

Douglasia

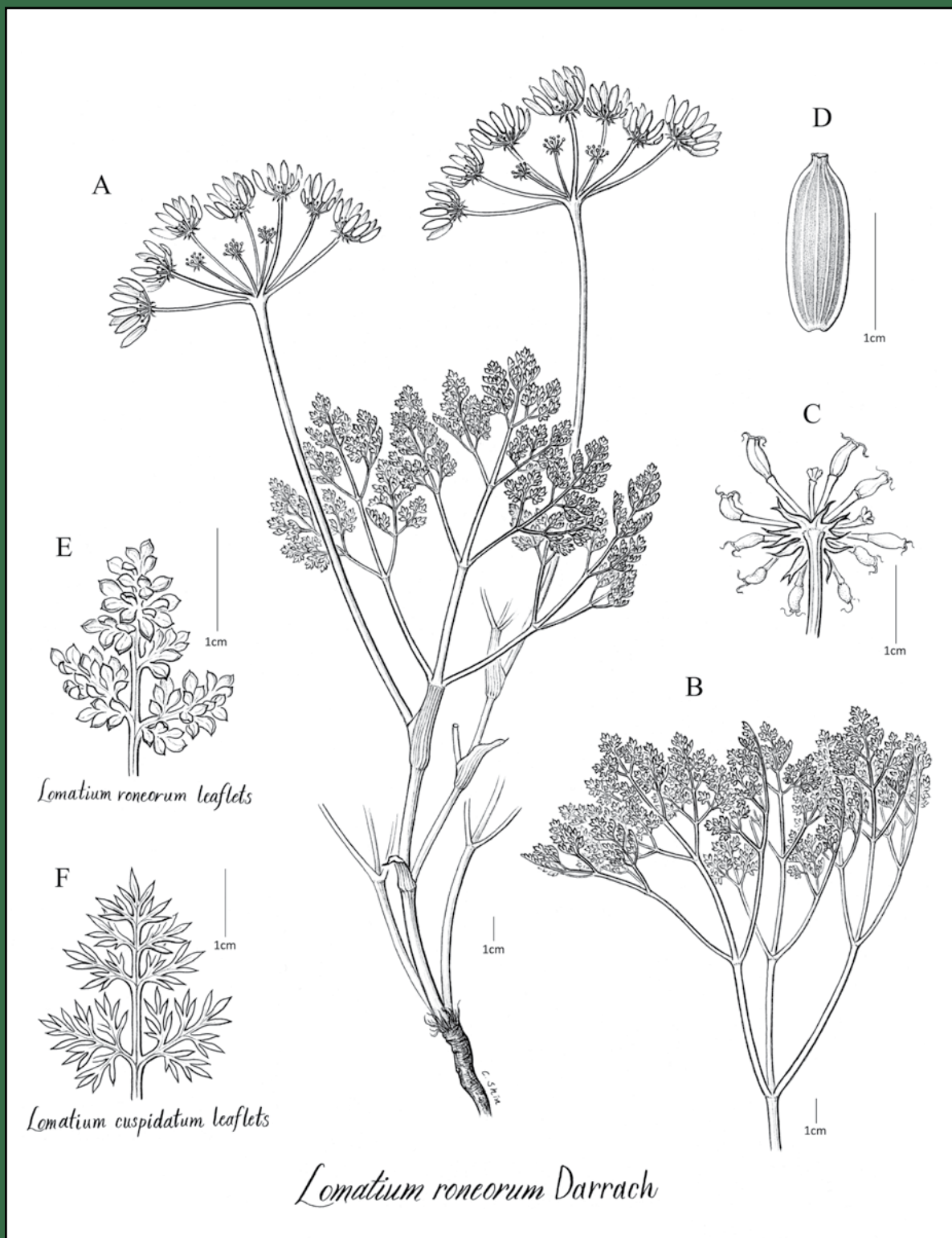
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Journal of the
WASHINGTON NATIVE PLANT SOCIETY

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



45TH
ANNIVERSARY
YEAR



About This Issue

by Alaina Kowitz

I've been soaking in the full fall season that we've been enjoying in eastern Washington, compared to last year when it snowed in late October(!). The winter season quickly approaches, however—I can feel a chilly hint of it on the breeze, and before we know it December will be upon us.

Some might wonder what plant-related activities one can enjoy during the winter months, when so many species lie dormant. Might I suggest some reading? Once you're done with this issue of *Douglasia*, perhaps an in-depth perusal of the new *Flora of Oregon* sounds intriguing, which Kathleen Sayce reviews in these pages. Or if something a bit less technical piques your interest, Ellen Kuhlmann gives her thoughts on *The Mother Tree* by Suzanne Simard, which explores tree-to-tree communication.

Our other articles are also worth a close read. Walter Fertig, esteemed *Douglasia* Editorial Chair, provides a potpourri of botanical news and happenings, as well as a fascinating look at mistletoes in Washington. We know you were on cactus spines and needles waiting for the second part of Ron Bockelman's *Pediocactus nigrispinus* report—well, it's here (the first part was published in the Spring 2021 issue of *Douglasia*)! David Giblin covers a hike near White River that he and his wife enjoyed recently, and also discusses a new species of rhododendron to be included in our state's flora. We have a great piece about the Mount Rainier National Park herbarium, written by the Park's former plant ecologist Arnie Peterson. And on the subject of important Washington mountains, Becky Chaney's Conservation Corner column covers a legal brief written by WNPS and other concerned parties opposing the development of a road across an important research area of the Mount St. Helens National Volcanic Monument. She also highlights three WNPS members who have been enormously instrumental in supporting the brief—do be sure to check it out.

Don Schaechtel, WNPS fundraising chair, wants to remind you that the estate gift is an excellent way to support WNPS—see page 27 for more information. And last but definitely not least, there's an absolutely lovely article by Katherine Darrow about Crystal Shin, who served as the lead illustrator for the *Flora of the Pacific Northwest*, 2nd Edition. Crystal's incredible work graces the cover of this issue, and we're indebted to her for her exquisite contributions to plant identification in our region. You'll be enraptured by her story.

I hope you have a gentle winter filled with warmth and peace, with the promise of spring plant excitement to look forward to. Thank you for supporting WNPS in whichever ways you do—we are very grateful for all of you.



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

** Deceased

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On the cover: Rone's or Leavenworth biscuitroot (*Lomatium roneorum*) is a recently described Washington endemic, named by Mark Darrach. It is restricted to outcrops of the Chumstick Formation in the mountains north of Leavenworth. Local botanical illustrator Crystal Shin, profiled in this issue, created the illustration. From: Darrach, M.E. 2018. *Lomatium roneorum* (Apiaceae), a new species from the east slopes of the Cascade mountains, Washington state. *Phytoneuron* 2018-78:1-12.

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President's Message: The View from Here

by Keyna Bugner

Dear WNPS Members,

As 2021 comes to a close, I want to reflect on my first year as WNPS President and highlight some of the great things that our organization has accomplished. Our big emphasis this year was implementing the three goals of the Strategic Plan.

Goal 1: Providing resources for everyone

The WNPS board members worked on a gap analysis to identify holes in our offerings so we can improve existing programs or develop new ones. One of the areas identified was to develop an introductory program template that could be adapted for use by all chapters. We also expanded our online resources, including a Just for Kids page on the WNPS website.

This was the first year of the Youth Ecology Education through Restoration (YEER) program. Our two coordinators, Janneke Peterson and Gretchen Garber, are busy working with middle school students at five schools throughout the state. We have learned a lot in this first year and have had to overcome several challenges, including adjusting presentations and field trips because of COVID restrictions. As we look back on this pilot year we will evaluate where we are and look forward to making improvements in the second year. We have had several new schools learn about the YEER program and want to bring it to their community. One of the busiest successes has been the relationships built with other conservation partners including



Grant County Conservation District, Jefferson Land Trust and the WNPS stewards.

Goal 2: Become a more inclusive organization

We established a Diversity, Equity, and Inclusion Committee. The committee is in the early stages of developing a committee charter and establishing leadership. Chapters continue to work with various partners to reach new audiences.

Goal 3: Build leaders

We have established committee and chapter councils to share program ideas, provide trainings, work together on common projects, and share challenges and lessons learned. These two councils will have met three times in 2021 and discussed topics such as how to recruit new members, how to develop leadership skills, and the role of volunteers at WNPS.

One of the outcomes of these councils was to help define staff needs to support our members. In July we welcomed Lorraine Sawicki as our new Volunteer Coordinator. This new position supports chapters on member recruitment and engagement, publicity, and social media support. We continue to explore other staff needs to support program development.

In September Elizabeth Gage, WNPS office coordinator, retired after five years with WNPS. Elizabeth interacted with every aspect of our organization as the main contact for WNPS. She will be greatly missed, but we wish her happiness in retirement. Karen Bosshart joined WNPS staff in October as the new office coordinator.

This is just a small sample of everything that WNPS has done this year. I look forward to what 2022 will bring. We are excited to bring back more in-person events including the Annual Meeting in March, Study Weekend in April, and Botany Washington in May.

Thanks everyone for all the work you do to support WNPS. Continue to send your feedback to me at wnpspresident@wnps.org.



Information for Contributors

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

Email submissions to Douglasia@wnps.org.

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Washington Botanica: Plant News and Notes from the Evergreen State

by Walter Fertig

Water Howellia Delisted

You will be forgiven if you have never seen water howellia (*Howellia aquatilis*) in the wild. First, you need to have a pair of chest waders and not be averse to wearing them in coffee-colored pond water lined with old logs, pokey sticks, and mysterious aquatic life forms. Second, you might need a pair of polarized eyeglasses and cloudy skies to catch a glimpse of the thread-like stems and slender grass-like leaves in the water or floating on the surface. Without flowers, howellia looks a lot like a floating grass, pondweed (*Potamogeton* or *Stuckenia* spp.) or water starwort (*Callitriche* spp.). Even in flower, the plant is hard to detect, as the blooms are quite small (less than 3 mm across) and borne in leaf axils, rather than a showy inflorescence. The bilaterally symmetric flowers have five lobes split into two lips, revealing its kinship with *Lobelia* and other members of the bellflower family (Campanulaceae). And third, you need to be visiting its kettle pond habitat during the brief flowering period from late April to late June. By mid-summer, these ephemeral ponds will be dry and the plants long gone, though their seeds will be buried in the exposed mud. Those seeds will germinate with the fall and winter rain as the ponds refill. Do not bother trying to find water howellia in permanent ponds, or in low spots that dry out too soon in the summer, as it will not be there.

Perhaps it is no wonder that water howellia is one of the rarer plant species in Washington. It is presently known from 74 ponds in the state, mostly in the vicinity of Spokane and on Joint Base Lewis McChord between Lacey and Tacoma. At least 12 of these populations have not been seen in over 30 years and may be extirpated. Individual populations contain 10 to 800 plants, though exact counts are difficult due to the challenges of finding plants and because plants can fragment at maturity and still produce fertile seed. Many populations are threatened by changes in hydrology from flooding or de-watering. Other pond sites are becoming increasingly dense with woody debris or invasive plant species, such as reed canary grass (*Phalaris arundinacea*). Long-term impacts from climate change may be significant, especially if its ephemeral pond habitats become too dry.

Water howellia was listed as Threatened under the US Endangered Species Act in 1994. At the time it was known from relatively few populations scattered across the Northwest from Washington to Montana and south to California and was thought to be highly threatened from habitat destruction. Since it was listed, the number of known populations has steadily increased and many occurrences are now afforded formal protection or are less threatened than originally suspected. The US Fish and Wildlife Service published a notice in the *Federal Register* in October 2019 recommending that water howellia be



Water howellia (*Howellia aquatilis*). PHOTO: WALTER FERTIG

removed from the Endangered Species List. This delisting became official on July 16, 2021. Water howellia joins Bradshaw's lomatium (*Lomatium bradshawii*) as the second plant species in Washington to be removed from federal ESA protection in 2021, leaving the state with 10 federally-listed plants.

Monitoring of water howellia populations will continue over the next 15 years to assess population trends at 30 sites in Washington. Should new threats emerge or numbers decline sharply, the species could be added back to the federal Endangered Species list. It will remain on the Washington Natural Heritage Program's (WNHP) list of plant species of conservation concern as state Threatened, but does not receive formal protection under state law.

New and Improved Online Washington Rare Plant Field Guide

Henry David Thoreau once said "books are the carriers of civilization." While this remains true, even Thoreau would recognize the value of digital books that can be readily updated to keep their content fresh.

In 2011, WNHP published the *Field Guide to the Rare Plants of Washington* in collaboration with the Washington Native Plant Society, the Bureau of Land Management, and University of Washington Herbarium at the Burke Museum. The *Field Guide*, edited by Pam Camp and John Gamon, included descriptions, range maps, and 1-3 line drawings and color photographs for 324 state-listed vascular plants, bryophytes, and lichens. Unfortunately, the 2011 guide has become outdated, as new information has accumulated on the status and distribution of these species and at least 70 additional taxa have been added to the list of state Endangered, Threatened, and Sensitive plants.

In September, WNHP released a new on-line version of the *Field Guide* on its website (<https://www.dnr.wa.gov/NHPfieldguide>). The new guide is built on a template designed by the Montana Natural Heritage Program and is used by other state heritage programs in the west. Text from the 2011 guide has been transferred to the new format, along with descriptions for new species (371 taxa are included in all). Content is no longer constrained by what will fit on a single printed page, so the online guide includes new images (which can also be magnified to show more details) and more features, such as updated range maps, information on abundance, trends, similar species, and more references. The guide also has external links for related content from NatureServe or Google. The online guide is more portable than the hard copy book (it can be accessed via the internet on a smartphone). Best of all, the revised guide can be kept constantly updated with revised information, additional photos, and new species. Sounds very civilized!



Wormskjold's northern wormwood - *Artemisia campestris* var. *wormskjoldii*

Full Botanical Name: *Artemisia campestris* L. var. *wormskjoldii* (Besser ex Hook.) Cronq.

Other scientific names: *Artemisia campestris* ssp. *borealis* var. *wormskjoldii*, *Artemisia borealis* var. *wormskjoldii*



Artemisia campestris var. *wormskjoldii*

Click an image to expand it to full-size.

Conservation Rank: [info](#)

Global: **G5T1**

State: **S1**

Agency Status: [info](#)

WA State Status: **ENDANGERED**

USFS: **SENSITIVE**

BLM: **SENSITIVE**

External Links



General Description

Wormskjold's northern wormwood is a low, taprooted biennial or perennial herb, generally 15-30 cm tall, with herbage, especially the leaves, conspicuously covered with silky hairs. Basal leaves in crowded rosettes, mostly 2-10 x 0.7-4 cm, and 2-3 times pinnatifid or ternately divided into mostly linear lobes. Stem leaves similar but smaller and less divided, the upper often ternate to simple. Inflorescence narrow, spikelike, with small disciform heads; involucre 3-4 mm high. Outer flowers female and fertile; disk flowers sterile with abortive ovaries. Flowers early to mid-April, with occasional individuals flowering throughout the season. Hairless achenes. Distinguished by a combination of short habit (typically 1-2(4) dm.), sericeous leaves, and relatively large involucre (3-4 mm.). Begins flowering in April, whereas other members of the genus present within its range typically do not flower until much later in the year (Camp and Gamon 2011).

Washington Natural Heritage Program. 2021. *Artemisia campestris* var. *wormskjoldii*.

In: Online Field Guide to the Rare Plants of Washington, <https://fieldguide.mt.gov/wa/?species=artemisia%20campestris%20var.%20wormskjoldii>.

New WNPS Office Coordinator

by Denise Mahnke

WNPS has replaced Office Coordinator Elizabeth Gage, who retired earlier this year, welcoming Karen Bosshart. The staff is now back to operational in the office. Please contact



Karen during office hours on Tuesday, Wednesday, Thursday and Friday. Karen is working in the Magnuson Park office, where the phone once again has live customer service support. NOTE: Wednesday hours are 9 am-1 pm. Tuesday, Thursday, and Friday hours are 8:30am-5:30pm. WNPS has hopes of the office building reopening to the public in early 2022. Reach Karen at 206-527-3210 or info@wnps.org.

Karen is a Washington native, growing up in Maple Valley, where she first learned the native flora of Washington through outdoor adventures with her family. She holds a degree in Environmental Studies from the University of Washington. She has an active history of program coordinator support roles as well as customer service at the front desk. Karen was involved in coordination of the Language Exchange program for the University of Washington, matching ELL students with English-speaking UW community volunteers. Karen also served as a Communications Intern at the City of Seattle, Office of Sustainability & Environment, and as a Park Ranger with the City of Bellevue Parks and Community Services. She comes highly recommended as a remarkable woman who provides quality support to the community and is eager to provide resources to customers. It is our pleasure to have her on staff serving the membership of WNPS and providing public customer service.



White River Trail: Old Trees for a Hot Day (or Any Day)

by David Giblin, Ph.D.

University of Washington Herbarium, Burke Museum

A few years ago I attempted to hike my namesake mountain in Chelan County – Mount David. I left the trailhead in clouds confident that I could beat the rain to the summit that was about 5,400 feet above me. I was wrong and had to turn around about 200 feet below the top. I felt like the 14-mile round-trip was largely in vain (I had zero views due to cloud cover). Returning to the parking area, I noticed that there was a trail leading up the north side of the White River. I thought it would be nice to check it out some day, but also realized that it was somewhat unlikely given how seldom I get to this part of the Cascades.



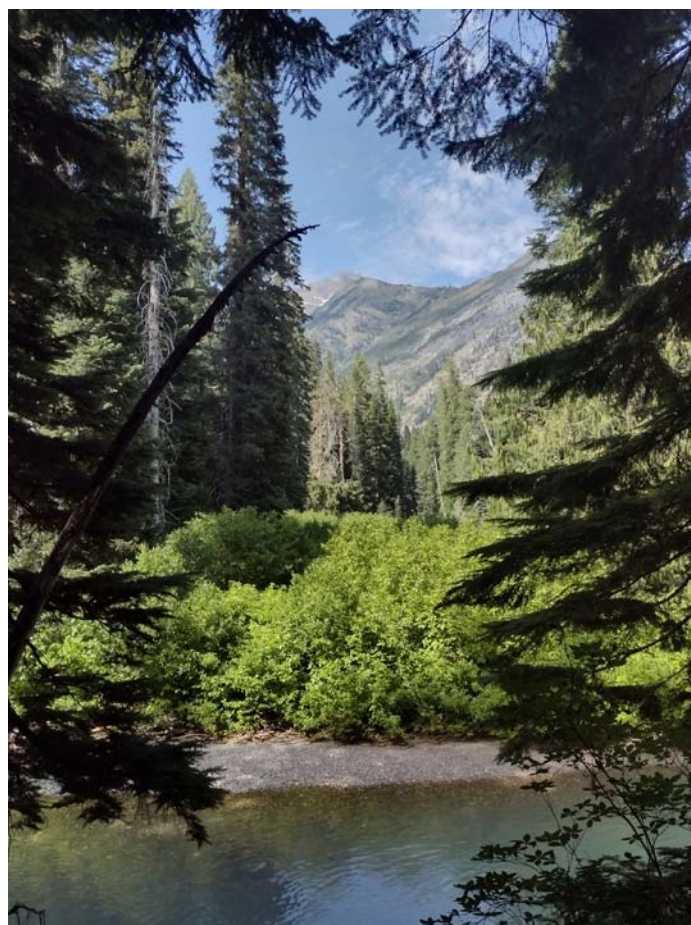
White River and surrounding old-growth forest from bridge at White River Trail parking area. PHOTO: DAVID GIBLIN

This past summer my wife Julie and I were camping along Icicle Creek outside of Leavenworth and in need of a hike that could be both long and relatively cool (our dog is black and heats up quickly in the summer sun). I suggested the trail along the White River that I had seen, so we made our way there as a day trip (not possible from our home in Seattle). It was probably in the low 90s as we passed through Leavenworth that day, but somewhere in the low 80s by the time we got to the trailhead (about 2,300 feet). It never got hotter than that along

the trail because the White River is a free-flowing, glacial melt river, nearly turquoise in color, that keeps the area cool. Plus, there was plenty of shade. Looking upstream from the bridge at the trailhead is like gazing into the forest primeval – lush, green, tall, and dark.

Shortly after starting the trail you enter the Glacier Peak Wilderness and you never leave it. You are heading west towards the Dokabed Range, which includes Glacier Peak and Clark Mountain. At this point you are just a few air miles east of the Cascades Range crest, which explains why you see so much old-growth red-cedar (*Thuja plicata*) and other more typical “west-side” tree species along the trail, including massive western hemlocks (*Tsuga heterophylla*) and cascara (*Frangula purshiana*). But you are nevertheless east of the crest, so gigantic ponderosa pine (*Pinus ponderosa*) and Douglas-fir (*Pseudotsuga menziesii*) are plentiful as well.

When the trail isn’t coursing beneath the towering overstory it traverses across broad avalanche chutes with overhead stands of mountain alder (*Alnus viridis*), thimbleberry (*Rubus parviflorus*), and fireweed (*Chamaenerion angustifolium*). If you go late in the season when berries are plentiful you may want to make some extra noise crossing the chutes in the event that there are bears enjoying the fruits of the season (in some places you can only see a few feet ahead of you, though the trail underneath is well-worn).



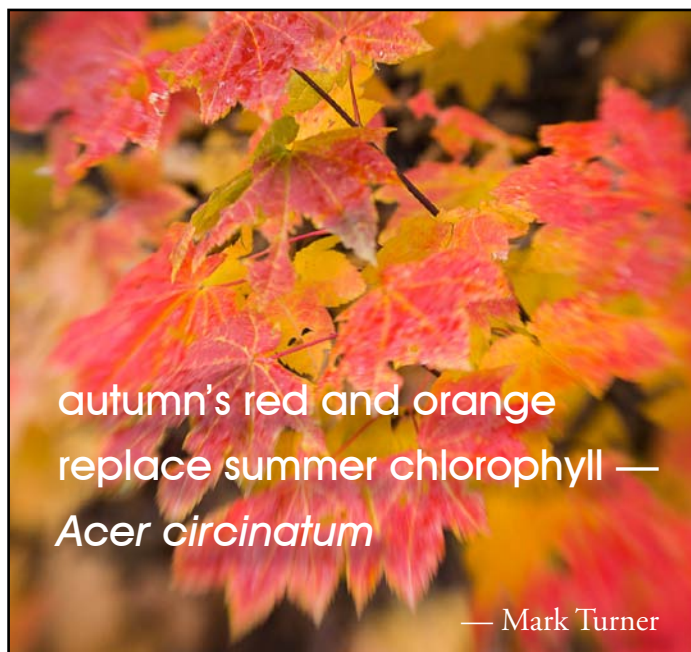
View from White River Trail with White River in the foreground and Dokabed Range ridgeline in the distance. PHOTO: DAVID GIBLIN

The understory vegetation varies in density, with some rather extensive areas devoid of an herbaceous layer altogether. These tend to be in places of large, well-spaced old-growth trees. The duff layer of needles is quite impressive, and their abundance and acidic nature may serve to exclude other species. Among the more interesting things that we encountered were the white-fruited form of baneberry (*Actaea rubra*), spotted coralroot (*Corallorhiza maculata*), and leathery grapefern (*Sceptridium multifidum*). There are lots of other things to see, but these are what stood out to me. If you go you should make a plant list because one currently doesn't exist for this trail.

We followed the trail for about four miles where it intersects with the Boulder Creek trail – the total elevation gain couldn't have been more than about 300 feet. We passed only two other people the whole day. In places the trail runs close enough to the White River that you can get down to the water to dip your toes or dunk your head, but be warned – that water was in the form of ice not too long ago, so it is cold.

Because of the trail's relatively low elevation, I imagine that this trail could be done in early spring as well as late into fall. This is an extraordinary place to visit in part because the ease of the hike allows you to simply appreciate the beauty of this untouched forest and wild river that flows through it. You need a Northwest Forest Pass or federal lands pass to park at the trailhead. The last 4-5 miles of the road to the trailhead is bumpy and rocky in places, but we made it without any problem in a sedan with pretty low clearance (we had to go slow in places). You can get all of the driving and trail directions at the Washington Trails Association website (<https://www.wta.org/go-hiking/hikes/white-river>).

Definitely put this trail on your list of places to visit in the central Cascades. Like us, you're likely to have the place to yourself and you'll be glad that you went.



Early Life History of *Pediocactus nigrispinus* from the Shrub-Steppe of Central Washington

by Ron Bockelman

As summarized in Part 1 of this grant completion report (Bockelman 2021), I began studying hedgehog cactus (*Pediocactus nigrispinus*) as a retirement project in 2018 at Wild Horse Wind Farm east of Ellensburg in Kittitas County. Wild Horse Wind Farm, referred to hereafter as Wild Horse, is owned and operated by Puget Sound Energy (PSE). In March of 2019 the Washington Native Plant Society (WNPS) Research and Inventory Committee awarded me a grant partially funding my preliminary research on phenology and early life history of this regionally endemic cactus.

The study site, phenology study methods, and preliminary phenology results are described in Part 1, which was published in the Spring 2021 issue of *Douglasia*. This article summarizes the *ex situ* seed germination and seedling development studies completed for the early life history component of the WNPS grant.

One of my study objectives is to see if sowing cactus seeds and/or planting seedlings are viable options for conserving and restoring this Species of Concern tracked by the Washington Natural Heritage Program (WNHP 2019). Either approach could be easier than replanting and caring for rescued mature cacti, as was done in conjunction with Wild Horse construction in 2006 and 2009 (Bockelman 2019).

Seed Germination

Studies of cactus germination and seedling establishment are important for understanding reproductive strategies, for perfecting propagation techniques, and for evaluating the conservation potential of seeds and early life stages (Rojas-Arechiga and Vazquez-Yanes 2000). Transplanting adult plants often is not an effective conservation strategy because it is usually very labor intensive and mortality rates of transplanted adult cacti can be high. Planting seeds or transplanting juveniles propagated from seeds may prove to be better approaches for cactus conservation and restoration.

Although *Pediocactus* seeds have a reputation for being hard to germinate, members of our informal Wild Horse Wind Cactus Team (Team) had success with seeds from the wind farm. The excellent five-part series of *Douglasia* articles, concluded in Summer 2019, by Bridget McNassar on propagating native plant seeds described factors to consider and techniques for me to try (McNassar 2019).



Figure 1. With practice, ripe cactus fruits can be collected without injuring the plant or the collector. PHOTO: RICK MATTSON

Ripe fruits were collected during June 17-19, 2019, from 11 cactus patches distributed throughout Wild Horse, most of which were also used for the phenology study. Ten fruits were sampled in each patch, one fruit each from a variety of solitary plants and multi-stemmed clumps (Figure 1), except at a couple patches where cacti were not very abundant. Each donor plant was photographed with a 0.25-m x 0.25-m marked PVC frame around it to document its size and condition (Figure 2). Geocoordinates for the donor plant were determined by synchronizing photo datetime with that of my GPS track log.



Figure 2. Donor plant diameter and fruit production were determined from a photo of the cactus surrounded by a marked PVC mini-frame. This 11.5 cm diameter donor produced 10 fruits. PHOTO: RON BOCKELMAN

Additional fruits were collected from four cacti planted in a display garden at Wild Horse, where it appeared likely that rodents would consume any seeds released (Figure 3). Because these plants were growing in the same environmental condi-



Figure 3. Widespread evidence of rodent predation at a display garden indicated seed germination and seedling survival was highly unlikely for the few remaining cacti. PHOTO: RON BOCKELMAN

tions, their seeds were ideal for preliminary testing of germination study procedures and treatments.

Back at home, mature (black) seeds were removed from each fruit and placed in seed envelopes (Figure 4). Batches of seeds were sown in starting trays with 20-cell units containing seed starting mix (Figure 5). Trays were bottom watered to saturate the mix, covered with clear plastic domes to maintain high humidity, and placed under 45-watt LED grow-lights set on a 16-hour light:8-hour dark cycle. Trays were examined daily, and for each seed the date was recorded when a projected

Mature Seeds (black)



Figure 4. Cactus fruits were dissected to remove the seeds for studying germination and seedling development. PHOTOS: RON BOCKELMAN

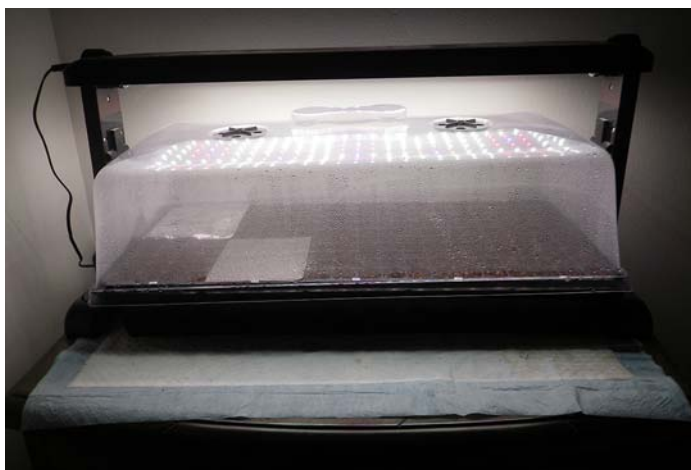


Figure 5. Germination and growth studies were performed with the same equipment as that used at home to start garden plants from seed. PHOTO: RON BOCKELMAN

radicle was first observed (Figure 6). Germination percentage and time were calculated using Ranal et al. (2009).

The first batch used sets of 20 seeds (five each from individual display garden fruits) to evaluate ten factors that might affect germination or be required to break dormancy (Table 1). Almost none of the seeds from one plant germinated under any condition, so subsequent calculations were based on the other 15 seeds for each treatment. Highlights of this preliminary study include:

- Light is required for germination (i.e., *P. nigrispinus* seeds are photoblastic).
- Germination was so high (93%) in the control set that further study of pretreatments is not needed if the primary objective is to propagate juveniles for restoration studies.
- The seed coat (testa) is too fragile for scarification with sandpaper.
- Seeds float in water for eight to 24 hours even with periodic shaking.

Two other trials also used sets of 20 seeds in groups of five, this time from fruits collected in the 11 wild cactus patches. Highlights of the results presented in Table 2 include:

- Germination was greater than 60% in all but one patch, and 80% or greater in five patches.

- None of the seeds from the highest elevation patch (near the top of Whiskey Dick Mountain) germinated.
- Otherwise, neither elevation nor aspect of the patches had a consistent effect on germination percentage, suggesting microhabitat may be more important.

Treatment	Description	n	G	MT
Control	No treatment or pre-treatment	15	93	8.1
Dark	Foil covered for 21 days, then examined uncovered	15	0	-
Screen	Light filtered through fine mesh (1-mm openings)	15	73	8.6
Scarify	Shake vigorously in coarse sand for 30 seconds	15	93	7.4
Cool 1wk	Pretreat on damp paper in refrigerator for 1 week	15	100	7.6
Cool 4wk	Pretreat on damp paper in refrigerator for 4 weeks	15	87	8.2
Cold 1wk	Pretreat dry in freezer for 1 week	15	93	8.6
Cold 4wk	Pretreat dry in freezer for 4 weeks	15	100	8.5
Soak 12hr	Pretreat in water for 12 hours, shaking occasionally	15	73	9.9
Soak 24hr	Pretreat in water for 24 hours, shaking occasionally	15	87	10.3
Sub with Dark	Excludes the bad plant	150	80	8.5
Sub w/o Dark	Excludes bad plant and Dark treatment results	135	89	8.5

Table 1. Germination results for pretreatments using seeds collected in 2019 from a display garden at Wild Horse Wind Farm. n=number of seeds, G=Germinability (%), MT=Rate (average days to germination). Data are excluded for one plant whose seeds did not germinate under any treatment.

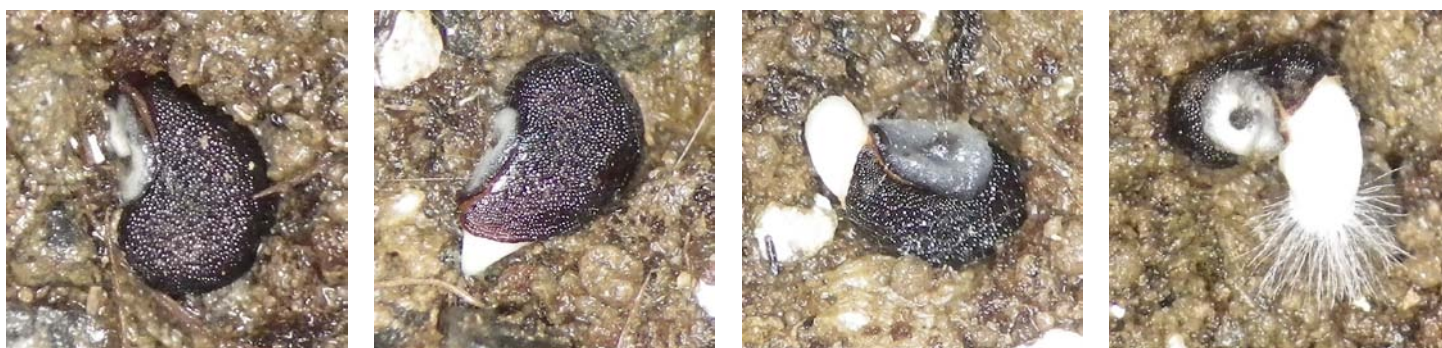


Figure 6. Photos taken through a stereomicroscope showing the transition from seed germination to seedling development. a) testa split=TS, b) & c) radicle projected=RP, d) collette hairs=CH. PHOTOS: RON BOCKELMAN

- Mean germination time ranged from 7.6 to 12.1 days.

Ongoing germination studies with seeds collected in 2020 are addressing:

- Effects of the mild winter in 2019-2020 on germination percentages and rates.
- Whether or not the germination problem persists on Whiskey Dick Mountain.
- Viability and dormancy of seeds that do not germinate.
- Thermal threshold for germination.
- Germination of mature seeds collected after seed release (versus those from fruits).
- Additional cactus patches found at Wild Horse.

Seedling Development

Hochstätter (2007) provides sketches of *P. nigrispinus* seedlings at one day, one month, and one year after germination, based on plants propagated *ex situ* from seeds he collected, some from Kittitas and Grant counties. The WNPS grant proposal included illustrations by a botanical artist of these and other intermediate stages during the first year of growth.

Patch ID	Patch Name	n	G	MT	Elevation (ft)	Aspect (O)
0801	North	40	87.5	9.8	3620	205
0902	Entrance	40	87.5	10.9	2670	195
2202	D4	40	85.0	7.6	3380	230
3301	REC	40	85.0	11.2	3540	135
2101	E7-Govt Spring	35	80.0	9.8	3480	225
2701	CWU	45	80.0	10.3	3230	165
0402	Midway	40	75.0	11.4	2980	145
2902	Solar	15	73.3	12.1	3830	160
3302	Q2	40	67.5	9.4	3250	230
3201	West	30	63.3	11.5	3530	235
2903	Whiskey Dick Mtn	35	0.0	-	3880	220

Table 2. Germination results for seeds collected in 2019 from cactus patches at Wild Horse Wind Farm. n=number of seeds, G=Germinability (%), MT=Rate (average days to germination).

Seedling development was studied using seeds collected in 2018 as well as those from 2019 described above for the germination studies. Dates on which various developmental stages were first observed were recorded daily for the first four weeks after the germination study began, and then weekly for another four weeks. Thereafter, seedling appearance was noted, usually with photos, on a quarterly basis until they were one year old.

Some seedlings for the biological illustrations were started using 2018 seeds so that seedlings of various ages would

Age After Germination	Stage Code	Description (above ground)
-1 day	TS	Testa (seed coat) split
0	RP	Radicle (root precursor) projected beyond split testa
1 day	CH	Collette (root-like) hairs near top of elongating radicle
2-4 days	HE	Hypocotyl elongated below the retained testa
3-9 days	CE	Cotyledons exposed after the testa falls off
4-6 weeks	AS	Apical spines (two distinct sets) evident between and twice as long as the cotyledons
6 months	-	Epicotyl is evident, its diameter > than hypocotyl diameter
1 year	-	Epicotyl becoming globose with areoles increasing in number and tubercles more pronounced

Table 3. Seedling developmental stages that were illustrated.

be available in the same time frame for the artist. Fragile roots of the earliest stages were drawn from seedlings grown on damp paper with black fabric under it. For older stages, seedlings were removed from the growth media and rinsed in water to expose the root structure. Both live seedlings and photos were used for the illustrations, all of which were drawn by Crystal (Soojeong) Shin, the botanical artist who completed nearly 900 of the new illustrations in *Flora of the Pacific Northwest, 2nd Edition*.

Table 3 provides the timing and description of the seedling development stages illustrated for this project. Figure

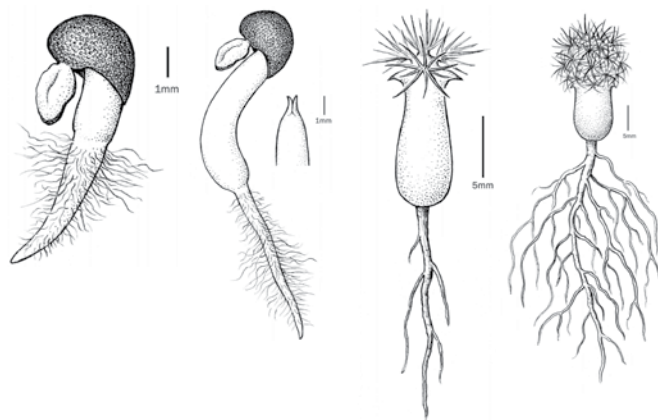


Figure 7. Illustrations of *Pediocactus nigrispinus* seedlings during the first year (*ex situ*). a) 1-day old showing collette hairs; b) 1-week old showing elongated hypocotyl with and without the testa covering the cotyledons; c) 1-month old showing apical spines and root development; d) 1-year old with epicotyl evident, root system much expanded, and cotyledons barely visible. DRAWINGS: CRYSTAL (SOOJEONG) SHIN

7 presents drawings for the ages illustrated by Hochstätter (2007), as well as one at one week for the transition from hypocotyl elongation to cotyledon exposure.

It is important to remember that these are *ex situ* results, and that development of the early stages is expected to take longer in natural habitat. These studies were conducted at room temperature, which is much warmer than ambient and soil temperatures at Wild Horse in spring when hedgehog cactus seeds probably germinate and begin seedling growth.

Moving forward, this study will focus on optimizing *ex situ* conditions to produce sufficient one-year-old seedlings for out-planting studies at Wild Horse. While seed germination rates are high, seedling survival needs to improve to reach this goal. Various grow mix formulas and watering regimes will be tested, as well as lighting conditions.

Soil Moisture and Temperature

Although measuring soil conditions was not included in my proposal, the WNPS grant indirectly resulted in continuous monitoring of soil moisture and temperature in a cactus patch at Wild Horse. When my grant award was announced, PSE inquired about the possibility of a partial match. I suggested—and PSE subsequently purchased—a datalogger, one soil moisture probe, and one temperature probe.

Upon discovering that the datalogger had unused ports for three more sensors, I began to pursue funds for addi-

tional probes to measure soil moisture and temperature just below the ground surface, where cactus seedlings need to survive and grow. Another probe to measure air temperature would provide a way to relate our results to climatic data from weather stations. Fortunately, the Wenatchee Valley and South Sound chapters of WNPS collectively funded the purchase of all three extra probes.



Figure 8. Team members installed soil moisture and temperature sensors below the ground surface, after first running the cables through a PVC pipe to prevent rodents from chewing them. PHOTO: RON BOCKELMAN

Table 4 describes the equipment that was installed on May 31, 2019 (Figure 8), in the patch where biology students from Central Washington University, with direction from Team member Dr. Eric Graham, have been measuring cacti since June 2016. Eric is very experienced with remote data collection and he volunteered to set things up (Figure 9), get the system running, and download data twice per year.

Detailed results are beyond the scope of this article, but the data to date demonstrate seasonal soil moisture nicely and also changes caused by rainstorms. With temperature probes at two depths, we have data to estimate temperature



Figure 9. Dr. Eric Graham of CWU sets up the datalogger (foreground) to continuously record temperature and soil moisture. PHOTO: RON BOCKELMAN

Type	Depth (cm)	Purpose
Temperature	20	Measure soil conditions in root zone of mature cacti and provide a deep soil basis for calculating temperatures throughout the soil profile.
Temperature	5	Measure soil conditions near the ground surface and provide a shallow soil basis for calculating temperatures throughout the soil profile.
Temperature	-	Measure air temperature in shaded conditions. Installed 30 cm above ground on a stiff sagebrush stem.
Soil Moisture	15	Measure volumetric water content in 1 liter of soil (10HS sensor) in the root zone of mature cactus and other shrubs.
Soil Moisture	5	Measure volumetric water content in 0.3 liter of soil (EC5 sensor) in the near surface root zone of cactus seedlings.

Table 4. Temperature and soil moisture sensors installed at Wild Horse Wind Farm on May 31, 2019.

at any soil depth. However, more data will be needed to understand winter and early spring conditions because our first winter in 2019-2020 was warmer and drier than normal, based on data from AgWeatherNet stations in Ellensburg and near the Gorge Amphitheater in Grant County.

Concluding Remarks

The studies that the WNPS grant helped to initiate are continuing. It should be noted that they are intended to provide preliminary results to begin filling the many data gaps in the natural history of *P. nigrispinus*. My goal is to learn something about many wide-ranging topics, rather than engaging in narrowly focused long-term studies. However, my hope is that these preliminary results will elucidate worthwhile hypotheses for rigorous scientific study by others.

Voluntary support by Team members was critical to the completion of this grant. Some I have known for nearly 15 years, others for only a couple. The Team includes Jennifer (Diaz) Galbraith, Andrea Crawford, Kristin Ashley, Eric Graham, Brian Coonrod, and Denise Horton. I also want to acknowledge the encouragement by and patience of my wife, Sue.

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Ron Bockelman is a member of the Central Puget Sound chapter, and he volunteers as plant lists database manager for WNPS. He can be contacted at ron.bockelman@hotmail.com if you would like to be copied on occasional Team emails about his hedgehog cactus observations and musings.



Drawing the Universe: Botanical Illustrator Crystal (Soojeong) Shin

by Katherine Darrow

When Crystal Shin first came to Seattle in June 2009 for a ten-month English as a Second Language (ESL) program, she had a little spare time in her schedule, and so she enrolled in a botanical watercolor class at Gage Academy of Art. Thus began her journey from working as a human resources specialist for a Korean-based tech company to becoming lead illustrator for the *Flora of the Pacific Northwest*, 2nd edition (*Flora*) and an assistant at the University of Washington Herbarium of the Burke Museum.

"Growing up in Korea, my interest in art wasn't encouraged because my family did not believe that making art was a way to make a living," says Crystal (*Soojeong* means Crystal in Korean). "But I always had a hidden desire inside me to make art."

The class at Gage Academy was her first formal art training. Her mentor there, botanical illustrator Kathleen McKeehen, recognized Crystal's extraordinary talent and recommended that she apply to earn the University of Washington's (UW) Certificate in Natural Science Illustration (NSI). Crystal



Crystal at work on a drawing of honey locust (*Gleditsia triacanthos*).

PHOTO: KATHERINE DARROW

held onto that dream after completing the ESL program, and returned to Seattle three years later to enroll at UW, having saved enough in her human resources job to support herself in Seattle.

One of the projects assigned for the NSI program was to do a pen and ink botanical illustration. A tour of the herbarium with collections manager David Giblin was part of the lesson, and became Crystal's introduction to the world of botanical research. After the tour, she asked if she could volunteer there and began helping out with mounting plant specimens.

"My drawing for that assignment was a common dandelion," says Crystal. "I was grateful for David's help while making the illustration, so I brought the finished drawing to show him. That is when he asked me if I would be interested in working on the *Flora* project."

"When she showed the drawing to me, the quality of her work felt like it leapt off the paper," remembers David, who continues to serve as project director, lead editor and co-author of the *Flora*, 2nd edition. "The sharpness and clarity of the lines were just remarkable. I took the drawing over to Ben Legler (co-editor of the *Flora*) so that he could see her work. I explained that while Crystal was not a botanist, I thought that her skills were so strong that we should have her do several illustrations to see if it would work."

As David put it in the final publication, "The *Flora* project began without a primary illustrator, but fortune shone upon us when our paths crossed with Crystal (Soojeong) Shin..."

Undaunted, Crystal accepted the opportunity to work as part of the team, and devoted much of the next four years to creating 882 of the 1,382 new illustrations for the project.

Working closely with botanists at the herbarium, voucher specimens were selected that would be most useful for

drawing representations of each species and diagnostic feature being added to the *Flora*. Any voucher that was used as a guide for illustrations is labeled for future reference: "Specimen used for illustration of *Flora of the Pacific Northwest*, Second Edition." (Photos were used as reference material as well, but very few fresh specimens were available, and no field sketches were made.)

One of Crystal's biggest challenges was figuring out what size to make the drawings, since they would have to be reduced for final publication. Large plants had to be drawn smaller; small plants and features needed to be enlarged. "At first I wanted to make drawings the actual size of the plant, but quickly learned that would not work for this project," says Crystal, remembering the early days of adapting her skills to the book design.



Crystal's illustration of a common dandelion (*Taraxacum officinale*) was her introduction to the universe of botanical illustration.

Using her super-powers of patience, acute observation skills, flexibility, and ability to focus for hours at a time, drawings began flowing from Crystal's drafting table. Stacks of notebooks in her desk drawers are filled with sketches, the beginnings of each drawing, which often required peering through a 10x dissecting scope to discern patterns and textures unique to a seed or a leaf or arrangement of stamens. She carefully made her final drawings on high quality paper and covered them with a protective layer of parchment. Each illustration took her between three to ten hours to complete, including consulting with researchers, sketching, tracing, and carefully inking the final drawing with fine-tipped pens.

The new drawings span the entire spectrum of plant families in the *Flora*, although a majority of the added taxa are not native to the

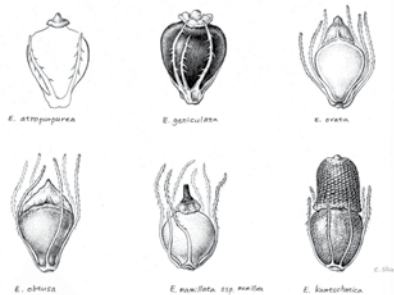
region. (Introduced species comprise nearly 70% of the 1,054 taxa added to the second edition.)

Through this process, she also became fluent in "Botanese," the language of botany. "One of my favorite genera are the spike rushes, *Eleocharis*," says Crystal. "These grass-like plants are not showy in real life, so their beauty is often not appreciated or are just unseen. But if you take time to look at them, especially under a microscope, you will find them very pretty. The shapes are fascinating. You will see a universe in a tiny achene!"

"...fortune shone upon us when our paths crossed with Crystal (Soojeong) Shin..."

—Dr. David Giblin, p. xvi in *Pacific Northwest Flora*, 2nd Edition

Although the *Flora* was published in late 2018, Crystal continues to spend many of her days working in the Herbarium, where she continues doing illustrations for updated treatments and new species descriptions. Like Jeanne Janish (1902-1998), the primary illustrator for both editions of PNW *Flora*, Crystal also works with paleontologists drawing fossils and bones.



A series of *Eleocharis* achenes is one of Crystal's favorite subjects.

On the side, she offers classes in her favorite drawing medium, colored pencil. Her first workshop for WNPS was at the 2019 Botany Washington weekend in Yakima County. Since then, she has taught dozens of workshops for numerous organizations,

including Gage Academy of Art where she first began her career as an artist. In 2020 and 2021, more than 100 students took drawing classes offered through WNPS with Crystal via Zoom. On-line classes have turned out to be an excellent platform for teaching botanical drawing, offering greater accessibility compared to traditional classroom courses.

"Zoom has expanded our audience dramatically," says Denise Mahnke, Business Manager at WNPS, who coordinates online classes and presentations. "Drawing classes are very interactive and allow for students to share their work and get valuable critiques. Many people sign up for multiple workshops with Crystal and we're getting students from all over the country." (You don't have to be a WNPS member to sign up for a workshop.)

Watching Crystal draw is worth the price of admission, as she calmly and confidently transforms a blank sheet of paper into a vibrant work of art, whether it features a single tomato, a single leaf, or a butterfly. I like to say she is the Bob Ross of colored pencil botanical art.

"Art is an excellent outlet to let our creativity out and enrich our lives," says Crystal. "Especially botanical art brings us special values. It balances out our fast-paced modern lifestyle by bringing calmness and patience while practicing this observant and slow form of art. It can be a way of meditating, calming inner/outer struggles that we all experience, and helps us find our inner peace to juggle with those challenges."

Stay tuned for more drawing courses offered through WNPS on the Events page at <https://www.wnps.org/events>.

You can see more of Crystal's artwork and follow her on Instagram at www.instagram.com/crystalflorafossil.



Original drawing and reference specimen of Balkan clary sage (*Salvia nemorosa*).

Resources

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Colored pencil drawing is Crystal's favorite medium.

A Brief History of Plant Collections from Mount Rainier National Park

by Arnie Peterson, Ph.D.

Beginning 20 years ago I have occasionally worked on a hobby of improving the plant species list for Mount Rainier National Park. Following the idea that a species list should be based on herbarium specimens that can be verified, I naïvely thought a preliminary draft could be created relatively easily from a list of herbaria specimens—but then I ended up with a list of 4,578 plant names (including synonyms and misidentifications).



Magenta paintbrush (*Castilleja parviflora* var. *oreopola*) and arctic lupines (*Lupinus latifolius* var. *latifolius*) at Paradise in Mt. Rainier National Park. PHOTO: MARK TURNER

Mount Rainier has long been a popular location for plant collecting, and, thanks to herbaria digitizing their collections and posting them on the Internet, we can now more easily find records for many Mount Rainier specimens. So far, I have found records for about 31,434 herbarium specimens distributed among 124 herbaria in ten countries. The specimens are composed of 17,115 vascular plants, 7,854 bryophytes, 3,245 lichens, 1,468 liverworts, 1,606 fungi, and 144 myxomycetes (slime molds). However, these numbers are approximate be-



Fan-leaf cinquefoil (*Potentilla flabellifolia*) type specimen at Royal Botanic Gardens, Kew. Collected by W.F. Tolmie September 2, 1833. specimens.kew.org/herbarium/K000762575. PHOTO: © COPYRIGHT OF THE BOARD OF TRUSTEES OF THE ROYAL BOTANIC GARDENS, KEW

cause some of the collection locations lack specificity; for instance, the location “general vicinity of Mt. Rainier” could be within the current National Park boundary or could be miles away. My search for these herbaria specimens has also led to learning some of the history in making these collections.

The First Collection

In September of 1832 a 20-year-old William Fraser Tolmie set sail from England. He arrived in the upper portion of the Oregon



Fan-leaf cinquefoil (*Potentilla flabellifolia*) close-up of specimen label. Possibly the date on the label (1836) refers to when the specimen was described, and the word “Oregon” may refer to the Oregon Territories. specimens.kew.org/herbarium/K000762575. PHOTO: © COPYRIGHT OF THE BOARD OF TRUSTEES OF THE ROYAL BOTANIC GARDENS, KEW

Territory (now known as Washington) eight months later in May of 1833. He was employed by the Hudson Bay Company as a physician and fur trader, and was initially stationed at “Nusqually” House, located in what is now the town of Tacoma. Setting out on a botanizing excursion on August 29, 1833, Mr. Tolmie traveled with five Native American guides for three days by horseback and by foot with the goal of reaching Mount Rainier. He most likely reached the peak of what is now known as Mt. Pleasant on the northwest side of Mount Rainier (Haines 1962). It had rained for much of their journey, and when they arrived at the summit of Mt. Pleasant on the evening of the third day there were six inches of snow on the ground, and it was still raining. However, “Next morning not a cloud obscured the sky & moving swiftly along the crisp snow I set out for the summit at sun rise & there a glorious prospect awaited me. Bearing S.E. from my stance the magnificent Rainier upreared its stupendous form, its snowy vesture bathed in a flood of light” (Tolmie 1833b). Mr. Tolmie collected plants on the slopes and summit of Mt. Pleasant, then turned around “& by forced marches arrived at home in 60 hours from the summit.” Upon his return to Nisqually House, the plant specimens were boxed with some bird skins and sent to Fort George in Vancouver where David Douglas had offered to take them with him to the Sandwich Islands (Hawaii), and there place them on a ship to Scotland. However, Mr. Douglas felt they were inadequately packaged and left them at Fort George.

Eventually the plant specimens were rewrapped and traveled by sailing ship to the Sandwich Isles, and thence around Cape Horn, and on to Dr. John Scouler at the Andersonian Museum in Glasgow. Dr. Scouler kept the bird skins and forwarded the plant specimens to Dr. William Jackson Hooker, director of the Royal Botanic Gardens, Kew in London. Thus began the first herbarium specimens of the future Mount Rainier National Park (Tolmie 1833b, Tolmie 1963).

Mr. Tolmie wrote in his journal a “List of plants collected in the neighbourhood of Mt Rainier” containing 42 plant specimens collected on his trip (Tolmie 1833a). Today 12 of these specimens are at Kew, one is at New York Botanic Gardens, two are at Harvard University Herbarium, and the location of the other 27 specimens is unknown. However, the remaining specimens may be in the Kew herbarium but unavailable on the Internet, as only about 12% of its collection has been digitized. While Mr. Tolmie listed the plants collected, many of the specimens were identified not by name but only by a brief comment. For instance, a specimen “6 in one spot near summit, its yellow flowers only appearing above the snow.” Thus until herbaria are fully digitized and the specimens can be found on the Internet, the list of species collected by Mr. Tolmie may remain incomplete.

Mr. Tolmie remained in the Pacific Northwest for the remainder of his life, and collected many more plant specimens

Collectors	Collection Dates	No. Specimens and plant type	Selected Publications
Charles Vancouver Piper	1885–1919	852 vascular	<i>Flora of the State of Washington, and Flora of Mount Rainier</i>
Joseph Alpheus Allen	1888–1913	3,549 bryophyte	
Oscar Dana Allen	1890–1913	1,900 vascular	
John B. Flett	1894–1920	869 vascular	<i>Features of the Flora of Mount Rainier National Park, and The Fern Flora of Washington</i>
Fred A. Warren	1926–1934	802 vascular	<i>The Plants of Mount Rainier National Park, with Harold St. John</i>
Charles Landes	1927–1939	1,271 vascular	
C. Frank Brockman	1929–1938	786 vascular	<i>Flora of Mount Rainier National Park, and Trees of Mount Rainier National Park</i>
E. T. Bodenbergh	1936–1938	376 bryophyte	<i>Moss Flora of Mt. Rainier National Park</i>
George Neville Jones	1925–1938	235 vascular	<i>The Flowering Plants and Ferns of Mount Rainier</i>
J. William Thompson	1930–1940	984 vascular	<i>Notes of the Flora of the State of Washington, vol. I, vol. II, vol. III</i>
Daniel E. Stuntz, Alexander H. Smith, Emery G. Simmons	1934–1983	487 fungi	<i>New or Noteworthy Fungi from Mt. Rainier National Park</i>
Henry A. Imshaug	1948–1954	1,685 lichen	<i>New and Noteworthy Lichens from Mt. Rainier National Park</i>
Elva Lawton, Robert R. Ireland, A. J. Sharp	1954–1977	1,108 bryophyte	<i>Moss Flora of the Pacific Northwest</i>
Irene Creso	1972–1983	614 vascular	
Won Shic Hong	1979–2002	832 liverwort	<i>Hepaticae of the North Cascades Range, Washington</i>
Burke Museum	2004–2008	1,628 vascular	
Judith A. Harpel	2010–2012	610 bryophyte	

Some of the larger plant collections from Mount Rainier, the main type of plants collected, and the publications resulting from them.



Magenta paintbrush (*Castilleja parviflora* var. *oreopola*) and glacier fleabane (*Erigeron glacialis*) dominate a wildflower meadow on Plummer Peak in Mt. Rainier National Park at sunset. PHOTO: MARK TURNER

that he sent to Dr. Hooker at Kew. However, there are no records of Mr. Tolmie making a second trip to Mount Rainier. Interestingly, a descendent of W.F. Tolmie (a J.W. Tolmie) collected plants at Mount Rainier in 1910 and 1912, but I have yet to discover who this J.W. Tolmie is.

Collecting at Mount Rainier Becomes Popular

Beginning in the 1890s the amount of collecting in the vicinity of Mount Rainier increased greatly. Charles Vancouver Piper collected over 850 specimens from Mount Rainier in preparation for writing his *Flora of the State of Washington* (1906), and his *Flora of Mount Rainier* (1901, 1905). Oscar Dana Allen (a retired professor from Yale University) settled in the town of Ashford (just outside of the park) and collected over 1,900 specimens. While many collectors curate their specimens at one or two herbaria, Dr. Allen distributed sets of specimens to multiple herbaria, as seen in his letter to the Royal Botanic Gardens, Kew. “Two of my collections made up into sets were distributed from Harvard Herbarium by Dr. Robinson the Curator. I have now completed a third collection of 105 additional species from the same region beginning with

No. 211 and ending with No. 315. This last collection I have attempted to distribute myself from here” (Allen, 1899). Notes in the letter’s margin state that a set was ordered and received with a bill for \$10. At the same time that O.D. Allen was collecting vascular plants his son, Joseph Alpheus Allen, made extensive collections of bryophytes (over 3,549 specimens from the Mount Rainier area), and like his father distributed sets of specimens to multiple herbaria.

By the end of 1899, the year Mount Rainier was established as a National Park, approximately 6,748 specimens had been collected in the vicinity by various people. Based on the level of detail of the collection locations, these specimens can be grouped as: 330 specimens “definitely collected in the Park,” 1,889 specimens “likely collected in the Park,” and 4,529 specimens “possibly collected in the Park.” Prior to 1899 there was no National Park and thus no boundary for collectors to note whether they were ‘in’ or ‘out,’ and even after the establishment of the Park many collection locations were ambiguous and stated only, “vicinity of Mount Rainier.” By 1910 the number of specimens increased to approximately 8,935 composed of 1,811 specimens definitely collected in the Park, 2,425 specimens likely collected in the Park, and 4,699 specimens possibly collected in the Park, the largest increase being those specimens clearly collected from within the Park boundary.

The National Park Service Collections

From about 1913 to 1940, staff at the new National Park focused on increasing the knowledge of plant species. This was a period of increasing access to the park (the first public car to drive to Paradise was in 1915), and increasing staffing of the Park (the National Park Service was established in 1916). Mount Rainier National Park had one of the first Naturalist Divisions of the National Park Service and those first naturalists embarked on a program of learning about the natural history of their Park. Five park rangers/naturalists especially (John B. Flett, Fred A. Warren, Charles Landes, C. Frank Brockman, and E. T. Bodenbergh) made substantial collections (over 4,100 specimens combined, with an additional 220 specimens collected by other Park naturalists). Also, beginning in 1929, part of the goal of collecting was to create and stock the Mount Rainier National Park herbarium. The knowledge gained from these collections led to the publication of a number of floras. The first flora of Mount Rainier (Piper 1901) had 295 taxa, and each subsequent government publication increased the number of species known to be in the park with the final flora listing, “almost 700 species of flowering plants” (Brockman, 1946).

Recent Collections

In following years, researchers (non-Park staff) have continued collecting and expanding the list of species present, especially in the area of non-vascular plants. Specialists in the fields of bryophytes, liverworts, lichens, and fungi have collected specimens and published species lists. In 2000, David Biek examined many herbarium vascular plant specimens in preparation for writing his book (Biek 2000), which resulted in 871 vascular plant taxa in the Park, including 148 taxa that are

non-native to the area. And recently (2004–2007), the Park collaborated with the University of Washington’s Burke Museum to collect specimens to improve the knowledge of the distribution and abundance of plant species in the park.

A summary of the currently found specimen records from all herbaria posted on the Internet yields 948–1,046 vascular plant taxa, and 384–523 bryophyte taxa (the range of values reflects the uncertainty of the collection locations being within the park). Likely these are more taxa than actually occur in the park and the additional taxa are due to some specimens having been misidentified (obvious misidentifications such as to taxa not found in Washington are not included in this count), and the difficulty of assigning current synonymy to obscure names.

A benefit of having duplicate specimens at multiple herbaria is that it can provide a way to look for errors (to identify the misidentifications)—the same specimen assigned different taxa names at different herbaria. For instance, O.D. Allen’s field number 225 was originally labeled as *Troximon laciniatum* and can be found today at different herbaria posted as either large flowered agoseris (*Agoseris grandiflora* var. *grandiflora*) or Puget Sound agoseris (*A. grandiflora* var. *leptophylla*). Duplicate moss specimens of J.A. Allen’s #120 can be found at different herbaria posted under six different scientific names (which can be reduced to two different currently accepted names according to the UC Jepson California Moss eFlora). Of the 255 different field numbers of O.D. Allen that can be found with duplicates in different herbaria, 40 sets of duplicates have different taxa names at different herbaria. Often the difference is between the original name assigned in the 1890s and a later annotation.

Using a Species List

Preparing a list of taxa with herbarium specimens can help identify which taxa are seldom collected, which taxa have collection locations that are ambiguous, and which taxa are lacking specimens. Even though the species list created from herbarium specimens may have more taxa names than there are taxa in the park due to the inclusion of misidentifications, this species list still does not include all taxa known to be in the park. For instance, Sitka spruce (*Picea sitchensis*) is known to grow in the park, however there are no herbarium specimens of it clearly collected from within the park. The only Sitka spruce specimens from the vicinity of Mount Rainier are labeled as from the “upper valley of the Nesqually”—a description which O.D. Allen used for locations both within the park boundary and outside of it, and therefore “possibly collected in the park” (note that most of O.D. Allen’s specimens were collected prior to the establishment of the park or a park boundary).

A paucity of specimens can raise the question: Is a taxon rare in the park? For example, plantain-leaf buttercup (*Ranunculus alismifolius* var. *alismellus*) was known from a single location and represented by a single herbarium specimen. Recently, a park volunteer, Carol Miltimore, took on the project to “keep an eye out for it while hiking” and discovered that there are many populations of this plant in the northeast corner of the

park. Carol continued looking for plants poorly represented by herbarium specimens and has now collected specimens of six taxa with no previous specimens collected within the park, three taxa whose previous collection locations were ambiguous, and two taxa for which she has expanded their known range in the park.

Alas, my ‘easy’ project of making a species list documented by herbarium specimens still isn’t completed. More work is needed correcting the identity of some of the specimens. But I have had some fun learning a little history on plant collecting.

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Arnie Peterson worked at Mount Rainier National Park during the years 2000–2001, 2007–2009, and 2016–2018. He retired as the Park's plant ecologist in 2018.



A New *Rhododendron* Species in Our Flora

by David Giblin, Ph.D.

University of Washington Herbarium, Burke Museum



Rhododendron columbianum leaves – note narrow leaf blades, conspicuous veins, and inrolled leaf margins. PHOTO: G.D. CARR

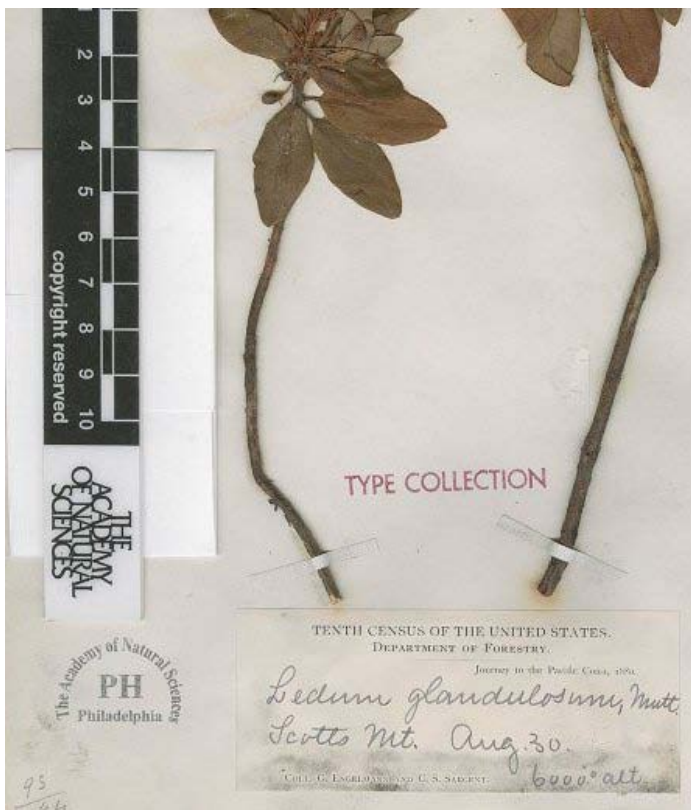
On Labor Day weekend of 2020 I was on Middle Tiffany Mountain in northern Okanogan County when I came across a colony of shrubs near the summit at about 2,400 meters (8,000



Type collection of *Ledum columbianum*. PHOTO COURTESY OF UNIVERSITY OF WASHINGTON HERBARIUM, BURKE MUSEUM

feet). It looked like something that many people might call Labrador-tea (formerly treated in the genus *Ledum*, but now clearly shown through DNA-based studies to be in the genus *Rhododendron*). However, the leaf margins were flat (as opposed to having curled or revolute margins as in Labrador-tea), and the habitat was distinctly not marshy or wet. I took a piece with me knowing that it was going to key out to *Rhododendron columbianum* (mountain Labrador-tea) in *Flora of the Pacific Northwest (Flora)*, 2nd edition, but I thought perhaps there was more to the story behind this name than I was currently aware. I was correct about it keying to *R. columbianum*, but for the first time I noticed that the illustrations for *R. columbianum* in the *Flora*, 2nd edition show both of these leaf forms!

Back in the University of Washington Herbarium at the Burke Museum, I was able to examine dozens of specimens in the collections there under the name *Rhododendron columbianum*. The specimens had all been examined and identified by the authors of the *Flora of North America* treatment for *Rhododendron* (<http://beta.floranorthamerica.org/Rhododendron>), so I was confident that the identifications were accurate. As I expected, I clearly found two groups of specimens—those with flat leaf margins and broadly elliptical leaf blades (like the ones that



Type collection of *Ledum glandulosum*. PHOTO: COURTESY OF PHILADELPHIA ACADEMY OF NATURAL SCIENCES AND JSTOR GLOBAL PLANTS

I found on Middle Tiffany Mountain), and those with revolute margins and narrowly elliptic leaf blades.

I was also curious to see if there were any habitat differences between the two piles of specimens that I had generated. As it turned out, the flat-margined, broad-leaved plants all came from middle to high elevation sites in mountains across the Pacific Northwest, and the revolute-margined, narrow-leaved plants all came from lowland areas west of the Cascades from British Columbia through Oregon.

Next, I was curious to know the synonyms (other published names) for *R. columbianum*, which the *Flora of North America* treatment (http://beta.floranorthamerica.org/Rhododendron_columbianum) showed to be *Ledum columbianum* and *L. glandulosum*. This was curious because it suggested that two names had previously been published and sometime afterward researchers decided that the two names described the same entity. Fortunately, published names are based on herbarium specimens called “types” (i.e. the cited specimen(s) used to describe a species, subspecies, or variety) and there is an online database (JSTOR Global Plants: <https://plants.jstor.org/>) that has pictures of type specimens from herbaria around the world (we received funding from the Mellon Foundation for this project to image our type specimens). Examining images of the type specimens would determine if in fact *L. columbianum* and *L. glandulosum* (as initially described) did in fact “look the same.”

Looking at the image for the 1904 type specimen of *L. columbianum* I saw revolute-margined, narrowly elliptic leaf



Rhododendron neoglandulosum leaves—note broad leaf blade and flat margins. PHOTO: BEN LEGLER

blades, and a collection locality (i.e., type locality) of Ilwaco in Pacific County, WA. Alternatively, the type specimen for *L. glandulosum* had flat-margined, broadly elliptic blades and was collected in the 1840s on the slopes of the Rocky Mountains. Collectively these multiple lines of evidence supported my reasoning that what we were currently calling *R. columbianum* here in Washington should likely be treated as two separate species. How and when they were synonymized (combined) under a single species concept is a mystery for pursuing in older regional floras at another time.

As interesting as it was to sleuth my way through this story, I was quite confident that I was not the first to notice this difference. So, my next step was to do an online literature search to see if there were any recent molecular (i.e., DNA-based) studies to support the idea that these two leaf forms may represent two distinct species. Not surprisingly, a paper published in 2017 (Hart et al.) confirmed my suspicions, and in 1990 someone had published a new name for the oval-leaved, flat-margin species—*Rhododendron neoglandulosum* (Harmaja 1990). As a brief aside, the name *R. glandulosum* had been validly published in 1917, so that name was not available here. Later this fall I will be producing a revised *Rhododendron* treatment to include this species, which will be quite straightforward to create (and we already have an illustration!). In the meantime, I have already sorted out photos of these two species that were combined in the Herbarium’s Plants and Fungi of Washington Image Gallery (<https://biology.burke.washington.edu/herbarium/imagecollection.php>). With the return of student assistants to the Herbarium, the specimens that I sorted into two piles will get databased under their respective names so that the distributions for these two species in Washington are more clearly reflected in the Image Gallery and on the Consortium of Pacific Northwest Herbaria online database (<https://www.pnwherbaria.org/data/search.php>).

The experience reminds me that on the one hand there are still so many details to resolve about our flora, and on the other hand that some of these details were worked out a long time ago. Special thanks to Drs. Valerie Soza and Emily Gillespie for interpretation of phylogenetic data relating to this taxonomic puzzle.

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Mistletoes in Washington

by Walter Fertig

A person's opinion of mistletoes may vary depending on their holiday spirit, hobbies, or occupation. Yuletide revelers appreciate the mistletoe for its role in promoting holiday cheer (and the opportunity for socially appropriate, consensual public kissing). Birders recognize the value of mistletoe as an important food source for overwintering songbirds. Foresters, however, take a more dismal view toward mistletoes because of



American dwarf-mistletoe (*Arceuthobium americanum*) can be recognized by having three flowers per node and growing on lodgepole pine (*Pinus contorta* var. *latifolia*), as in this specimen from Sherman Pass in the Kettle River Range of northeastern Washington.

PHOTO: WALTER FERTIG



Western dwarf-mistletoe (*Arceuthobium campylopodum*) grows mostly on ponderosa pine (*Pinus ponderosa*) and is the most widespread mistletoe species in Washington. PHOTO: BEN LEGLER FROM THE BURKE HERBARIUM IMAGE COLLECTION

the reduced growth and vigor of commercially valuable trees infected with these plants.

Mistletoes are parasitic or partially parasitic (hemiparasitic) herbaceous plants that grow from the stems of other woody species. In Washington, mistletoe hosts are conifers, but elsewhere these plants can also infect oaks, acacia, mesquite, eucalyptus, and even arborescent cacti. The mistletoe lifestyle has been adopted by members of three or four closely related plant families found throughout the world, but most commonly in the tropics. The families (Loranthaceae, Misodendraceae, and Santalaceae—which now includes the Viscaceae) differ in floral morphology, fruit, and inflorescence characters. Only one family, the Santalaceae, occurs north of Mexico.

Like many parasites, mistletoes have a greatly simplified body plan. Most of a mistletoe is found below the bark of its host. Specialized, fungus-like stems called cortical haustoria grow just beneath the bark in the food-transporting phloem tissue of the host. Root-like stems called sinkers diverge at right angles from the haustoria into the outer layers of sapwood or xylem. The haustoria and sinkers help anchor the mistletoe



Fir dwarf-mistletoe (*Arceuthobium abietinum*), like other mistletoes, has separate staminate (male) and pistillate (female) flowers on separate plants. Staminate flowers (left) have 3 to 4 fleshy sepals bearing a single, sessile anther in the center. Pistillate flowers (right) are paired and on drooping stalks with 2 tepals attached to the ovary. At maturity, the ovary ripens into a fleshy, white berry. PHOTOS: GERALD D. CARR FROM THE BURKE HERBARIUM IMAGE COLLECTION

into the stem and allow it to tap into its host's food and water pipelines. Depending on the species, bushy aerial stems emerge from the bark near the site of the original infection or sprout periodically along the length of the host branch as the mistletoe elongates.

In our species, all in the genus *Arceuthobium*, leaves are absent or reduced to small, opposite scales. In Oregon, oak mistletoe (*Phoradendron villosum*) has well-developed green leaves that are capable of photosynthesis. At least 35 mistletoe species in Australia (from several other genera and families) even produce leaves that mimic the size and shape of their host plants, usually eucalyptus. Non-photosynthetic and fully parasitic mistletoes usually have yellow, brown, or orangish stems.

In the former members of the Viscaceae, flowers are small and unisexual, and lack showy petals to attract visually-oriented pollinators, like birds or insects. Our mistletoe species in Washington have sessile or short-stalked yellowish to green fleshy flowers borne in a spike-like, scaly inflorescence at the tip of aerial stems. The flowers have a perianth of three or four tepals which are all similar in shape, size, and texture, unlike the distinct sepals and petals typical of most flowers. Staminate flowers have three or four pollen-producing stamens. Fruit-producing pistillate flowers are either paired or whorled at each branch of the inflorescence.

Washington has three to seven taxa of dwarf-mistletoes (*Arceuthobium*), depending on one's taxonomy. These species occur exclusively on conifers, with each specializing on one or a few species or genera. American dwarf-mistletoe (*A. americanum*) is easily recognized by its whorled, bushy branches and inflorescences with three or more flowers per node. It specializes on lodgepole pine (*Pinus contorta* var. *latifolia*) and is found on the east slope of the Cascades and Okanogan Plateau. Douglas-fir dwarf-mistletoe (*A. douglasii*) has tiny, olive-green stems mostly less than an inch tall that are difficult to spot amid the needles

of its eponymous host plant (*Pseudotsuga menziesii*). This species is rarely collected, but probably overlooked within its range in the East Cascades, Okanogan Range, and Blue Mountains.

The remaining Washington mistletoes have traditionally been lumped into one variable species, western dwarf-mistletoe (*A. campylopodum*), characterized by opposite or whorled branches that form flattened, fan-like sprays. Today, taxonomists split *A. campylopodum* into four to five species that are best identified based on their primary host. White fir dwarf-mistletoe (*A. abietinum*) grows on silver firs, especially white fir (*Abies concolor*), and was last collected in the state in 1900 in Skamania County. Larch dwarf-mistletoe (*A. laricis*) is found on western larch (*Larix occidentalis*) as its name suggests, but can also grow on mountain hemlock (*Tsuga mertensiana*). Two forms of hemlock dwarf-mistletoe (*A. tsugense*) are recognized—ssp. *tsugense* on western hemlock (*Tsuga heterophylla*) and ssp. *contortae* on shore pine (*Pinus contorta* var. *contorta*). The latter taxon appears to be quite rare in the state (being limited to the San Juan Islands), though this may be an artifact of under-collection. Western dwarf-mistletoe (*A. campylopodum*) in the modern, narrow sense, is mostly found on ponderosa pine in eastern Washington.

Oak mistletoe (*Phoradendron villosum*) parasitizes Oregon white oak (*Quercus garryana*) in the Willamette Valley, and might be expected in the white oak forests of western Washington, but apparently has not crossed the Columbia River. Juniper mistletoe (*P. juniperinum*) is a widespread species in the American southwest that reaches eastern Oregon and might also be expected in the scablands of eastern Washington, but has never been documented in the state. The *Phoradendron* mistletoes produce white, pinkish, or red berry-like fruits that resemble tiny beachballs and are readily consumed by birds. The seeds within the fruit are indigestible and covered with sticky goo. The seeds are either excreted on a branch (with a dollop of organic fertilizer) or smeared on a stem by a bird's

Mount St. Helens Update 2021

by Becky Chaney, WNPS Conservation Committee Chair

In 1980 Mount St. Helens erupted, drastically altering patterns of renewal, growth, and succession there. The eruption created a unique opportunity for scientific observation of ecological processes. In 1982, the same year that the first plant, prairie lupine (*Lupinus lepidus*), reappeared on the devastated Pumice Plain, Congress set aside the Mount St. Helens National Volcanic Monument. Now, a tunnel built in 1985 to control the water level of Spirit Lake needs repairs. The US Forest Service has proposed building a 3.2-mile road across the Pumice Plain, through the middle of the densest and oldest research plots, to the shore of Spirit Lake to accomplish this work. The Forest Service's environmental assessment dismisses concerns about the potential impacts on scientific research.



Mount Saint Helens from Johnston Ridge with giant red paintbrush (*Castilleja miniata*), yarrow (*Achillea millefolium*), and hairy cat's ears (*Hypochaeris radicata*) in the foreground. PHOTO: MARK TURNER

In response, on August 27, 2021, WNPS, Cascade Forest Conservancy, and other partners filed a legal brief opposing the Forest Service's decision to construct a road across the Pumice Plain. WNPS argues that the Forest Service failed to consider the environmental effects of its decision on the Pumice Plain landscape and the ongoing scientific research that occurs there. WNPS alleges that the Forest Service violated several federal environmental laws and is asking the federal court to vacate the Spirit Lake Environmental Assessment (EA) and Decision Notice/Determination of No Significance (DN/FONSI) and reconsider the decision to build the road.

The Monument was created to protect the main features of the blast zone. From its founding, the intent was to protect geologic, ecologic, and cultural resources and to allow geologic forces and ecological succession within the monument to continue substantially unimpeded. Recognizing a unique opportunity, full use of the Monument for scientific study and research was included from the start. Its 1985 Comprehensive Plan explains that "the landscape and ecosystem within the

beak as it tries to dislodge the seed from the tasty fruit pulp. (The word 'mistletoe' comes from an Anglo-Saxon term for 'dung-twig'.) *Arceuthobium* species have distinctly bicolored ovoid berries that explosively discharge their single seed 15-50 feet (at a speed of 60 miles per hour). Dwarf-mistletoes slowly build up water pressure in their fruits for over a year until the pressure becomes so great that the fruit wall bursts. As with *Phoradendron*, these seeds are viscous (putting the 'visc' into Viscaceae!) and stick to any surface they contact.

Masses of mistletoe stems are sometimes called witches' brooms due to their fanciful resemblance to the preferred flying conveyance of a sorceress. These structures can be important as nesting habitat for songbirds, raptors, and squirrels and can provide forage for deer and elk. However, not all witches' brooms result from mistletoe infection. Rust fungi and amoeba-like microbes called phytoplasmas can infect the phloem of a tree and cause broom-like growths similar to mistletoe.

Since ancient times, humans have been fascinated by the peculiar habit mistletoe has of arising from the stems of other plant species. In Europe, the traditional Christmas mistletoe (*Viscum album*) was thought to have been sent to Earth by a special envoy of the gods, the mistletoe thrush (a winter migrant from Africa that feeds extensively on mistletoe berries). Many cultures across the globe thought mistletoes possessed spiritual power and medicinal value, especially for promoting fertility. Mistletoes have often been considered omens of good fortune and were frequently hung indoors during winter for some color and to foster positive spirits. Over time, this tradition may have morphed into the practice of hanging a sprig of mistletoe over the door at Christmas time. According to Norwegian tradition, a man should remove one berry for each kiss from a woman until all the berries are gone (at which time the smooching must cease!).

Very few foresters are likely to feel particularly romantic about mistletoes. Dwarf-mistletoe infections are especially deleterious to western conifer species used for commercial timber harvest. Each year an estimated 3.3 billion board feet of timber is lost to mistletoe (for perspective, 13,600 board feet of lumber goes into a typical 2,000 square foot home). Mistletoe infestation reduces the vigor of the host tree, damages wood, and increases susceptibility to drought stress, attack from pine beetles, and fire. Fire suppression and high-grading (harvesting large, healthy trees but leaving infested ones) over the past century has probably increased the abundance of dwarf-mistletoe in many western forests.

Complete control of mistletoes is unfeasible and undesirable in our forests, given the value of these plants to wildlife. Besides, without mistletoe, how would shy people work up the courage for a consensual holiday kiss?

Walter Fertig is an avid mistletoe seeker based in McCleary, Washington.





Dwarf or prairie lupine (*Lupinus lepidus* var. *lobbii*) on Pumice Plain below Mount St. Helens. PHOTO: MARK TURNER

Monument are of extremely high scientific importance. Opportunities for basic and applied research and for public education are unparalleled.” It consequently limits access that may disturb natural processes or research areas.

Three of the 11 declarations supporting the legal brief were from WNPS members—Dr. Virginia H. Dale, Susan Saul, and Rebecca Evans. The statements not only make the case for protecting the Pumice Plain but also exhibit WNPS members’ ongoing dedication to environmental research and protection of Washington State’s treasured habitats.

In 1980, Virginia Dale was a graduate student studying ecological succession at the University of Washington (and served as Conservation Chair of WNPS from 1982-3). In her words, “When the massive eruption occurred on May 18, I essentially had a proposal in hand to conduct research on ecological succession there. The eruption clearly created a once-in-a-lifetime opportunity to improve ecological understanding about the processes of plant reestablishment and recovery.” Her deep commitment to the protection of the volcano and its surroundings led her to testify before Congress on behalf of WNPS regarding the creation of the Monument in 1982. She stated that “an adequate protection plan includes more than just a

few geologic features of the devastated area” and “studying the vegetation succession in the different areas near Mount Saint Helens has tremendous land management implications”—as printed in *Douglasia* 6(2):1-3, Spring 1982. Virginia has been studying plant succession at Mount St. Helens ever since and has written 17 scientific papers based on that research.

Susan Saul, a current WNPS Conservation Committee member and founder of Cascade Forest Conservancy, is dedicated to protecting Mount St. Helens. Her work dates to 1977, pre-eruption, when she joined Mount St. Helens Protective Association and promoted a Mount St. Helens National Scenic Area by meeting with legislators, writing letters, and leading hikes. This was all to ensure that people knew what was threatened by mining, road construction, and timber sales. After the eruption, as the Forest Service moved ahead with timber salvage sales, Susan worked tirelessly behind the scenes with scientists who warned that “important areas for research, such as ash deposition studies, were being lost to salvage logging” and publicly building a coalition in support of a protected monument centered on Mount St. Helens and the blast zone. On

“As an active volcano in the Pacific Ring of Fire, Mount St. Helens is a powerful mountain—historically, geologically, culturally—for the United States and the world. It is a place that has commanded the attention and resources of all levels of government—city, county, state and federal—and continues to command respect, curiosity, creativity, and awe from humans who come in contact with its unpredictable, explosive potential.”

—Opening Brief, CFC, WNPS, et al vs. USFS.

January 15, 1981, Susan announced the proposal of a 216,000-acre National Monument dedicated to preserving the processes of vulcanism and the associated natural succession of flora and fauna and other geologic, ecologic, recreational, and cultural resources. In February 1981, the Forest Service countered with an 84,710-acre “interpretive area” to be left in its natural state, with boundaries shrinking, eventually to nothing, as the landscape recovered. Eventually, and over objections of the Forest Service, a compromise bill for a Monument of 110,000 acres was reached. As Susan notes in her Declaration, “The advocacy and testimony of scientists about the eruption as a once-in-a-lifetime research opportunity that was in jeopardy convinced Congress to move forward.” Passed by a House vote of 393 to 8, and without dissent from the Senate, President Reagan was compelled to sign the veto-proof bill into law on August 26, 1982.

Flora of Oregon, Vol. 2: Dicots A-F

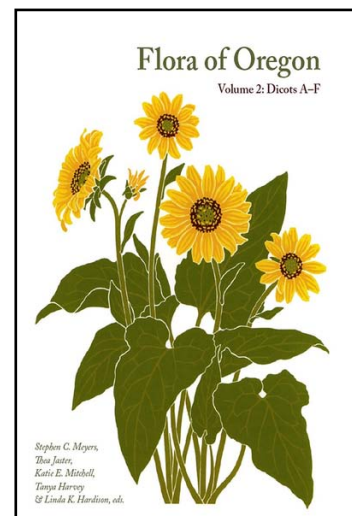
by Stephen C. Meyers, Thea Jaster, Katie F. Mitchell, Tanya Harvey and Linda K. Hardison, Editors

Published by Botanical Research Institute of Texas, Fort Worth, TX, 2020, 861 pages

Review by Kathleen Sayce

Editor's note: Flora of Oregon is the first comprehensive flora of Oregon in over 50 years, and is a three-volume reference that will be the first illustrated floristic work exclusively addressing Oregon. Volume 1, published in 2015, presents treatments of the pteridophytes, gymnosperms, and monocots. Volume 3 will cover the remainder of Oregon's dicots and is currently in production.

The second volume of the *Flora of Oregon* includes taxonomic treatments for 39 plant families, from Aizoaceae to Fagaceae, covering 1,668 taxa; 785 taxa are illustrated, most by John Myers, and this volume showcases the changes in illustration style since 1972. A gorgeous Tanya Harvey print of deltoid balsamroot illuminates the jacket. The front inside covers contain two maps showing ecoregions of Oregon, and the back inside covers have a map of Oregon counties, a family index, an elevation scale in meters and feet, and a measurement scale in centimeters and inches.



The Introduction presents the scope of work, conventions used throughout, the philosophy of the taxonomic approach used, and abbreviations and symbols. Page layouts for species treatments strikes a good visual balance between illustrations, maps and text. I was struck by how usable this format is, compared to many older floras. The notes at the end of species treatments are well worth reading: For example, *Berberis darwinii* recently escaped into nearby conifer forests on the south coast of Washington; this flora shows that it is coastal in Oregon as well.

The next three chapters include landscaping with native plants, insects as plant taxonomists, and herbaria and a modern flora. The landscaping chapter discusses some philosophic aspects of landscaping with native plants. There is a distinct sense of right plant, right place in a garden, or any planted landscape, when native species settle in and thrive. It is worth the time and trouble that juggling different ecoregion sources takes, removing plants that just do not work, and setting aside those that go toes up and die, to find the right palette of local native plants for your garden.



Dwarf or prairie lupines (*Lupinus lepidus* var. *lobbi*) among pumice on the north shoulder of Mount Saint Helens. PHOTO: MARK TURNER

Rebecca Evans, a recipient of a 2019 Conservation Grant for her research on mycorrhizal community composition, is a next-generation Mount St. Helens scientist. Her expertise in the development of soil and how invasive species affect soil formation, function, biogeochemistry, and microbiology is based on the work of past scientists, while her research on understanding the controls and mechanisms of soil carbon sequestration is relevant to current concerns regarding climate change. She states that "Mount St. Helens provides a rare opportunity to investigate abiotic and biotic processes controlling soil C development" and notes that her work "will help to fill the gap in knowledge as to the role fungi play in plant-soil interactions and how current global change agents threaten the understudied soil mycological community." Rebecca's research has been complicated and delayed by Covid-19 and recent Pumice Plain access limitations, but we are expecting to feature her work in a future *Douglasia* issue. She, like Susan, is a current member of the WNPS Conservation Committee.

With the brief and declarations submitted, WNPS is waiting for the government response. A final decision on the case is unlikely before 2022. I invite you to learn more about Mount St. Helens research work and the work of the WNPS Conservation Committee. As an evolving story, WNPS will post updates on the Conservation Advocacy page of our website. The brief, and Susan, Virginia, and Rebecca's declarations on which this article is based, are also there.

Becky can be reached via e-mail at conservation@wnps.org. She is always happy to hear your conservation interests, concerns, and comments. Ideas for conservation-oriented webinars are also welcome.



For other landscaping reads, *Gardening with Native Plants of the Pacific Northwest* by Arthur Kruckeberg and Linda Chalker-Scott will provide those interested in native plant gardening with information to help make plant selections based on climate, soil and ecoregion. For those interested in the ecological processes that native plants promote in food webs, *Bringing Nature Home* and *Nature's Best Hope* by Douglas Tallamy provide a deeper look at the ecological relationships that are enhanced by gardening with native plants. Home landscapes need not be culturally standardized constructs, and the *The Living Landscape* by Rick Darke and Doug Tallamy offers information on layering from canopy to wetland and meadow.

The chapter on plant-insect interactions offers a look at the diversity of insects found on native plants, presented by generalized plant habitat and then by plant family, and gives a detailed look at which insects to find where. This is the first regional treatment of this important subject. The more we understand about why diverse native plants are important to support diverse native animals, the clearer the message will be that gardening with native plants is a critically important way to improve regional faunal ecologies. For example, insects that need Fagaceae species for habitat are found on pages 44-45, mentioned here because *Quercus* is a keystone forest genus over much of North America. For more on the evolution of oaks and insects, and notes on some of its insect interactions, see Douglas Tallamy's *The Nature of Oaks*.

Taxonomic treatments begin with a reference page, listing which plant groups are featured in which volume, and a family index to this volume. The family treatments begin on the next page and are alphabetical by family. Texts for each taxon are accompanied by range maps, and illustrations are well placed. Gone are fresh-from-the-plant-press illustrations of Asteraceae as seen in Hitchcock and Cronquist, 1973, *Flora of the Pacific Northwest: An Illustrated Manual*. I rejoiced on seeing the new illustrations for the revised edition in 2018 and now, these newer illustrations for this volume. Taxonomic treatments are followed by a glossary, references and several appendices.

The glossary contains, among other illustrations of flower parts, numerous illustrations of leaf shapes, and a well-done composite illustration of hairs and surfaces. The quality of detail is a visual marker of how much digital photography has changed the way we now look at plants with digital camera in hand. Those who recall struggling with hand lenses to find forked or stellate hairs, or the differences in hirsute, hispid, pilose and villous hairs will appreciate this illustration (see page 758). Illustrations throughout the book show the advent of digital photography, revealing fine details that went unseen and undrawn in prior decades.

Absent in the appendices are citations, though these are listed in References, which I located initially by looking for Robert Michael Pyle's books on butterflies of the Pacific Northwest. The pertinent citations can be located by reading through the References for insect titles; it is a curious omission, perhaps

made due to a lack of space or a desire to keep the total page count as low as possible.

The first appendix is two listings of misapplied and in part scientific names by family in this volume. Old names are lined up with currently accepted names for cross reference; in part names are lined up with their accepted names. Those of us who are still trying to keep up with name changes may bookmark this appendix for quick reference. The index also includes old names, directing the reader to the page with the current name.

The second appendix is a list of selected species for native plant gardens with generalized geographic icons; several aspects of preferred growing conditions are also summarized with icons and codes. This appendix includes all plant families, not only those discussed in this volume, arranged by plant groups. For those who like grasses: Eight grasses, ten sedges, and five rushes are listed for gardening use.

The third appendix covers native plants for insect habitat, listed by plant genus, with ecoregions and kind of habitat support provided: butterfly nectar, bees and other, beneficial insects, and foodplants. Note that "butterfly" includes moths; butterflies can be considered day-flying, large colorful moths.

The fourth appendix is a specific list of butterfly foodplants, listing butterfly species by host plant genus, and including the common name, plant genera, reference page in the Insect as Plant Taxonomist chapter, and allelochemicals present in plants that affect the caterpillar-plant interaction. Enticing people into creating more habitat for insects often begins with butterflies; only later will you realize what a slippery slope this was, when your now mostly-native-plant garden has food and shelter for swallowtails, veined whites, echo azures, hover flies, solitary bees, bumblebees, golden dagger wasps, carrion beetles, and numerous other insects.

Appendix five covers solitary bees, which include more than 90% of all bee species. In this appendix, the list of solitary bee species is grouped by plant family, and includes bee common names, and plant genera that host them. Page numbers refer to the reference page in the Insect as Plant Taxonomist chapter. Solitary bees are far more numerous and diverse than colonial bee species; honeybees and bumblebees are better known, but much less important in nature than solitary bees.

The appendices are followed by a combined index to plants by family, common name and scientific name. Old names are included.

Overall, this second volume provides a solid update to Oregon's plant taxonomy, and helps connect current taxonomy to the past. As many plant species' ranges, ecoregions and insect communities extend north into Washington, south into California, and east into the intermountain west, so does its utility appeal to regional botanists well outside its borders.



Sharing Trees: The Connected and Cooperating Forest

Thoughts on *Finding the Mother Tree* by Suzanne Simard

by Ellen Kuhlmann, Koma Kulshan Chapter

Tree value is usually described in monetary terms or in services provided. Wood is harvested and sold, made into a dizzying array of products. Trees produce oxygen, sequester carbon, and limit soil erosion. They provide shelter and food for wildlife. But are they more than that? Do they have agency, presence, a form of intelligence? Are they sentient?

It has been well established that plants are aware of their surroundings; they are able to note and react to changes in temperature, light, and airborne chemicals analogous to human senses. For light, experiments have shown plants have receptors for different wavelengths similar to photoreceptors in human eyes (Chamovitz, 2012). There is increasing acceptance that plants send signals to one another after injury. A recent study showed that trees under attack by bark beetles release compounds into the air that are picked up by unaffected trees. These trees then bolster their bark beetle defenses, preparing for an attack—indicating that a message was sent, received, and acted upon (Hussain et al., 2019).

Humans have long felt an affinity for trees and suspected they contain mysteries. Folk and mythological stories of many cultures have featured trees with supernatural or human qualities. World or creation trees, such as the Norse Yggdrasil, provided a framework of how realms are arranged, a representation of how the physical and nonphysical worlds were connected. Sacred trees, found in many religions, are revered as symbols, seen to possess special qualities, or as places where spirits resided. These ideas have surfaced in more recent stories such as in J.R.R. Tolkien's tree-people, the Ents, in part two of the Lord of the Rings trilogy *The Two Towers* (1954) as well as the fighting trees of *The Wonderful Wizard of Oz* (1900).

The idea that trees might be sending messages to each other and that they may be self-aware or exhibit social behaviors gives many scientists pause, as these are qualities traditionally reserved for human beings. Anthropomorphizing a subject has been viewed in science as a severe flaw, making such experi-

mental results suspect. Are scientists who conclude that plant signaling and perception of their surroundings show a form of consciousness straying into fantasy, or could they be discerning a deeper truth about trees, one intuited since ancient times?

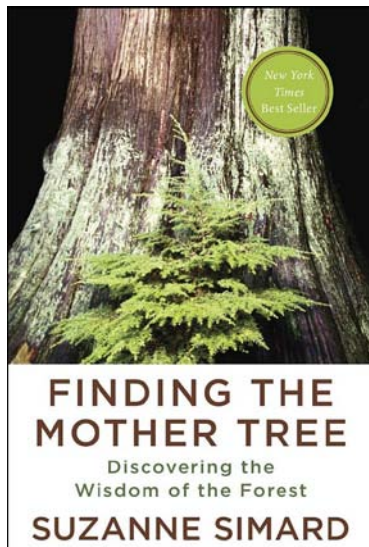
Canadian scientist Suzanne Simard has been researching factors affecting tree seedling growth and carbon transfer among trees since the 1980s. Simard discovered that mature (hub) trees aid the growth of younger trees, giving preferentially to their genetic offspring, leading her to name them “Mother Trees.” She believes Mother Trees exhibit qualities that comprise sentience: intelligence, decision-making, memory.

Simard's new book, *Finding the Mother Tree* (2021), has the style of a memoir, mixing anecdotes from her personal life with tales of her research and showing how her ideas formed and progressed over time. This approach to mixing the personal with the professional parts of her life works for the most part, drawing the reader into the narrative. It provides context for her scientific work and enlivens her accounts of field work and data analysis. In a few instances the approach is discordant, as when she juxtaposes an argument with her brother over gender roles with a meeting at which her research results are disparaged by the masculine leadership of the Canadian Forest Service.

Initially, a summer job while a forestry student sparked Simard's interest in tree growth. Simard was tasked with assessing seedling growth in plantations, logged areas that have been replanted. She found that the spruce seedlings, planted as a monoculture in evenly spaced rows, were struggling, their needles yellowing and falling off. Meanwhile in the jumbled old growth forest she'd walked through to reach the plantation, seedlings were flourishing. She thought, what did the unmanaged forest have that the replanted area lacked?

At the time, Canadian foresters had developed and implemented what was called the free-to-grow policy. Conifer seedlings were planted as a monoculture after clearcutting (the removal of all standing trees) and herbicide was applied to remove other plant species. Like in industrial farming, it was thought young trees would thrive and grow faster without competition than they would in a mixed setting.

Simard's musing led to research on what might be causing the poor growth in the tree plantations. Her initial experiments found that mycorrhizal fungi were absent from the roots of plantation seedlings but present in abundance in young trees in old growth stands. Continued work found that the fungi may be beneficial to tree growth due to nutrients moving from the fungal hyphae into tree roots. Most surprisingly, her research indicated that the nutrients transported through the fungal network might come from tree species typically viewed as conifer competitors. These studies compared fir seedlings grown with either alder or birch to fir grown alone. Results showed that nitrogen moved from alder to fir through the fungal network, while excess carbon in the form of carbohydrates went from birch to fir seedlings.



This movement of nutrients among trees is considered by some scientists, including Simard, as a form of communication. In *Finding the Mother Tree* Simard writes, “We were listening to birch communicate with fir” when their Geiger counter crackled, showing the presence of radiolabeled carbon in the fir seedlings that originated in the paired birch. Simard sees sharing of resources among trees as evidence of cooperative behavior, of one plant giving to another. Skeptics, however, might conclude that materials are only moving along a gradient, from an area of higher concentration to a lower one.

The implications of the benefits of planting “competitor” species along with conifers challenged the dogma behind the free-to-grow policy. Canadian Forest Service leaders rejected Simard’s findings, which served as evidence that the policy was flawed. But the initial response to the study, published in *Nature* in 1997, within the academic community was glowing, her work being hailed as uncovering the “wood-wide web.”

Simard had long noticed that in old growth stands trees had a patchy distribution, forming clumps with seedlings ringing the Mother Tree. Her research following the *Nature* article focused on possible transfer of carbon from older trees to younger ones. She also wondered if Mother Trees, like their human counterparts, might aid their genetic offspring over unrelated seedlings. Results from experiments of one of Simard’s graduate students, Monika Gorzalek (2017) suggest carbon transfer may be greater to kin seedlings than to other seedlings.

Simard increasingly suspects that trees are “tree people,” sentient beings that form social communities. The possibility is tantalizing, the evidence not yet conclusive. However, at one time Jane Goodall was widely derided for her conclusion that chimpanzees had feelings and personalities. Today most agree with Goodall, including noted primatologist Frans B. M. de Waal, who calls rejection of such findings “anthropodenial” (Sleek, 2019) and a consequence of belief in “human exceptionalism.”

In one of his Round River essays published in 1970, Aldo Leopold called for the development of a land ethic by which all plants and animals had a right to existence, not just human beings. He called for us to regard them as fellow living beings, rather than as their master or conqueror. Leopold’s land ethic has been adopted by some, but not widely enough to be reflected in our laws or policies.

Simard’s work echoes Leopold’s ideas and expands them, saying that trees have a right to live because they possess quali-

ties indicative of sentience such as kin recognition, communication, and cooperative behavior. She believes her work and that of others shows trees to have a complexity and form of wisdom long invisible to science. Perhaps those who believed in tree spirits or wrote of talking trees realized something science has missed until it develops the insight and tools to measure it.

Simard hopes that readers of *Finding the Mother Tree* gain a deeper understanding of trees and realize the complexity and interdependence of the natural world.

She also hopes that the benefits shown when forests are managed less as a crop and more like a complex community spur changes to forest management. The free-to-grow policy was amended by the Canadian Forest Service in 2000; however clearcutting is still the preferred method of harvesting timber in Canada and on many forestlands in the United States. While the United States curtailed harvest of most old growth after adoption of the Northwest Forest Plan in 1992, Canada continues to log old growth forests. Simard feels trees have much to tell us, and if we start listening we may discover much, perhaps even solutions to looming challenges like climate change.

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World’s record Sitka Spruce (*Picea sitchensis*) at Lake Quinault in Olympic National Park. PHOTO: Mark Turner



The Power of Planned Giving to WNPS

by Don Schaechtel

The Washington Native Plant Society (WNPS) has been fortunate to receive occasional estate gifts. These gifts, both big and small, have boosted the WNPS Endowment Fund, supported short-term budget needs, and provided funding for strategic planning. The recent bequest from Joe and Margaret Miller helps fund additional staffing as we have added a volunteer coordinator to support our chapters and committees. I want to encourage our members to consider including WNPS in their estate plans.



PHOTO: GLENN CARSTENS-PETERS ON UNSPLASH

The Wenatchee Valley Humane Society, near my home in Leavenworth, provides a good example of how powerful estate giving can be for an organization. Upon receiving a sizable estate gift, they were able to initiate construction of a new, state-of-the-art animal shelter that has made a big difference in the lives of the animals that pass through their doors. And recently, another estate gift initiated a fundraising drive that allowed them to build an onsite veterinary clinic, not only for animals in their care but also for pets whose owners cannot afford needed care. The transformation in the last ten years has been amazing. Imagine what similar gifts could mean for WNPS.

In our strategic plan we identified three goals: providing programs and resources for everyone, becoming a more inclusive organization, and building leaders. The “Youth Ecology Education Through Restoration Program” is one example of a new WNPS program that fits within the strategic plan. It is being piloted at five middle schools during the 2021-22 school year. Upon success, more funding will help scale it up to serve more middle schools in our state. And that is just one of the ideas that have come from focus groups and planning discussions. Most require additional funding, and an estate gift could be the boost needed to get a new program started or expand an existing program.

There are many ways to include WNPS in your estate plans, including naming WNPS as a beneficiary in your will, retire-

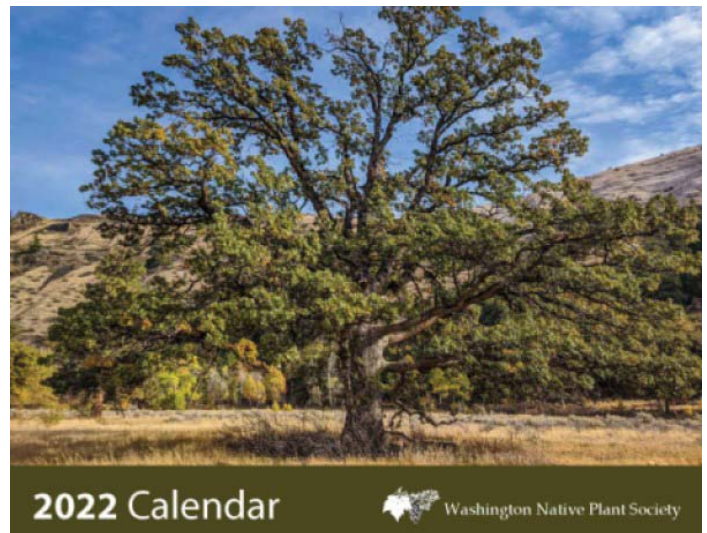
ment account, or life insurance policy. You may choose to direct your gift to the WNPS Endowment, which is a permanent fund that preserves your donation as capital and pays out earnings and capital gains to support research, conservation, and education projects of the Society. This year, the Endowment is providing \$10,500 toward projects. With each gift to the Endowment, it will be able to support more and more projects. You can also specify how WNPS should use your gift with a memorandum of understanding to document your wishes.

We want our members to live a long time, but we also know how important it is to plan for the future. By planning an estate gift to WNPS you can leave a legacy for native plants and the mission of the Society. If you have questions about estate giving to WNPS, please contact Denise Mahnke, our Business Manager at (206) 527-3319 or wnps@wnps.org.

Don Schaechtel is a past president of WNPS and chair of the fundraising committee.



WNPS 2022 Calendar



The WNPS 2022 Calendar is now available in the website online store for \$12.00 per calendar. <https://www.wnps.org/store/wnps-2022-calendar>

The WNPS calendar is a showcase for the top photos entered in the 2021 WNPS photo contest. Thank you to the photographers who submitted their beautiful and educational photos of our native flora.

Customer service is available to support check purchase by mail. To process this order, please contact Karen at 206-527-3210. Karen will provide a total order amount including shipping and sales tax.

Purchases by members support the member's chapter, with \$3.00 per calendar being sent to the chapter on February 1.



WNPS Fall Campaign

Do you donate to non-profit organizations through your work place? Consider WNPS in that gift. We are registered with Benevity Causes to support work place giving and matching gift opportunities to WNPS. Yes, that's twice the gift, with your contribution matched by your employer. In recent years many members are donating this way, doubling their gift for a big benefit to WNPS. Thank you! Find WNPS in the Ws in your workplace giving portal directory, or if your company uses Benevity: https://causes.benevity.org/content/washington-native-plant-society_



WNPS is registered with the Combined Federal Campaign for Federal Employees and that campaign is on now! Make your pledge with the CFC by January 15, 2022 to support WNPS all year. Again, find us in the Ws in the listing guide. Use #69374 to donate!

November 30th, 2021 is Giving Tuesday!



This year for Giving Tuesday, we are providing a gift to WNPS members with a webinar featuring updates on the Youth Ecology Education through Restoration program taking place in five schools around Washington. Meet Program Coordinators Janneke Petersen and Gretchen Graber and hear the early results being expressed by students and teachers as they implement this program in the classroom and in early field experiences. The webinar will be on November 30 from 3:00 to 4:00pm, <https://www.wnps.org/calendar/1427> or watch a recording which will be posted on the YEER program web page: <https://www.wnps.org/youth-ecology-education>.



**GIVING
TUESDAY**

Support Our Work

The Washington Native Plant Society depends on your support to deliver the mission of the society. Your help can make the difference and sustain the impact of WNPS into the future.

Become a Member

Join our community of plant lovers and be the first to learn about the programs in your area. Contact the office or go online at www.wnps.org/store-membership/membership.

Donate Online

You may donate any amount online through our secure website at www.wnps.org/donation/make-a-donation.

Donate through Your Workplace

- Workplace giving is an easy way to support WNPS.
- Federal Employees may donate through the Combined Federal Campaign—CFC # 69374. NEW! The CFC is now a giving option for retired Federal workers.
- Washington State Employees may donate through the Combined Fund Drive—CFD # 0315051.
- King County Employee giving—WNPS agency code #9600.
- Workplace matching gifts: Your employer may offer to match your charitable donations—and help your gift do more. contact your workplace's charitable giving contact.

WNPS Endowment Fund Giving

Endowment gifts are kept as permanently restricted fund as designated by the donors. This fund provides annual distributions that support the WNPS Grant programs in Research and Plant Inventory, Conservation and Education. Donations may be made in the following ways:

- Online at www.wnps.org/donation/endowment (and review our Endowment Policy www.wnps.org/bylaws-and-policies/state).
- By mail: Please make checks payable to WNPS Endowment Fund.

Make A Planned Gift

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

Here are examples of how to make a planned gift:

- Name the Washington Native Plant Society in your will.
- Make the Washington Native Plant Society a beneficiary to your IRA or life insurance policy.
- Name the Washington Native Plant Society as the beneficiary of a charitable remainder trust.

There are many other ways you can make a charitable gift through estate planning—consult your lawyer or financial planner.

Make A Stock Donation

WNPS can now support a transfer with a brokerage account.

Learn all the ways you can support WNPS at www.wnps.org/donate. For more information on giving options, call the WNPS office 206-527-3210.

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Subalpine larch (*Larix lyallii*), along with their close relative western larch (*Larix occidentalis*), are our only deciduous conifers. You’ll find subalpine larches at higher elevations, like these growing on the slopes above Blue Lake near Washington Pass and photographed in early October.

PHOTO: MARK TURNER

