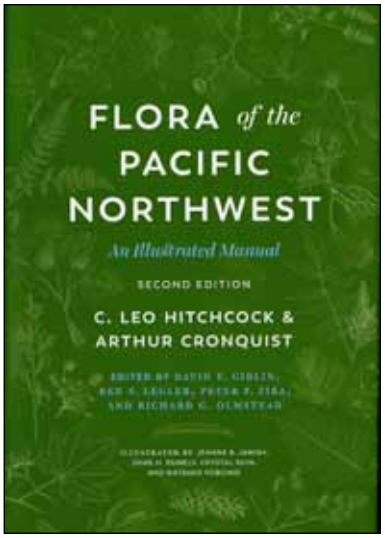
We don't recommend this book as a technical guide, but as the author indicated, he wrote it for casual observers not deeply familiar with the natural history west of the Coast Range. The book is a bit too large to easily carry as a field guide, but with its lovely photos, it's a book that visitors would be delighted to find in any vacation rental house along the coast. —*Kathleen Sayce, Filipendula Chapter*

**Flora of the Pacific Northwest, An Illustrated Manual, Second Edition**

C. Leo Hitchcock and Arthur Cronquist. Second edition edited by David E. Giblin, Ben S. Legler, Peter F. Zika, and Richard G. Olmstead. 2018. University of Washington Press, Seattle, WA. ISBN 978-0295742885. 936 pp. Hard cover $75.

The *Flora of the Pacific Northwest* is the long awaited, fully updated, second edition of Hitchcock and Cronquist's 1973 classic botanical text for our region. This masterpiece has been revised to include current research in vascular plant systematics, including reorganized family structure and up-to-date name changes. It also includes over 1,000 newly described or documented native and naturalized non-native species, and an additional 1,382 illustrations.

The need for an update is obvious when one considers that 40% of the taxa in the first edition have new names. The scope of this update is enormous. The editors are to be congratulated, along with the many others who helped both in time and money. However, the revisions are not just in names and taxa. The editors' experiences in field taxonomy shines throughout the volume. To my surprise, the keys and descriptions were improved in ways that would only be possible by expert botanists well versed in the original edition.




I have been using the *Flora of the Pacific Northwest* with students for more than 30 years. Steven Yeager, Heron Brae, and I teach a 300-hour class that focuses heavily on field taxonomy as a skill. We read the family descriptions and keys out loud and define every term. I have compared keying in both versions for all the plants we identify in class, plus many more, for a total of over 100. The results exceeded all my expectations in that almost every plant keyed as well as or better than in the first edition.

Many keys in new floras use computer-generated statistics to design couplets that separate out the highest number of taxa. Although this makes the key shorter, sometimes a distinctive, easy-to-see characteristic for a taxon is not mentioned until its description. Hitchcock and Cronquist realized that humans are good at seeing "which of these are not like the others," and often used couplets that easily separated distinctive species from the others, a process that works particularly well in condensed floras that do not include descriptions. The new version of their keys continues this approach. For example, on the first page of the family key, branch parasites and cacti are distinguished from other families by their unique characters, simplifying the rest of the key.

The new edition maintains the style of the original edition in which each couplet contains more than one characteristic and numbers are used instead of relative terms like large vs. small. The editors further improved the keys by selecting additional characters to couplets that were difficult in the first edition. For example, in the first lead, the new edition adds the character whether the keel is pubescent or glabrous, which quickly distinguishes *Collinsia sparsiflora* from other *Collinsia* species. This small addition makes a great difference in a couplet that was often difficult for me.

When we teach how to use the family key, after reading a family description, we teach supplemental information, such as particular terms and techniques for measuring floral parts specific to the family. The editors made our work easier by adding this information to the family descriptions (and other places, as needed). For example, the editors describe how to measure the corolla of a bilabiate tubular flower in the Lopseed Family (*Phrymaceae*).

We use the buttercup family to teach our students about flower morphology and how to recognize each of the four floral whorls. For example, students often mistake the showy sepals for petals. The revised key clarifies this common error, and shows a much-appreciated attention to detail.

Old version:

1a. Fl(lower) strongly bilaterally symmetrical, showy
1b. Fl(ower) nearly or quite reg(ular), often not showy

New version:

1a. Fl(ower)s strongly bilaterally symmetrical, sepals showy, > petals.
1b. Fl(ower)s radially symmetrical, sepals showy or not, petals various, occ(asionally) absent.

The authors also go to great trouble to help the reader understand technicalities not evident, or of concern, to non-professionals. For example, some new taxa are morphologically identical to, but differ genetically from, the original taxon. The authors describe the diploid variant of Youth on Age (*Tolmiea diplomenziesii*) and group it with the original taxon in the key. Also, the *Liliaceae* has been split to several new families, which is confusing at first. Along with keys for each of the new families, understanding that lilies in the traditional sense are easy to recognize as a group, the editors include a lily key that encompasses all the original taxa.

A current trend in contemporary keys is to use a simpler vocabulary, the "dumbing down" of botanical language. Academic botany is moving away from the traditional field approach; young botanists are immersed in genetics. Some newer keys are written primarily as checklists and descriptions of taxa, and the actual keys are of poor design. I have been told that within the next decade, keys will be obsolete. I guess we will have handheld iPhone-size "gene-machines" that identify the plants for us. Thus, I was concerned that the rich vocabulary of the original *Flora of the Pacific Northwest* would be lost, as well as the skill of field taxonomy, much like the art of celestial navigation, "hands-on" physical assessment by doctors, and the language and music of indigenous cultures. With this second edition, the editors have revitalized and preserved the tradition of field taxonomy for the enjoyment of future generations.

This book is the most up-to-date, comprehensive reference of vascular plants for the Pacific Northwest, except the southern part of Oregon where botanists will continue to use The Jepson Manual and the Intermountain Flora until the remaining volumes of the Flora of Oregon are published. Unlike field guides illustrated with color photos of flowers, this is a technical manual, replete with dichotomous keys, line drawings, and botanical terminology. The University of Washington Press website states it will be of interest to (and I would add "a must have" book for) "professional and amateur botanists, ecologists, rare plant biologists, plant taxonomy instructors, land managers, nursery professionals, and gardeners." —*Howie Brounstein, Columbines School of Botanical Studies, Emerald Chapter.*

**NOTICE TO CONTRIBUTORS**

Members of the Native Plant Society of Oregon and others are invited to submit articles, book reviews, artwork, and photographs for publication in *Kalmiopsis*. All materials submitted should pertain to Oregon's native vegetation and flora. Acceptance will be based on suitability (articles dealing with formal nomenclatural proposals or of a highly technical nature are not acceptable). *Kalmiopsis* publishes two series articles: *Plant of the Year*, and *Oregon Plants, Oregon Places*. We also publish articles about botanical history and features related to native plants or plant communities in Oregon.

Please consider that the readers of *Kalmiopsis* are people with varied educational backgrounds and all articles must be comprehensible to a broad, but relatively well educated, audience. The goals of *Kalmiopsis* are to disseminate correct information about and generate interest in native plants, thus each article is reviewed by the editorial board and selected technical reviewers before publication.

Contact the Publication Committee (publications@npsoregon.org) or the *Kalmiopsis* Editor (kalmiopsis@npsoregon.org) to request a copy of Instructions to Authors, or to inquire about the suitability of an idea for an article.

**CONTACT INFORMATION**

Kalmiopsis Editor: Cindy Roché, kalmiopsis@NPSOregon.org
Bulletin Editor: Lisa Schomaker, bulletin@NPSOregon.org
Membership Chair: Margaret Conover, membership@NPSOregon.org
Webmaster: Sunia Yang, webmaster@NPSOregon.org
Email Discussion List Login: See NPSO website, select subscribe to list under membership.
Website: http://www.NPSOregon.org
Facebook page: https://www.facebook.com/NPSOregon
Facebook Group: https://www.facebook.com/groups/6380707570/

**MEMBERSHIP**

Membership in the Native Plant Society of Oregon is open to all.
Membership applications, renewals, and changes of address (include old address and zip code) should be sent to the NPSO Membership Chair, P.O. Box 902, Eugene, OR 97440.
Student $12; Regular $25; Family $35; Sustaining $60; Patron $125; Life member $500

**ACKNOWLEDGEMENTS**

Kalmiopsis Logo: Linda Ann Vorobik (VorobikBotanicalArt.com)
Pagesetting: Cat Mead (leafandsteel.com)

Table of Contents



**~ Native Plant Society of Oregon ~**

*Dedicated to the enjoyment, conservation, and study of Oregon's native plants and habitats.*