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



President's Message: The View from Here

by Keyna Bugner

Dear WNPS Members,

For those that don't know me I would like to introduce myself. I grew up in a small town in eastern Kansas where most of my time was spent outside exploring tall grass prairie and woodlands. While I love the Midwest, I was ready to venture west for college. I earned a Bachelor of Science degree in Wildlife Biology from Colorado State University, where I really got interested in native plants. After graduating, I moved to the Pacific Northwest to conduct surveys for native and non-native plants, fish and Marbled Murrelet. After several field seasons I joined the US Peace Corps working with local communities teaching environmental education and helping to improve farming practices in Zambia, Africa. In 2008, I moved to Ellensburg and began working in the Natural Areas Program at the Washington Department of Natural Resources. I am currently the Natural Areas Manager for the southeast region where I get to conduct monitoring and restoration projects on some of the most amazing places in eastern Washington.

When I moved to Ellensburg, I wanted to get more familiar with the local native plants in Eastern Washington. I learned there was a native plant field trip sponsored by the WNPS Central Chapter. I showed up at the meeting location not knowing anyone, but the other folks were so welcoming I felt right at home. Best of all I found a group of people I could get excited about plants with and discuss the current Latin name for each plant species along the trail. The goal of the hike was not to



On the cover: Hedgehog Cactus (*Pediocactus nigrispinus*) in full bloom on the Whiskey Dick Wildlife Refuge. PHOTO: MARK TURNER

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get to the top of the mountain, but how many plants could we identify at the end of the day. It was on this field trip that I met one of my mentors, Don Knoke. He was so knowledgeable about the local plants I tried to absorb as much information as I could get from him. In 2015 I started serving as the Central Chapter Secretary/Treasurer. Since 2017 I have been on the WNPS Board of Directors, serving as Vice President for two years, and now as President. I am also the chair for the Human Resources Committee.

For the coming year there are a few areas I would like to focus on to strengthen the structure of WNPS and improve communication:

We are in full swing implementing our three-year Strategic Plan. The plan has three goals: create programs and resources for everyone, become a more inclusive organization and build leaders. These goals are a part of everything that we do. We are an organization that is primarily run by volunteers. Like any organization we need strong leadership in order to sustain our work. People come and go in various roles, but we need to make sure people feel comfortable to take on new assignments and provide the resources to support them.

Like many of our members, I would rather be outside leading a plant walk than sitting in a meeting or writing a report. In order to strengthen our organization we need members to do both. To make that event or plant hike a success we need members to maintain the website so we can attract participants, have strong leaders to lead the hike, and report that event so we can share information to our donors.

As part of the goal to build leaders and improve communication within WNPS there are two changes we are making this year. One is the formation of two councils; one for standing committees and one for chapters. These councils will meet occasionally throughout the year and provide opportunities to work together on similar projects, learn from others, share challenges and find ways to support each other. While we are a state organization I think our chapters and some committees don't always feel connected to what others are doing around the state. My hope is that these councils will help improve communication among chapters, committees, Board of Directors and the state office.

The other change is for the Board of Directors to meet more often. For several years the state board has met just twice a year, usually in person for six hours or more each meeting. First off that is a long time to sit in one setting for a meeting! Second we tried to fit a lot of business in those two meetings and in many cases we don't get to everything. It also involved a lot of travel for many directors. This year we have changed to having four board meetings per year, with at least three being via Zoom. While each meeting will be shorter, meeting more often will allow the board to respond in a more active way to improve the structure of WNPS. The board will also be able to get updates from the councils that they may not have received at previous meetings.

It's now been over a year since COVID was first found in the US. Since last March our lives have been drastically

changed and we find ourselves still living with some of the same restrictions we had last spring. While we had to quickly adjust our in-person events and cancel Study Weekend and Botany Washington, WNPS adapted and moved events online when possible. We utilized new virtual resources and improved our software and databases so that we could provide better online resources and reach a broader audience. We learned a lot last year and now we are in a better position to continue offering online webinars and workshops to provide resources for everyone. Thank you to everyone that contributed to leading a webinar or workshop as well as to those that participated. We want to continue to provide online opportunities so please share any ideas you have for an online event.

Lastly, this strategic plan has highlighted the need to increase staff capacity to support our members and conduct the business of WNPS. Denise and Elizabeth do great work and we could not accomplish what we have without them, but we have known for several years that we need to either increase paid staff or bring on more volunteers to support the work in the office. As we expand our programs we need to consider increasing paid staff to keep our organization strong.

Thank you everyone. I look forward to a great year with WNPS. I always appreciate feedback so please feel free to send me an email if you have any questions or comments: wnpspresident@wnps.org.



Smooth Prairie Stars (*Lithophragma glabrum*) at Catherine Creek in the Columbia Gorge. PHOTO: MARK TURNER

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From Forest to Florist: Harvesting Salal on the Olympic Peninsula

by Katherine Darrow

On a brisk November morning, a small crowd gathered outside the Quilcene Ranger Station for their chance in a seasonal lottery. Fifty people would be chosen to purchase a coveted 60-day permit to harvest salal (*Gaultheria shallon*), an evergreen shrub native only to the Pacific Northwest. Bundles of salal leaves are sold by the truckload to make wreaths, garlands and flower arrangements, bringing cheer from our local national forests to florists across the country and throughout Europe.

Most professional salal harvesters in our region today are Hispanic, so the lottery was conducted in Spanish. A local Forest Service employee picked numbered discs from a bag, and the winners were called out one by one. For Juana Jaime, *cincuenta y cuatro* (54) was her lucky number that day. I asked Juana if I could join her next time she went out to harvest. The following week, my husband Tom and I joined Juana and her husband Hugo to learn the art and craft of salal picking.



Hugo with bundles of salal. PHOTO: KATHERINE DARROW



Salal fruit among the leathery leaves. PHOTO: KATHERINE DARROW

We parked at a turnout near Mount Walker and walked up a steep narrow pathway onto a forested hillside that is part of the harvest area designated on their permits. Hugo has been harvesting salal, known as *brocha* in Spanish, for twenty years, having learned from his uncle when he was just 16. “I like this work a lot,” says Hugo, “because I like being in the mountains and I can be my own boss.” He and Juana are able to supplement their income by harvesting salal during eight months of the year as contractors for one of the numerous wholesale floral greens warehouses in Belfair, Washington. On a good day, an experienced harvester can easily meet the USFS daily quota of two hundred “hands” in a few hours. (One hand is about 25 stems or a $\frac{3}{4}$ lb. bunch.)

Each of us wore a few dozen thick rubber bands on our wrists, which are used to secure each bunch. Hugo and Juana waste no time getting to work, and before I’ve figured out how to pick and wrap one bunch, Hugo has harvested about a dozen. As he works his way through the forest, he drops each bunch to make a trail that he can backtrack, picking them up to create a larger bundle of 25 hands. After gathering them all into a pile, he pulls out a wad of orange twine from his pocket and deftly arranges and wraps the bunches together into 20 lb. bales that he can sling over his shoulders. After an hour, Tom and I contribute about 12 hands to their 63, making three full bales. Hugo had made sure to provide us with blue rubber

bands instead of the yellow ones he and Juana used, so that they could easily pick out our substandard beginner's work if necessary. We felt proud that our hands passed inspection.

Selecting a stem to pick is a skill in itself. When pickers are looking for a good area to harvest, they first do a brief survey to assess whether the stand is healthy enough to harvest quickly. If not, they'll move on to a different area. Florists want full green leaves without brown spots or signs of insect damage. Stems snap easily, so you don't need any special tools to cut them. The bottom leaves or any damaged leaves are stripped off to leave about a 16-inch long stem with five to nine leaves, keeping in mind that these are normally used in flower arrangements as an end product. There's a rhythm to the process once you get the hang of it.

It's not easy work. Besides finding perfect, unblemished sets of leaves, you have to navigate scrubby, rugged terrain full of downed logs and no clear trails. You must pay close attention to your surroundings so you don't get lost. Juana and Hugo are remarkably comfortable moving through the forest and seem to recognize each tree. Indeed, they have been here many times before, and are careful to not overharvest, leaving younger shoots to grow and branch out so that there will be plenty to harvest next season. Over the years, they have both accumulated a valuable store of local ecological knowledge that enables them to be excellent stewards of the land that we all depend on.

Salal is abundant and easy to identify. These robust shrubs have shiny, deep green, leaves on red-tinted stems. The size and shape of the leaves has earned the plant the alternate name "lemon-leaf." It forms dense thickets in the mixed coniferous forest lowlands throughout the Pacific Northwest from Alaska to northern California. In shady humid forests, salal can grow to more than two meters high. Along the edges of trails or in open sunny areas, it will form more of a ground cover. Where we were picking, the salal was waist to shoulder deep in the understory of Douglas-fir, red cedar and western hemlock forest.



Salal flowers. PHOTO: JOHN HASKINS

During warmer months between May and August, you can find elegant rows of pale pink, urn-shaped flowers dangling below the leaves. The Forest Service reserves summer months to let the plants put on new growth, flower and set fruit, so no harvests are permitted during that time. From August through October you can find deep purple-blue succulent berries where each flower once was, a bounty that supports many species of wildlife as well as people. Native Americans throughout the Pacific Northwest harvest the berries and reputedly prefer to eat them fresh after being dipped in whale or seal oil. They also

mashed them and made jam or cakes mixed with other berries to store for later consumption and for trade.

Nearly 20 Native American tribes live in the region that overlaps with salal, and each has a slightly different name for the plant. The S'Klallam tribe calls it *táqa?*, which sounds roughly like *taka* to an English speaker's ears. The names salal and shallon are derived from Chinook Jargon, a language that was commonly used by European and Anglo-American explorers during the 1700's and 1800's to communicate with tribes across North America. Botanists classify the species as *Gaultheria shallon*, combining the Chinook name with the honorable memory of 18th century French-Canadian botanist Jean Francois Gauthier.

No matter what you call it, salal is one plant every citizen of our region can easily learn to recognize. Not only can you enjoy harvesting and snacking on nutritious berries, you can make a simple, long-lasting bouquet of salal stems for your home any time of year. As a bonus, you can help support our local communities and the sustainable harvest of forest greenery on our public lands when you purchase holiday decorations and floral bouquets that include salal and other Pacific Northwest native plants.

For more information about non-timber forest product permits, including salal, visit this Olympic National Forest website: <https://www.fs.usda.gov/main/olympic/passes-permits/forestproducts>.

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This article was first published in The Port Townsend and Jefferson County Leader, November 25th 2020. Katherine Darrow is a natural history writer and serves on the board of the Olympic Peninsula Chapter of Washington Native Plant Society.



Mountaineering and Botanizing on the Ptarmigan Traverse: A Rare Plant Monitoring Expedition

by Jennie Green

Three experienced mountaineers accompanied a botany student with novice climbing skills through an alpine climbing route in the North Cascades of Washington. They did it for the mountains. I was searching for alpine azalea (*Kalmia procumbens*, or formerly *Loiseleuria procumbens*), a rare plant in Washington that has not been formally recorded in the state since its first observation in 1963. Finding the plant was the objective of my monitoring assignment for the Washington Rare Plant Care and Conservation Program, more familiarly known as Rare Care.



Kalmia procumbens. JEANNE R. JANISH, COURTESY OF THE UNIVERSITY OF WASHINGTON PRESS

I had the assignment for *Kalmia procumbens* in mind since winter of 2019, when I asked Stacy Kinsell, the Volunteer and Outreach Coordinator for Rare Care, if there were any monitoring assignments for an alpine plant. She told me about an assignment for alpine azalea located near a glacier on the Ptarmigan Traverse, an alpine climbing route that stretches from Cascade Pass in North Cascades National Park to the Downey Creek trailhead near Darrington, Washington. The project was a high priority because the last attempt to locate the plant was made almost two decades ago and was unsuccessful. The trip required traversing the glacier with all of the necessary mountaineering gear and skills that most Rare Care volunteers don't have. I told her that as it so happens, my partner, Abbott King, is an expert mountaineer and an entire room of our house is filled with ropes, ice axes, snow pickets and other technical climbing gear. Stacy shared my enthusiasm, and I walked away with a fire ignited in my stomach.

After I was given the assignment in March of 2020, the next step was to plan for backcountry travel along the Ptarmigan Traverse. The route also follows a portion of the border between the Mt. Baker-Snoqualmie National Forest and the Okanogan-

Wenatchee National Forest. Part of the planning required securing permissions from the United States Forest Service land manager. This had to be done well in advance of the trip because regulations for permitting backcountry travel had been altered since the COVID-19 pandemic started. Then, there was also the matter of jurisdiction over the plant site. I had vague descriptions of the plant's location on the ridge where the plant was last seen, and the area straddled both sides of the border between the two National Forests. By May, Rare Care had put me in contact with the land manager that requested the site visit and I was able to confirm my travel plans for August.

Phenology accounts for *K. procumbens* state that the flowering time in the north Cascades would likely occur in mid- to late-August. Finding this plant during its flowering period was imperative because otherwise it would be nearly impossible to identify among the meadows of pink mountain-heath (*Phyllodoce empetrifomis*) that would likely be growing in masses in the same habitat. The phenology also depended on climate patterns. It was entirely possible that in August the site would still be covered in snow because 2020 was not a drought year in Washington state. In fact, there was a lot of precipitation until about the first week of August, so I contacted several ranger stations around the area asking for snow reports. Normally they would be more informed of mountain conditions during peak climbing season, but because of COVID the offices were understaffed and no one knew about current conditions. Based on my research and predicted weather reports, and the schedules



Every day I had to remind myself to look at my feet, not the flowers, to avoid casualty. PHOTO: ABBOTT KING

of my climbing party (which had now increased to four), we started our five-day journey on the second Sunday of August.

Our goal for the first day was to reach a small alpine lake where we would spend our first night. The mountain meadows along our route were filled with wildflowers in peak bloom. I recognized great purple monkeyflower (*Erythranthe lewisii*), Sitka valerian (*Valeriana sitchensis*), and broadleaf lupine (*Lupinus latifolius* var. *subalpinus*). This was encouraging because it meant there would probably be flowers at the lake as well, which had a similar elevation and aspect to the ridge where the occurrence of *K. procumbens* had last been seen. In consideration of time and the patience of my travel party, I was only able to take a few photos of plants for later identification. In fact, I quickly learned that it was more important to pay attention to the terrain and the narrow footpath (when there was a footpath) instead of looking at plants. I had to remind myself to look at my feet, not the flowers, constantly over the next five days.

The assignment materials given to me by Rare Care mentioned that the lake was also the site of another occurrence of *K. procumbens* recorded in the same year. I searched the small area describing the location and did not find alpine azalea, but the environment gave me a better idea of what to expect when I reached the targeted plant site. The plant community was dominated by pink mountain-heath, which was about 60% in flower. The information I had in the materials for *K. procumbens* stressed the importance of finding flowers in its habitat, so the sea of pink gave promise for the days ahead. Unfortunately, loss of light and exhaustion prevented me from botanizing much more of the area around the camp.

The second day of the expedition tested my physical and mental strength. I won't give too much detail about the terrain, except for the narrow, roughly 200 feet of ledge carved into the vertical cliff face we crossed. Defying my previous rule of keeping my eyes on my feet, I didn't look down as I crab-walked along the 2-foot wide ledge. Instead, I focused on the mélange of plants thriving in the cracks of the shady cliff face: there were a few species of saxifrages (*Saxifraga*), a cliff paintbrush (*Castilleja rupicola*), and a tiny but sturdy-looking fern (probably *Woodsia*).

That evening we reached a pair of subalpine lakes where we would camp for the next two nights. The location is a short but steep distance to the ridge where 1963 observation of *K. procumbens* occurred. At this point our party decided to part ways. We would all go up to the ridge the next day, but my partner and I would spend the afternoon looking for the plant and then make our way back to Cascade Pass while our two friends continued on through to travel the entire Ptarmigan Traverse. I was glad to have the better part of the day to look for the alpine azalea and study the land, but I was sad to see our friends go.

The ridge proved to be a slightly different environment than the first lake because of the increased exposure to wind and sun. Pink mountain-heath and Mertens's moss-heather (*Cassiope mertensiana*) were the two most abundant shrubs and were both still in flower. There were small clusters of subalpine fir

(*Abies lasiocarpa*) and mountain hemlock (*Tsuga mertensiana*) in krummholz form. My partner and I searched for five hours over an area of approximately 2.3 acres and did not find *K. procumbens*. I spent some time scrutinizing an evergreen look-alike growing out of a large boulder that turned out to be Davidson's penstemon (*Penstemon davidsonii*). On a neighboring boulder there was a similar plant, but with spent flowers. Their distinctive tubular shape was indicative that it was a species of penstemon.



When not in flower, Davidson's penstemon (*Penstemon davidsonii*) can look similar to alpine azalea (*Kalmia procumbens*). PHOTO: JENNIE GREEN

Interestingly, the majority of plant diversity on the ridge came from the flowering plants growing out of rock outcrops. There was more cliff paintbrush, moss campion (*Silene acaulis*), golden fleabane (*Erigeron aureus*), and umber pussytoes (*Antennaria umbrinella*). I was fascinated to see the striking differences in plant communities of different habitats within the same environment: every crack of rock had a different flower, and any presence of soil was dominated by pink mountain-heath. However, there were several herbaceous plants poking through the heath, including bird's beak lousewort (*Pedicularis ornithorhynchos*) and subalpine fleabane (*Erigeron glacialis* var. *glacialis*). The extensive search, combined with the presence of



The remarkable scarlet bloom of cliff paintbrush (*Castilleja rupicola*). PHOTO: JENNIE GREEN



On the ridge at 6600 feet, where *K. procumbens* was last recorded in 1963. PHOTO: ABBOTT KING

the dominant heath species and passage of time since its last sighting all gave evidence that suggests *K. procumbens* is not at this location anymore.

A second night at the lakes allowed me some time to botanize the area for my own interest. The lakes were partly surrounded by dense growth of white rhododendron (*Rhododendron albiflorum*). The unfamiliar sight of this shrub combined with its abundant pale blossoms enthralled me. The plant is allelopathic, which may have explained its solitary dominance in large patches around the lakes. There was a stream running by our campsite and I was amazed at the diversity of plants growing in and on the bank. I must have counted at least a dozen different species in the microsites of this tiny stream. The most notable plant was the semiaquatic alpine butterbur (*Petasites frigidus* var. *frigidus*) thriving in the stream's current. There were also patches of subalpine monkeyflower (*Erythranthe caespitosa*) and sticky asphodel (*Triantha occidentalis* ssp. *brevistyla*).

Although disheartened at not finding *K. procumbens*, the splendor and incredible diversity at 6500 feet was extraordinary and worth every effort. The sight of the immense Cascade River



Subalpine monkeyflower (*Erythranthe caespitosa*) growing along the diverse microecosystem of an alpine lake outlet. PHOTO: JENNIE GREEN

valley framed by endless snowy peaks and glaciers brought me to tears, although my feelings were intensified after a scramble up the last 20 feet of a quarter mile high couloir. Climbing the glacier was a long slog under a bright sun. I used the rhythm of my feet and pondered a mysterious large red flower growing along the glacier to pass the time. The descent from the ridge involved careful steps through a lot of loose scree and hopes that a bear we had hollered away from our route wouldn't turn around and track us. Abbott and I traveled 24 miles with a total elevation gain of 11,800 feet. Our friends, Peter and Susan, navigated through the more difficult southern half of the Ptarmigan Traverse. My journey was made possible because of the members of my team, who were always there guiding me with encouragement and handlines.

Monitoring species for Rare Care provides information that is useful for land management strategies and conservation efforts. The program is supported by volunteers for population monitoring of rare plants of Washington state in many different ecosystems. In alpine ecosystems, plants and their associated animal species can be important indicators of climate change because they can be greatly affected by small changes in temperature and precipitation. *K. procumbens* is not a rare plant outside of Washington state. Its distribution in North America extends north into the mountain ranges of Alaska and is even found on the Aleutian Islands. It is possible that the evident disappearance of this species in Washington is due to significant changes in climate over the last several decades. It is important to continue monitoring alpine plant species, like alpine azalea, and alpine climate patterns to collect valuable data that will further implicate the effects of climate change.

The monitoring assignment is not complete until the paperwork is done. Rare Care has a field data sheet for each visit to a rare plant site, with detailed information including GPS coordinates, population distribution, phenology, site characteristics and associated plant species. Because *K. procumbens* was not found some of the form could not be filled out, but I included my interpretation of the few descriptions of the plant's location from a 1982 letter written by the original observer, Mary Fries. In her letter, written nearly two decades after the sighting, she describes the location of the plant in a few sentences. I studied maps and repeated the descriptions from the letter over and over in my head before, during, and after the site visit. I felt like a treasure hunter trying to decipher an ancient text to find where "X" marks the spot. The treasure I found was in the mountain views and the diversity of Washington's alpine plants. I look forward to the next adventure.

Jennie Green is a senior at Oregon State Ecampus and lives in Verlot, WA. She has been a WNPS member and a Rare Care volunteer since 2018. To learn more about how to volunteer with Rare Care, visit botanicgardens.uw.edu/science-conservation/rarecare.



What Ever Happened to Taylor's Draba?

The Search for Historical and Extirpated Plants in Washington

by Walter Fertig

It was already past the time we were supposed to return to camp, but the summit was so close, and the prospect of leaving the mountain without finding our quarry left me feeling as empty as my stomach. A couple of people in our party had already turned back following a brief afternoon storm. We were climbing Rock Mountain, high in the Okanogan Mountains near the Canadian border, as part of the 2018 Rare Care study weekend expedition looking for a suite of rare alpine and subalpine plant species tracked by the Washington Natural Heritage Program. The day had been a success, as we relocated pink agoseris (*Agoseris aurantiaca* var. *carnea*), slender crazyweed (*Oxytropis campestris* var. *gracilis*), snow cinquefoil (*Potentilla nivea*) and two rare sedges, *Carex media* and *C. scirpoidea*. Yet the grand prize still eluded us—a tiny mustard that no one had seen in Washington for 85 years. Maybe we could keep searching for another half hour.

The cause of all this commotion was Taylor's draba (*Draba taylorii*). Not much larger than a 50 cent piece, Taylor's draba is a mat-forming perennial herb with a dense cushion of gray basal leaves topped by short branches of 2-4 yellow, 4-petaled flowers and flat, elliptic fruits no more than 5 mm long. On June 19, 1933, local orchardist Charles Fiker made a collection of the species somewhere on Rock Mountain at 7,500 feet elevation. His specimen ended up at the University of Washington Herbarium where it was determined as *Draba paysonii* var. *treleasii* (now *D. novolympica*).

In the early 2000s, Ishan Al-Shehbaz of the Missouri Botanical Garden and Gerald Mulligan from Agriculture Canada began working on a revision of *Draba* for the *Flora of North America*. Al-Shehbaz and Mulligan examined some herbarium collections from the Cathedral Park area of southern British Columbia and noticed that the hairs on the leaves had an unusual crinkled shape, somewhat like the rack of antlers on an elk. This, and some other technical differences of the fruit and pollen, prompted the pair to name the BC plants as a new species in 2013, honoring the late Ron Taylor, a botany professor from Western Washington University. Ben Legler, then of the University of Washington, examined collections from the Burke Herbarium to see if any fit the new species, and discovered that Fiker's specimen from Rock Mountain was a match. Thanks to Legler (and Fiker!) Washington had a new species for the state flora, though one that was deemed "historical."

Conservation botanists take a special interest in species that have not been relocated for many years. NatureServe, the umbrella organization of state and provincial natural heri-



Taylor's draba (*Draba taylorii*) is a narrow endemic of alpine rock outcrops in southern British Columbia and northern Washington. Since being relocated at Rock Mountain in 2018, it has since been found on Middle Tiffany and Chopaka mountains in Okanogan County. PHOTO: WALTER FERTIG

tage programs, considers species historical if they have not been observed for 40 or more years. Often, historical species are obscure and known by just a few specialists. They may be extremely rare, or restricted to unusual habitats or remote locations, and thus easy to overlook. Sometimes the habitat of the species may have been significantly altered, and prospects for its continued survival seem bleak. If an historical species has been searched for repeatedly but not found, and its habitat has been lost, it is considered extirpated in the state. Should that species become extirpated in every state or province in its range, it would then be extinct.

Based on data from the Consortium of Pacific Northwest Herbaria and the state Natural Heritage Program, there are 145 vascular plant taxa (species and varieties/subspecies) that have not been observed or collected in Washington since 1981. Of these, 41 are introduced (non-native), and so not of concern to conservationists in the US (though conceivably they could be rare in their country of origin). Of the remaining 104 native taxa, 11 are potentially extirpated in the state and 93 are historical (see Tables 1 and 2).

A study published in the journal *Conservation Biology* in 2020 found that at least 65 plant taxa have become extinct in North America (excluding Hawaii) since the 1500s—a higher number than previously suspected. Richard Olmstead, Curator of the Burke Herbarium and a co-author of the paper, notes that nearly 2/3 of the extinct species were documented from a single location. Without herbarium specimens, these species might never have been known.

Washington state was formerly home to two plant taxa now considered extinct in the *Conservation Biology* study. Douglas's thistle milkvetch (*Astragalus kentrophyta* var. *douglasii*) was first collected by David Douglas in 1830 or 1833 on the Columbia River and then again by T.S. Brandegee and Tweedy "in sand" in the "Walla Walla Region" of

Table 1: Extirpated (last observed before 1981 or thought to no longer occur in the state due to habitat loss)				
Species	Common Name	Family	Year Last Seen	Notes
<i>Arenaria paludicola</i>	Swamp sandwort	Caryophyllaceae	1896	Tacoma swamps, Pierce Co; other reports probably erroneous; still extant in CA, Listed Endangered under ESA
<i>Astragalus diaphanus</i>	John Day milkvetch	Fabaceae	1920	Bingen area, Klickitat Co
<i>Astragalus kentrophyta</i> var. <i>douglasii</i>	Thistle milkvetch	Fabaceae	1883	"Great Bend of the Columbia River", Walla Walla Co?; variety presumed to be extinct
<i>Bergia texana</i>	Texas bergia	Elatinaceae	1922	Bingen & Almota, Klickitat & Whitman Cos
<i>Carex crawei</i>	Crawe's sedge	Cyperaceae	Pre 1850	Camp Colville, Stevens Co
<i>Carex davyi</i> (<i>C. constanceana</i>)	Davy's sedge	Cyperaceae	1909	Mount Adams, possibly Hellroaring Valley, Yakima Co
<i>Corispermum pallidum</i>	Pale bugseed	Amaranthaceae	1953	Sand dunes in Grant Co; WA endemic, may be extinct
<i>Eriogonum maculatum</i>	Spotted buckwheat	Polygonaceae	1884	Columbia Basin, Yakima Co
<i>Geranium oreganum</i>	Oregon geranium	Geraniaceae	1936	Lacamas Creek, Clark Co
<i>Lomatium tenuissimum</i> (<i>Tauschia tenuissima</i>)	Leiberg's umbrellawort	Apiaceae	1916	Hangman Creek, Spokane Co
<i>Microseris bigelovii</i>	Coast silverpuffs	Asteraceae	1983	San Juan Islands (San Juan Co), habitat destroyed at last known site

Washington Territory in June 1883. Like many early collections, the exact locality of these collections is unknown. What is known is that this matted, white-flowered legume has not been seen since and is presumed gone (several other varieties are still present over much of the western US). Pale bugseed (*Corispermum pallidum*), another sand dune endemic of central Washington, was last observed in 1953 and is thought to have been lost due to expansion of irrigated agriculture. Ironically, both of these species were not formally named by taxonomists until well after they disappeared: the *Astragalus* in 1964 and *Corispermum* in 1995.

Occasionally, extinct species come back from the dead—or more correctly are rediscovered by intrepid field botanists. Columbia milkvetch (*Astragalus columbianus*) had last been seen in 1922 above Priest Rapids when it was written off as extinct by the Smithsonian Institution in 1975. The following year, Ronald Sauer rediscovered the species in Benton County and in 1977 Joy Mastrogioseppe, Robert Smookler, and Sauer found another population above the Priest Rapids Dam on the Columbia River. Since then, it has been seen at nearly 20 other locations in the Columbia Plateau.

The same Smithsonian report also listed sticky phacelia (*Phacelia lenta*) as extinct, since it was only known from the type collection, made by T.S. Brandegee in May 1883. As with many specimens from the 19th century, the information from the herbarium label is minimal by modern standards, stating only "bare hills of Columbia River, Washington Territory." In the 1960s, an expert on the genus surmised that the

specimen may have come from the vicinity of Priest Rapids or Wallula, based on other collections by Brandegee around the same time. Ed Alverson was botanizing in the Rock Island Creek drainage south of Wenatchee in May 1981 and rediscovered this showy white-flowered plant with fern-like foliage growing in basalt outcrops above the Columbia River. Whether this was the same area where Brandegee found the plants is unknown, but the range of the species remains limited to an area of about 12 × 8 miles in Douglas County.

In just the past five years about a dozen historical species have been successfully relocated in Washington. Sometimes these species are found as part of targeted surveys focusing on documenting the flora of a specific area, and other times accidentally in the course of surveys of other rare plant species or just while recreating. For example, David Giblin rediscovered Cascade rockcress (*Boechera cascadenensis*) in 2014 while doing general plant collecting in the Chimney Peaks area of Okanogan-Wenatchee National Forest. This was the first observation of the species since 1933 when J.W. Thompson collected the type specimen. Four years later I found another population in the Blue Mountains while surveying some rare plant species on Griffin Peak and others have recently collected it at several sites in British Columbia. While preparing a revision to the state list of threatened, endangered, and sensitive plant species of Washington, I ran across recent photo vouchers of several "historical" species on iNaturalist (<https://www.inaturalist.org/>). These include sticky crazyweed (*Oxytropis borealis* var. *viscida*) photo-

Table 2: Historical (last observed before 1981, but habitat may remain and surveys are incomplete)				
Species	Common Name	Family	Year Last Seen	Notes
<i>Aconogonon phytolaccifolium</i>	Alpine knotweed	Polygonaceae	1977	Mt Adams area, Klickitat & Yakima Cos
<i>Acorus americanus</i>	American sweetflag	Acoraceae	1948	Newman Lake, Spokane Co
<i>Allium geyeri</i> var. <i>tenerum</i>	Geyer's onion	Amarylilidaceae	1952	Haney Meadows, Kittitas Co
<i>Androsace filiformis</i>	Slender rock-jasmine	Primulaceae	1908	Bingen, Klickitat Co
<i>Anemone drummondii</i> var. <i>lithophila</i>	Drummond's anemone	Ranunculaceae	1972	Hart's Pass, Sheep Mountain, and Olympic Mts, Clallam, Okanogan, & Whatcom Cos
<i>Antennaria pulcherrima</i>	Showy pussytoes	Asteraceae	1978	Asotin, Okanogan, Stevens, Whitman, & Yakima Cos
<i>Arabis olympica</i>	Olympic Mountain rockcress	Brassicaceae	1980	Olympic Mountains, Clallam & Jefferson Cos
<i>Astragalus laxmannii</i> var. <i>robustior</i>	Standing milkvetch	Fabaceae	1931	Okanogan, Pend Oreille, & Spokane Cos
<i>Atriplex argentea</i>	Silverscale orache	Amaranthaceae	1911	Douglas, Kittitas, Walla Walla, & Yakima Cos
<i>Boechera drepanoloba</i>	Soldier rockcress	Brassicaceae	1978	Tomyhoi Peak, Whatcom Co
<i>Boechera padoensis</i>	Mt Adams rockcress	Brassicaceae	1952	Mt Adams (Paddo) and E Cascades, Kittitas, Klickitat, and Yakima Cos
<i>Boechera paupercula</i>	Small-flowered rockcress	Brassicaceae	1934	Olympic Mts, Jefferson Co
<i>Brickellia microphylla</i>	Small-leaved brickellbush	Asteraceae	1948	Snake River Canyon, Asotin Co
<i>Brodiaea rosea</i>	Indian Valley brodiaea	Asparagaceae	1908	Pierce & San Juan Cos; Recent reports on iNaturalist appear to be <i>B. coronaria</i>
<i>Camissonia pusilla</i>	Little suncup	Onagraceae	1936	Douglas, Franklin, Grant, & Okanogan Cos
<i>Carex haydeniana</i>	Hayden's sedge	Cyperaceae	1913	Blue Mts, Garfield & Walla Walla Cos
<i>Carex nudata</i>	Naked sedge	Cyperaceae	1972	Bingen & White Salmon, Klickitat Co
<i>Caulanthus lasiophyllus</i>	Western wild cabbage	Brassicaceae	1890	Whatcom Co; reports from Clallam Co are misidentified
<i>Chenopodium fremontii</i>	Fremont's goosefoot	Amaranthaceae	1972	Grant & Okanogan Cos; more recent records are misidentified
<i>Chenopodium incognitum</i>	Gaping goosefoot	Amaranthaceae	1926	East Cascades, Chelan Co
<i>Chenopodium subglabrum</i>	Smooth goosefoot	Amaranthaceae	1972	Benton, Douglas, Grant, & Okanogan Cos
<i>Clarkia viminea</i>	Twiggy clarkia	Onagraceae	1893	Vancouver, Clark Co
<i>Coleanthus subtilis</i>	Moss-grass	Poaceae	1905	Bingen & Columbia River, Klickitat Co
<i>Cuscuta indecora</i>	Large-seeded dodder	Convolvulaceae	1964	Benton, Garfield, Klickitat, Okanogan, San Juan, Spokane, Stevens, & Whitman Cos
<i>Cyperus acuminatus</i>	Short-pointed flatsedge	Cyperaceae	1911	Bingen & Almota, Klickitat & Whitman Cos
<i>Delphinium occidentale</i>	Western larkspur	Ranunculaceae	1974	Columbia & Kittitas Cos
<i>Delphinium stachydeum</i>	Hedgenettle larkspur	Ranunculaceae	1967?	"SE Washington", reports from Lewis and Clallam Co need confirmation

<i>Delphinium sutherlandii</i>	Sutherland's larkspur	Ranunculaceae	1958	Pend Oreille, Spokane, & Stevens Cos
<i>Dodecatheon alpinum</i>	Alpine shooting star	Primulaceae	1970	Klickitat, Skamania, Whatcom, & Yakima Cos
<i>Draba crassifolia</i>	Thickleaved draba	Brassicaceae	1979	Clallam, Jefferson, Okanogan, Stevens, and Whatcom Cos
<i>Draba platycarpa</i>	Broad-pod draba	Brassicaceae	1927	Buffalo Rock & Bingen, Asotin & Klickitat Cos
<i>Eleocharis bella</i>	Delicate spike-rush	Cyperaceae	1928	Asotin, Klickitat, Spokane, & Whitman Cos
<i>Eleocharis geniculata</i>	Canada spike-rush	Cyperaceae	1892	Lake Chelan, Chelan Co
<i>Eleocharis uniglumis</i>	Slender spike-rush	Cyperaceae	1935	Grand Coulee, Grant Co
<i>Elymus curvatus</i>	Awnless wildrye	Poaceae	1902	Box Canyon, Pend Oreille Co
<i>Epilobium leptocarpum</i>	Slender-fruit willow-herb	Onagraceae	1980	Clallam, Grays Harbor, Klickitat, Lincoln, Pend Oreille, Pierce, Skamania, & Whatcom Cos
<i>Equisetum variegatum</i> ssp. <i>alaskanum</i>	Northern scouring-rush	Equisetaceae	1980	Jefferson, Klickitat, & Whitman Cos
<i>Erigeron caespitosus</i>	Tufted fleabane	Asteraceae	1924	Kittitas & Whitman Cos
<i>Eriogonum cernuum</i>	Nodding buckwheat	Polygonaceae	1970	Sand dunes, Benton Co
<i>Eriogonum ovalifolium</i> var. <i>ovalifolium</i>	Cushion buckwheat	Polygonaceae	1944	Chumstick Mountain, Chelan Co
<i>Eryngium articulatum</i>	Beefthistle coyote-thistle	Apiaceae	1916	Hangman Creek & Pullman, Spokane & Whitman Cos
<i>Erysimum inconspicuum</i>	Small wallflower	Brassicaceae	1973	Okanogan & Stevens Cos
<i>Erythranthe ampliata</i>	Nez Perce monkeyflower	Phrymaceae	1949	Grande Ronde River, Asotin Co.
<i>Erythranthe inflatula</i>	Disappearing monkeyflower	Phrymaceae	1916	Bingen & Latah Creek, Klickitat & Spokane Cos
<i>Erythranthe jungermannioides</i>	Liverwort monkeyflower	Phrymaceae	1892	Bingen, Klickitat Co.
<i>Hesperostipa comata</i> ssp. <i>intermedia</i>	Intermediate needle-and-thread	Poaceae	1932	Omak & Phileo Lake, Okanogan & Spokane Cos
<i>Hordeum pusillum</i>	Little barley	Poaceae	1951	NE of Wawawai, Whitman Co
<i>Hosackia gracilis</i>	Seaside birdsfoot-trefoil	Fabaceae	1968	Grays Harbor, Klickitat, & Mason Cos
<i>Ipomopsis congesta</i> ssp. <i>congesta</i>	Ballhead gilia	Polemoniaceae	1937	Spokane River, Spokane Co
<i>Kalmia procumbens</i>	Alpine azalea	Ericaceae	1963	Chelan & Skagit Cos
<i>Lepidium nitidum</i>	Shining pepperwort	Brassicaceae	1974	Klickitat & Pierce Cos. Recent reports in iNaturalist are misidentified
<i>Lipocarpha occidentalis</i>	Western halfchaff sedge	Cyperaceae	1886	Conboy Lake area ("Falcon Valley"), Klickitat Co.
<i>Lomatium sandbergii</i>	Sandberg's biscuitroot	Apiaceae	1973	Muckamuck Lookout & Roundtop Mountain, Okanogan & Pend Oreille Cos
<i>Lonicera cauriana</i>	Bluefly honeysuckle	Caprifoliaceae	1886	Skamania & Yakima Cos
<i>Lupinus lepidus</i> var. <i>cusickii</i>	Cusick's prairie lupine	Fabaceae	1974	Columbia & Walla Walla Cos; confirmation needed
<i>Lupinus lepidus</i> var. <i>utahensis</i>	Utah prairie lupine	Fabaceae	1933	Moses Meadows, Okanogan Co

<i>Lygodesmia juncea</i>	Rush skeletonplant	Asteraceae	1974	Okanogan & Spokane Cos
<i>Malvella leprosa</i>	Alkali-mallow	Malvaceae	1951	Franklin, Okanogan, & Yakima Cos
<i>Melica aristata</i>	Awned melic	Poaceae	1883	Mt Adams, Skamania Co
<i>Microseris laciniata</i> ssp. <i>leptosepala</i>	Slender-bracted silverpuffs	Asteraceae	1939	Cowlitz, Grays Harbor, Klickitat, Pierce, Skamania, Thurston, & Yakima Cos
<i>Muhlenbergia minutissima</i>	Littleseed muhly	Poaceae	1898	Klickitat, Spokane, & Yakima Cos
<i>Muhlenbergia racemosa</i>	Satingrass	Poaceae	1972	Chelan, Okanogan, Pend Oreille, Whitman, & Yakima Cos
<i>Oenothera flava</i>	Long-tubed evening-primrose	Onagraceae	1884	Yakima River, Yakima Co.
<i>Orthocarpus luteus</i>	Yellow owl-clover	Orobanchaceae	1980	Kittitas, Klickitat, Lincoln, Okanogan, Pend Oreille, Spokane, Whitman, & Yakima
<i>Oxalis suksdorfii</i>	Western yellow wood-sorrel	Oxalidaceae	1977	Clark, Kitsap, & Klickitat Cos
<i>Oxytropis deflexa</i> var. <i>sericea</i>	Pendent-pod locoweed	Fabaceae	1933	Wauconda, Okanogan Co
<i>Ozomelis diversifolia</i>	Varied-leaved mitrewort	Saxifragaceae	1974	Bingen, Husum, & White Salmon, Klickitat Co
<i>Pedicularis bracteosa</i> var. <i>siifolia</i>	Bracted lousewort	Orobanchaceae	1928	Anatone, Asotin Co
<i>Penstemon lyallii</i>	Lyall's penstemon	Plantaginaceae	1974	Columbia? & Pend Oreille Cos
<i>Perideridia oregana</i>	Oregon yampah	Apiaceae	1920	Cape Horn, Skamania Co
<i>Physaria didymocarpa</i>	Common twinpod	Brassicaceae	1934	Echo Valley, Okanogan Co.
<i>Physaria occidentalis</i> ssp. <i>occidentalis</i>	Western bladderpod	Brassicaceae	1899	Mt Adams, Yakima Co.
<i>Poa bolanderi</i>	Bolander's bluegrass	Poaceae	1967	Columbia, King, Klickitat, Snohomish, Wahkiakum, Whatcom, & Yakima Cos
<i>Poa pratensis</i> ssp. <i>agassizensis</i>	Kentucky bluegrass	Poaceae	1970	Lake Chelan, Chelan Co.
<i>Poa reflexa</i>	Nodding bluegrass	Poaceae	1937	Kittitas & Yakima Co.
<i>Polygonum achoreum</i>	Blake's knotweed	Polygonaceae	1975	Penrose Beach, Pierce Co.
<i>Polygonum californicum</i>	California knotweed	Polygonaceae	1927	Bingen & Major Creek, Klickitat Co
<i>Potentilla gracilis</i> var. <i>brunnescens</i>	Glandular cinquefoil	Rosaceae	1959	Asotin, Garfield, & Stevens Cos
<i>Potentilla newberryi</i>	Newberry's cinquefoil	Rosaceae	1898	Bingen, Klickitat Co.
<i>Pyrola elliptica</i>	White pyrola	Ericaceae	1968	Mt Chuckanut & Mt St. Helens, Skagit & Skamania Cos
<i>Salix vestita</i>	Rock willow	Salicaceae	1965	Colchuck Lake & Mt Baker area, Chelan & Whatcom Cos
<i>Schoenoplectus heterochaetus</i>	Slender bulrush	Cyperaceae	1977	Gooseberry Flat, Kittitas Co
<i>Sphenopholis intermedia</i>	Slender wedgegrass	Poaceae	1963	Klickitat, Spokane, & Yakima Cos
<i>Sporobolus neglectus</i>	Small dropseed	Poaceae	1916	Spokane River, Spokane Co
<i>Stellaria humifusa</i>	Low starwort	Caryophyllaceae	1978	Grays Harbor & Pacific Cos (report from Snohomish Co is erroneous)

<i>Suaeda nigra</i>	Bushy seablite	Amaranthaceae	1905	Bingen, Klickitat Co
<i>Symphyotrichum falcatum</i>	Creeping white prairie aster	Asteraceae	1922	Klickitat & Okanogan Cos
<i>Taraxacum scopulorum</i>	Alpine dandelion	Asteraceae	1934	Mount Baker, Whatcom Co
<i>Thelypodium howellii</i> ssp. <i>howellii</i>	Howell's thelypody	Brassicaceae	1965	Yakima & Vantage area, Grant & Yakima Cos
<i>Trifolium albopurpureum</i>	Rancheria clover	Fabaceae	1900	Bingen, Klickitat Co
<i>Trifolium bifidum</i> var. <i>decipiens</i>	Pinole clover	Fabaceae	1911	Bingen, Klickitat Co
<i>Trifolium eriocephalum</i> var. <i>eriocephalum</i>	Woolly-head clover	Fabaceae	1972	Clark, Klickitat, & Skamania Cos
<i>Trifolium plumosum</i>	Plumed clover	Fabaceae	1980	Kooskooskie & Mill Creek, Walla Walla Co.

graphed in the Olympic Range by Peter Zika, Mount Lassen draba (*Draba aureola*) from Mount Rainier by Matt Below, and Snake River baby blue-eyes (*Nemophila kirtleyi*) by Alex Wright. Additional rediscoveries have come from the Consortium of Pacific Northwest Herbarium website (<https://www.pnwherbaria.org/>), including Washington monkeyflower (*Erythranthe washingtonensis*) collected by Paul Slichter on Mount Adams.

Unfortunately, not every search for an historical or extirpated species ends in success. This past year I spent several days in waders mucking about swamp and marsh areas of Joint Base Lewis McChord and Carlisle Bog trying to relocate swamp sandwort (*Arenaria paludicola*), our only federally Endangered missing plant species in the state. Swamp sandwort is reliably known only from an 1896 J.S. Flett collection from “swamps near Tacoma.” More recent collections have all proven to be misidentifications of related species in the Caryophyllaceae, usually northern starwort (*Stellaria calycantha*) or boreal starwort (*S. borealis*). Tacoma resident and former state botanist John Gamon thinks that Flett may have collected his specimen from Flett Creek in the Lakewood area (where the Fletts ran a dairy), but so far this area has not been searched. The species is probably extirpated in Washington, but still occurs in coastal wetlands in San Luis Obispo County, California, and from central Mexico to Guatemala.

Tables 1 and 2 contain lists of the vascular plant species currently recognized as extirpated or historical in Washington. Many botanists may not realize that these species have not been reported in recent years. Some of these may have already been documented in unmounted specimens or unlabeled photos. Hopefully the list will spark an interest in rediscovering these species. If you do find any of these plants take some photos, record the location, and share the information with your local herbarium, the Washington Natural Heritage Program, or on iNaturalist so we can winnow the list of historical species down even more!

Back on Rock Mountain, my partners and I kept heading to the summit, still hoping to relocate Taylor's draba. Our

progress was slow, in part because we found several *Draba* species on the way and carefully keyed each one out in hopes it was *D. taylorii*. Janka Hobbs located a possible specimen under a small rock ledge, but it turned out to be Yellowstone draba (*D. incerta*). Near the summit I got excited about a yellow-flowered draba peeking out of a vertical ledge, but was crestfallen to key it readily to Trelease's draba (*D. novolympica*) with the revised *Flora of the Pacific Northwest*.

We finally reached the top and a small weather station. While I checked out a promising ledge on the north side, I heard Kelli Van Norman call out that she had found a *Draba*. Hopping over the boulders I dropped over the east rim onto a series of stair-like ledges with krummholz whitebark pine and juniper. Kelli pointed to some small silvery mounds and I immediately had a good feeling. I pulled the mangled photocopy of the *Draba* key from my pack and proceeded to eliminate species that did not match. With my 30× hand lens I could easily see the crinkly elk-antler hairs. I congratulated Kelli on being the first person in Washington to see *Draba taylorii* in the wild since Charles Fiker. We took photos, counted plants (there were only about 25 present), recorded the location with a GPS, described the plant community and terrain, and then started down the mountain. Back in camp we had a great story to tell and could report there was one less species on the historical list in Washington.

Walter Fertig is the state botanist for the Washington Natural Heritage Program in Olympia and chair of the Douglasia editorial committee. He promises a shout-out in Douglasia for every reader who successfully rediscovers an historical or extirpated plant species.

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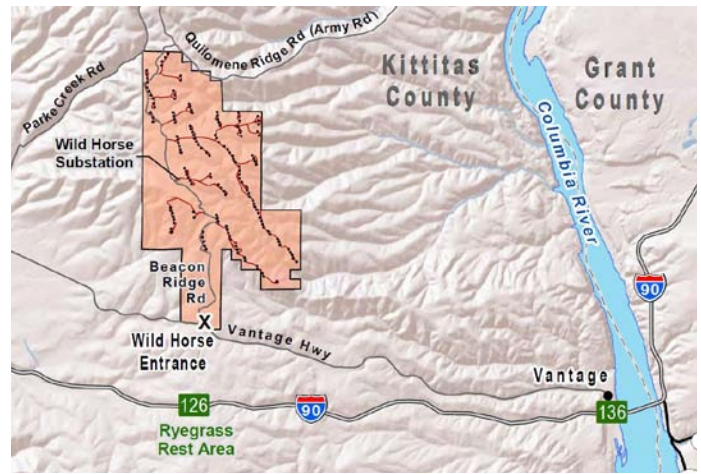


Figure 1. Location of Wild Horse Wind Farm.

WNPS Grant Completion Report – Part 1

Phenology of *Pediocactus nigrispinus* in the Shrub Steppe of Central Washington

by Ron Bockelman

Early in 2018 I started studying *Pediocactus nigrispinus* at Puget Sound Energy’s (PSE) Wild Horse Wind Farm east of Ellensburg as a retirement project. After several years first photo-documenting the flora at this site and then collecting herbarium specimens, I was ready for a new challenge and reason for continuing my botanical forays into the sagebrush steppe.

Hedgehog cactus (snowball and dark-spine ball cactus are other common names) seemed like an ideal candidate for study. It can be observed year-round, except when covered by snow in winter (a season not particularly appealing in my retirement). Unlike most other plants, this cactus can be easily photographed in the windiest of conditions, which are common at wind farms. It is a regional endemic, Washington’s only *Pediocactus* (Bockelman 2020), and a Species of Concern tracked by the Washington Natural Heritage Program (WNHP 2019).

Much of what has been published about *P. nigrispinus* relates to its distribution or taxonomic status as a distinct species, still sometimes a controversial topic. Information about its biology and ecology is mostly limited to field observations in books self-published by Fritz Hochstätter (1995, 2007). These are supplemented by anecdotal articles on Washington populations by Dixie Dringman (2009, 2013, 2014), a local cactus enthusiast and long-time crusader for the protection of this species from unscrupulous collectors. The limited information about hedgehog cactus in Washington is summarized in an online rare plant fact sheet (WNHP 2005). These sources did not answer some of my questions about the natural history of this species, so I began shifting my focus from cactus distribution and abundance to studying its biology and ecology.

Wild Horse Wind Farm (Figure 1) is an excellent study area for sagebrush steppe and shallow rocky soil (lithosol) habitats. Not only are hedgehog cacti widespread throughout the wind farm, but many patches are also reasonably accessible (by authorized users) from the network of gravel roads used to service and maintain the wind turbines. However, the site is relatively secure from vandalism and disturbance because PSE controls vehicular access to the roads, recreational access is regulated by a permit system, and wind farm workers are visibly present year-round. Its main disadvantage is a personal one—the 2-hour drive from my home. Luckily, I found some wind farm staff and other locals interested in helping me, who we informally dubbed the Wild Horse Wind Cactus Team (Team).

In March 2019 the WNPS Research and Inventory Committee awarded me a grant to partially fund research on phenology, seed germination, and seedling development of hedgehog cactus. This article summarizes the preliminary results for phenology. Part 2 of the grant completion report, discussing other study components, will appear in a future *Douglasia* article.

Phenology

Phenology is the timing of life history events, such as flowering, over the course of a plant’s yearly life cycle. Understanding plant phenology is important in evaluating and forecasting potential effects of climate change. An excellent study example in our state is the University of Washington’s MeadowWatch program at Mount Rainier National Park (<http://www.meadowwatch.org/>). This citizen science project has volunteers record the timing of flowering, fruiting, and seed production while hiking trails through the park’s beautiful alpine wildflower meadows.

To document hedgehog cactus phenology, we field tested a photo-monitoring method using square PVC frames placed around 21 solitary plants and multi-stemmed clumps, in patches distributed throughout the wind farm. The frames measured 0.5-m × 0.5-m and had marks at 1-cm and 1-dm intervals for measuring cactus diameter from photos (Figure 2). Starting in April 2019, we took digital photos ap-

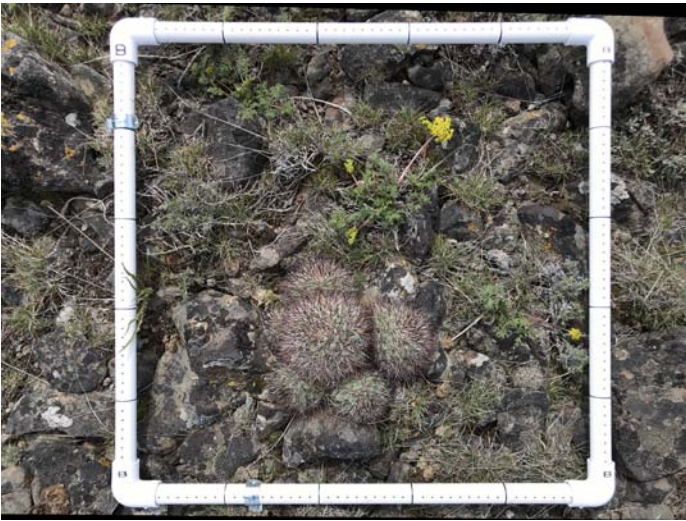


Figure 2. PVC phenology frames were secured with spikes and brackets (left) or rocks (right) if the soil was too shallow. PHOTOS: JENNIFER DIAZ AND KRISTIN ASHLEY

proximately every week during spring 2019 and 2020 and monthly during summer and autumn 2019 (Figure 3). Over 500 photos were digitally processed to correct any distortion in perspective and to make them a uniform size and rotation

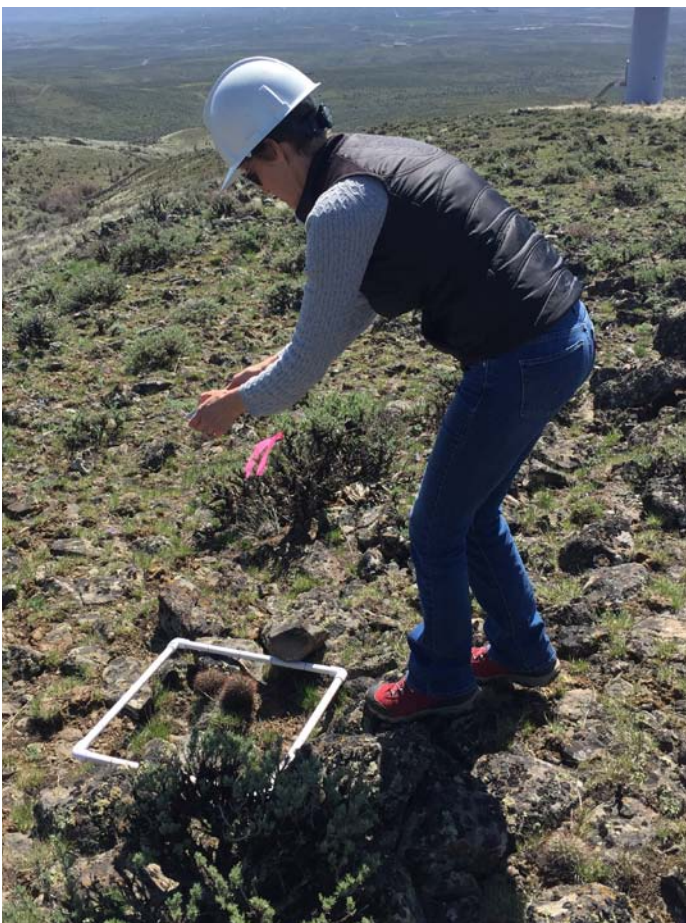


Figure 3. Fixed frames made it quick and easy for Team members (Jennifer Diaz) to take phenology photos. PHOTO: ANDREA CRAWFORD

for analysis.

Based on the phenology results for 2019, most cacti at Wild Horse emerged from winter dormancy by early April, although some plants still had a slightly shrunken, dark



Figure 4. In early April, cacti often still have the dark reddish-brown color typical of winter dormancy. PHOTO: RON BOCKELMAN



Figure 5. Buds are easily seen on this multi-stemmed clump in early May 2019. PHOTO: JENNIFER DIAZ

	Year	Earliest Date (#)	Most Plants (#)	Latest Date (#)
Buds	2019	4/6 (3)	4/24 (14)	5/17 (1)
	2020	4/9 (4)	4/23-24 (20)	5/19 (1)
Flowers	2019	5/2 (1)	5/8-9 (12)	5/23 (1)
	2020	4/24 (5)	4/28-5/1 (15)	5/28 (1)

Table 1. Phenology results for buds and open flowers. Latest date for buds indicates the last date buds were not obscured by flowers on a cactus. Number of plants in each category are in parentheses.

reddish-brown appearance (Figure 4). Buds became evident and enlarged in April (Figure 5), with most cacti displaying them during the second half of the month (Table 1). Some cacti never formed buds or flowers even though they were large enough to be considered mature.

New spines develop concurrently with the buds, both forming from new areoles produced by the apical meristem at the top of the cactus stem. New spines appear red and quite short initially (Figure 6). New whitish tissue around them makes these spines more conspicuous, but buds and flowers tend to hide them. At Wild Horse they are usually visible in late April on stems without buds, but not until after flowering otherwise.

Hedgehog cacti at Wild Horse typically flower in the first half of May, usually within a week of Mother's Day. In 2019 flowering started at the beginning of May and continued for three weeks. Flowering in 2020 started and then peaked about ten days earlier than in 2019 (Table 1). The difference in 2020 may have been due to mild winter and early spring temperatures, as recorded at AgWeatherNet (WSU 2021) stations east and west of Wild Horse near the Gorge Amphitheater in Grant County and in Ellensburg, respectively. Interestingly, flowering



Figure 6. New spines are short and red. They are easier to see if buds or flowers are not present. PHOTO: KRISTIN ASHLEY

continued until late May 2020, rather than ending after three weeks.

Figure 7 illustrates flowering of one particular cactus in 2019 and 2020. The first flower was just opening on May 2, 2019, whereas in 2020 half of the flowers were already open on April 24. All flowers were spent on May 17 in 2019 versus May 7 in 2020.

Spent flowers change color from pink to cream to tan as they wither while the fruit develops (Figure 8). Fruits remain relatively inconspicuous in phenology photos because they are



Figure 7. Collage of cropped phenology photos showing flowering of one cactus in 2019 and 2020. PHOTOS: WILD HORSE WIND CACTUS TEAM



Figure 8. Spent flowers turn from pink to cream (such as these) to light tan while the fruit develops. PHOTO: RON BOCKELMAN



Figure 9. It was unusual to see fruits in the phenology photos because the spent flowers often hid them. PHOTO: RON BOCKELMAN



Figure 10. When ripe in late June or early July, the mature fruit splits vertically so the seeds can gradually spill out. PHOTO: RON BOCKELMAN

obscured by the spent flowers, which remain attached even after seeds are released (Figure 9).

Fruits split vertically to release seeds in late June or early July, approximately six weeks after flowering (Figure 10). Seeds are sometimes visible (Figure 11) on top of the cactus after the fruits fall or are blown off in July (Figure 12), especially if there is dense woolly pubescence on top of the plant to hold them.

Tubercles (conical protruberances with spines) on hedgehog cactus allow the stem to expand or contract in response to the amount of water stored. Although plants tend to reach maximum diameter between flowering and seed release, changes are relatively minor through spring and summer when compared to those associated with winter dormancy. In autumn the stems shrink 10-15% in diameter by mid-November (Figure 13). Changes in stem height cannot be measured with the photographic methods used in this phenology study.



Figure 11. Black cactus seeds are most conspicuous when they occur on woolly pubescence. PHOTO: RON BOCKELMAN

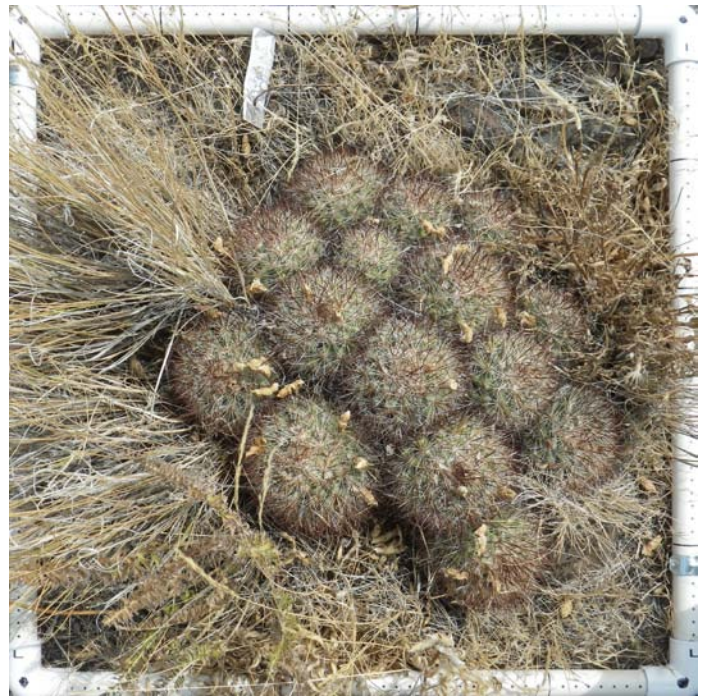


Figure 12. Empty dry cactus fruits are conspicuous on plants and around them in mid-summer. PHOTO: RON BOCKELMAN

High elevation appears to be a factor delaying the onset of flowering by *P. nigrispinus*, most likely through its effect on spring warmup. At Wild Horse, hedgehog cacti flowered about one week later at elevations over 3600 ft (1100 m) than those in other phenology patches. Dringman (personal communication) found that cacti on Babcock Bench (elevation about 1200 ft, 365 m) usually start flowering in mid-April, but a week or two earlier after mild winters. In 2020 photos of flowering cactus from that general area appeared on the internet during the first week in April.

This preliminary phenology study found the following:

PVC frames were not dislodged by grazing cattle nor by wildlife.

Installed PVC frames allowed Team members to take phenology photos with minimal instruction and appear to have great potential in citizen science monitoring studies.

Cactus diameter can be estimated from the phenology photos at an accuracy of 0.5 cm.

Except for large multi-stemmed clumps, smaller frames (e.g., 0.25 × 0.25 meter) are adequate to photo-document the phenology of individual plants.



Figure 13. Cactus shrink between October (left) and November (right) as they prepare for winter dormancy. PHOTOS: RON BOCKELMAN

Weekly photos (or observations) may not be frequent enough to accurately establish baseline phenology for monitoring effects of climate change.

Using these study methods, monitoring the onset and duration of flowering is more accurate for assessing potential effects of climate change than the formation of buds, new spines, and fruits (all of which are somewhat obscured by other plant features), and more precise than the onset or breaking of winter dormancy (which appears to be a gradual process).

Future phenology studies might focus on:

Small PVC frames fixed around easily accessible cacti near the Wild Horse Renewable Energy Center, where PSE staff and visitors normally are present daily and could take photos.

Time lapse photography conducted annually throughout the onset and duration of spring flowering for a few selected cacti.

Different methods, photographic or otherwise, to document when fruits split and release seeds.

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Our Native Flora: Past, Present, and... Possibilities

by Eric G. DeChaine

Setting the Baseline

Our world is changing. And our collective perception of what's *normal* or *natural* shifts with it. The environmental changes are typically slow enough, subtle enough, that they are unseen by each new generation. The decline of nature befalls unnoticed until the baseline of what was *natural* is forgotten. It passes into the realm of myth and legend. Subsequent generations create new definitions of *natural*, based on the environmental conditions in which they grow up. And through this process, the standards for acceptable environmental conditions erode away. These shifting baselines (Pauly 1995) and the associated cultural acceptance keep us from recognizing and correcting environmental issues (Soga and Gaston 2018).

Today, we stand on the precipice of unforgettable, and unforgivable, change. According to the recent UN Report (IPBES 2019) "Nature is declining globally at rates unprecedented in human history—and the rate of species extinctions is accelerating, with grave impacts on people around the world." Look around. You will find that we are now deep within Earth's 6th Mass Extinction—wherein the current rate of global species extinctions is 10-100× higher than the average of the last 10 million years, and accelerating (IPBES 2019). We humans are colliding with the natural world just as a certain asteroid did 65 million years ago. Indeed, the current extinctions are largely due to 1) changes in land and sea use (anything from clearing forests to urbanization), 2) direct collecting and exploitation of organisms, 3) climate change, 4) pollution, and 5) invasive species.

In order to appreciate what we have already lost and how far our baseline has shifted, we must rely on historical accounts—the descriptions of early explorers and data archived in museum collections. We must set the baseline in the past. David Douglas saw a very different Pacific Northwest in the early 1800s: vibrant valleys encircled by unmeltable blue glaciers, brown bears lumbering through endless meadows, enchanting forests of impossibly huge conifers, torrential rivers flooding with salmon, and rich estuaries resounding in the cacophony of opportunity. If we looked through his eyes, what we would witness would today seem like a world of hyperbole. A dream-scape. One we couldn't trust to be real. But that is the one and true baseline from which all change should be measured - the Pacific Northwest (PNW) in its *natural* state (Nisbit 2009). A place we don't know.

Shifting into the Present

All you have to do is glance out your window as you cruise down I-5 to see that the environment of the PNW has been altered by humans. We have changed the natural world, and it would be ever more immoral for us to let the baseline slip. A

baseline, after all, is a starting point or the initial set of conditions—the original threshold from which we can measure change. And, because we are interested in the natural environment, the baseline should remain set to the time of early explorers like David Douglas, for those are our first detailed accounts of the natural world herein.

That then begs the question: How far has our baseline shifted? Many of us hold on nostalgically to the enchanting realm of Douglas, but those expectations do not fit with what we see around us. We struggle to reconcile the difference. We seek secluded natural places that match the old descriptions. Our hearts ache for the immense forests, the boundless prairies, and the productive estuaries, though we have never truly experienced them.

The unfortunate reality is that we are a generation of blackberry pie bakers. After all, what is more emblematic of the PNW these days than Luther Burbank’s invasive Himalayan blackberries (*Rubus bifrons*)? They snuck in under the guise of easy-growing, juicy fruits. But, they proved to be anything but easygoing. By the early 1900s, they were thriving throughout the Puget Sound. Nowadays... well, they’re hard to escape. We native-flora lovers despise the invasive blackberries. We rip them out of the ground at every opportunity. We proudly display battle scars from their bacteria-laden thorns like badges of eco-courage. But, odds are, that by late summer we will all be baking fresh blackberry pies. It’s the ... er ... *natural* thing to do.

Survey and Monitor (SAM) Project

So, my students and I set out to reconcile the gap between the perceived and actual baseline through our botanical Survey and Monitor (SAM) Project. The SAM project is an attempt by the Pacific Northwest Herbarium (WWB) at Western Washington University (WWU) to record changes in the occurrences and distributions of plants native to the PNW. We aimed to determine 1) how much the native flora of the PNW has changed over the past 200 years—changes in species distributions and occurrences of population extirpations, 2) what factors are driving the decline, and 3) what that may mean for the future of our native flora.

To address this, we first examined historic herbaria records for approximately 900 species of flowering plants in Oregon and Washington and determined their population locations through the process of computer mapping or georeferencing. The process of georeferencing involved 1) searching the Consortium of Pacific Northwest Herbaria (CPNWH) database for specimen records, 2) reviewing the location information, and 3) estimating geographic coordinates for the populations. Once we were confident of the locations, we (a cadre of students at WWU) personally revisited those sites to confirm the presence or absence of the historic populations.

We then generated *extinction slopes*. Here, I must emphasize that our analyses are preliminary because we still have a lot of data to collect yet and more robust analyses to be performed. We used the presence/absence data from our fieldwork to esti-

mate the extinction slope of a species (where a slope = 1 means that the populations are stable and anything less than 1 means that populations are disappearing, and 0 would mean that they are already gone). A staggering 79% of the species we searched for had an extinction slope < 1, indicating the species has experienced population extinctions. Though there is undoubtedly some sampling error in that estimate, it shows that populations of native plants in the PNW have been lost.

Finally, we performed linear regression analyses on the extinction slope against a suite of variables to determine which of those factors were tied to plant population extinctions. Like I said, our preliminary results are not conclusive but they are informative. The variables we examined included changes in climate, such as shifts in temperature and precipitation, and land-use changes, such as freeways and tree farms, etc. These initial results should be viewed as a prelude to a greater understanding of what might be going on with the native flora of the PNW.

The simplest way to think about the numbers in the Influential Factors Table (Table 1) is to remember that R is the correlation between the predicted values from the model (our variable of interest, such as proximity to I-5) and the observed values of the data we collected (presence/absence of plant populations). The higher the value of R, the stronger the relationship.

The correlations show us that the factor most closely tied to plant population loss was 3G cell towers (measured as bars on phone used for recording data; R=0.42). That converts to an

Potentially Influential Factors Affecting Population Extinctions	
Factor	R
Latitude	0.11
Longitude	0.07
Elevation	0.12
Flora Population	0.26
30 Year Temperature Change	0.25
30 Year Rainfall Change	-0.16
70 Year Annual Maximum Temperature Change	0.21
Phenology	0.28
Insects Observed	0.24
Birds Observed	0.19
3G Strength	0.42
Distance from State DNR, Private Tree Farms	0.23
Distance from Federal Forests, Parks	0.00
Distance from Columbia River	0.01
Distance from I-5 Freeway	0.03
Distance from Asphalt	0.05
Washington Rare Status	0.33
Global Rare Status	0.27

R is the correlation coefficient signifying the strength of the relationship between the factor and the extinction slope.

$R^2 = 0.21$. Thus, 3G signals were 3x more powerful as a predictor of a native plant extinction slope than any other measure gathered (excluding those already listed as rare). One possible explanation is the negative impacts of electromagnetic radiation (EMR) on species, which has been shown for a wide range of flora and fauna (Malkemper et al. 2018). In plants, EMR causes significant changes at the molecular and cellular levels. Our preliminary data suggests that it could be affecting entire plant distributions. An equally plausible explanation is that the cellular signal strength is a proxy for the degree that humans have disturbed the local landscape. And 5G, which employs shorter wavelengths, is on the way with increased threats to the flora and fauna.

In addition, changes in climate are influencing the native flora of the PNW, including temperature increase ($R=0.25$), annual max temperature change ($R=0.21$), phenology ($R=0.28$, later summer flowers appear to be more affected). These findings are not surprising in light of the multitude of other studies demonstrating species responses to climate change. We need to better understand the impacts on all the plants across our region and how changes in one species affect others. But, it is important to note that climate was not the best predictor of the extinction slope. So, we should not limit our focus to climate change but rather broaden it to examine all aspects of human-induced environmental changes.

Proximity to DNR and private tree farms ($R=0.23$) were also important. The tree farm data are interesting in that it may have something to do with the differences in herbicide spraying and management strategies. We are working to get more information on this.

Interestingly, bird and insect observations (somewhat anecdotal in our data collection procedure) were also related to the extinction slopes. One might expect that as the plants go, so go the pollinators and their predators.

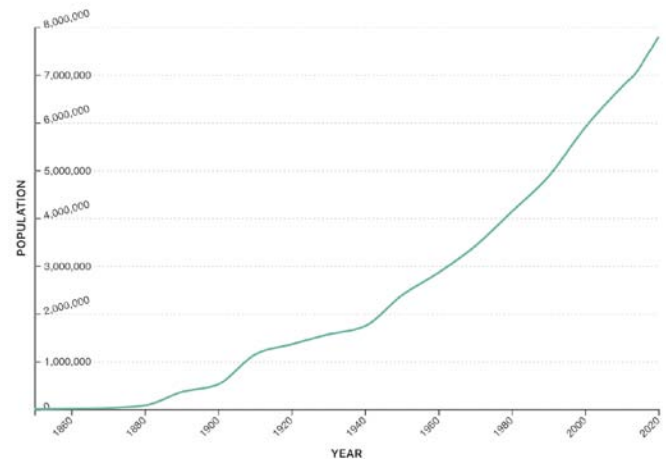
Finally, the flora population factor (a measure of the ease of locating species; $R=0.26$), WA Rare ($R=0.33$), and Global Rare ($R=0.27$) show that plants that are difficult to find have an extinction slope < 1.0 , which is not surprising. On the one hand, this demonstrates a sampling bias—the harder taxa are to find the more likely they will not be found. On the other hand, this shows that rare and endemic taxa, those species that make this region unique, are at most risk and need continued priority in management considerations.

Implications for the future

These drivers of plant demise are our fault ... and it is likely to get worse. Much worse. Not only may the Pacific Northwest experience a 3°C increase in mean annual temperature over the next century, but our human population is growing exponentially. We are projected to top out near 11 billion people by the year 2100 (Cilluffo and Ruiz 2019). Over the next 30 years, the population of Washington state will probably reach 8.9 million, with migration accounting for about 59% of that increase (World Population Review: <https://worldpopulationreview.com/states/washington-population>).

Washington Population 2020

7,797,100



Population growth curve for Washington. The rapid growth of Washington's population will have dramatic consequences on the natural environment. SOURCE: WORLDPOPULATIONREVIEW

[com/states/washington-population](https://worldpopulationreview.com/states/washington-population)). To put this in perspective, Washington became a state in 1889 with a population of just about 350,000. That's less than half of Seattle's current population. One hundred years later (by 1989) the population had exploded to 4.9 million. That number is expected to double by the year 2039 (a timespan of just 50 years). What will be the impact of our population explosion on our already fragmented environment?

How will our collective baseline shift? The extinction trajectories may become reality. And, by shifting our baseline those tragic stories will become acceptable and go largely unnoticed by future generations of Northwesterners. The true natural environment of the PNW would fade into the fog of myth and legend.

Imagine the hopeless perspective of the parental native plant, sending your seeds out from your cozy island-like plot across a soil-less sea of pavement, well-weeded croplands, and herbicide-laden timber cuts that constitute the PNW. Further loss of diversity across the region is the likely outcome. And that directly affects us. "The health of ecosystems on which we and all other species depend is deteriorating more rapidly than ever. We are eroding the very foundations of our economies, livelihoods, food security, health and quality of life worldwide." (IPBES 2019)

Possibilities

But wait! It's Spring, the time of renewal. Isn't there something we can do? We can see how much our natural world has changed from the days of Douglas. We can conserve and protect what remains. If we accept that we are responsible for the demise of the environment then we must also be accountable. I mean not only accepting culpability but also striving to make amends. And I believe that through proper stewardship we can provide more than just hope.

We could assist plants in their movements among habitat patches and by so doing, increase their chances of survival. The controversial concept of assisted migration (AM) generally refers to intentionally moving species outside their historic ranges. Assisted migration was introduced in the 1980s as a potential means of assisting organisms with specialized climate needs or poor dispersability to migrate across a landscape fragmented by insurmountable human-induced obstacles (Peters and Darling 1985). The major benefits of AM are to prevent extinctions and protect biodiversity particularly for poor dispersers by moving individuals across unnatural barriers in fragmented landscapes, facilitating ecosystem services such as interactions and remediation, and augmenting genetic fitness, along with socioeconomic benefits. The risks are irreversible impacts of invasions, changing ecosystem properties through interactions, potential genetic impacts, a bias towards ‘valued’ species, and diverting conservation resources from the cause to treating the symptom (Hewitt et al. 2011). Scary consequences.

But, AM can also take a lighter form: assisted population migration or moving seeds across barriers to locations within the species historic range. This approach poses the lowest threat to current biological communities. It could provide huge benefits for species and the ecosystem, while minimizing the risks. Even within species ranges, we would have to 1) rely on historical barriers and avoid any movement of plants into isolated areas (such as the Olympics), 2) consider sensitive/endemic taxa and avoid introducing plants to their areas due to potential competition (especially from close relatives that could supplant the endemics through competition or hybridization), 3) protect sensitive habitat and avoid moving plants into areas already under ecological stress (e.g., Mima Mounds), and 4) focus on assisting plants with the greatest need (those experiencing population loss or heavily impacted by human-induced factors). Assisted population migration is an option to consider. But we must rely on the experts, such as Washington Natural Heritage Program, Rare Care, National Park Service, etc., to determine if and when it is the right thing to do.

The one thing we can and must do is get young people involved and enamored with our natural world so that they can ‘perceive’ changes from the true baseline, witness the wonderful world around them, and see that there is hope for the future. As one of the SAM botanists put it “The diversity of life on our planet is stupendous and working as a field botanist continually inspires me to try and protect the wonder that I see all around.” Failure to get more young people involved in the preservation of our native flora, fauna, and ecosystems will have devastating economic and environmental consequences throughout the PNW.

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Nature in Seclusion. Overlooking the Hoh River from high in the remote Bailey Range of Olympic National Park. PHOTO: ERIC DECHAINE

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The Polemoniaceae (Jacob's-ladder Family) and How to Distinguish Some of its Members in Washington

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

Here in Seattle it seems that spring begins in mid-January. As I write there are three shrub species blooming in our garden (none of them native) and an assortment of bulb species have pushed their leaves through the soil surface. The buds on our Indian plum (*Oemleria cerasiformis*) are swelling and will soon be flowering. By April spring colors abound, and I errantly assume the same is true across the state. Without fail I will then journey to the Columbia Basin in the hopes of seeing an abundance of spring wildflowers, only to be disappointed by a brown, largely still-dormant sagebrush flora. Disappointed but not deterred, I'll return in late April and early May to find what I was seeking, and when I do I am always delighted to see several common members of the Polemoniaceae (Jacob's-ladder family) that for me mark the season and help characterize the landscape.

As far as plant families go, Polemoniaceae is not particularly large, with about 85 genera and nearly 400 species. By way of comparison, the pea family (Fabaceae) has nearly 800 genera and 19,000 species. In terms of geographic distribution, Polemoniaceae occur largely throughout western North America, but also range as far west as Eurasia and as far south as South America. Interestingly, there are no tree species in the Polemoniaceae—only herbs, shrubs, and vines. In a phylogenetic (evolutionary history) context, the family appears to have evolved about 40–50 million years ago, so it is relatively young (the earliest flowering plant families appeared about 130 million years ago). Several of the most closely related families to Polemoniaceae are almost exclusively tropical, though some are well represented in the temperate world (e.g., Primulaceae [primrose] and Balsaminaceae [touch-me-not]).

In Washington we have 13 Polemoniaceae genera comprising a total of 54 species and 12 subspecies or varieties. Remarkably there are no non-native Polemoniaceae species in our flora! It is hard to think of another family of this size in Washington for which the same is true. Our understanding of the evolutionary relationships of genera within Polemoniaceae, particularly in western North America, has been extensively rewritten by results from a series of molecular studies over the past 25 years. Perhaps most notable in terms of Washington's flora is that several species previously assigned to the genus *Gilia* have been scattered among multiple genera that include *Aliciella*, *Ipomopsis* (scarlet-gilia), *Lathrocasis*, and *Microgilia*.

I find Polemoniaceae as a family fairly easy to recognize due to a unique combination of floral traits that are remarkably



Figure 1. *Polemonium micranthum* (annual Jacob's-ladder) showing fused petals with five lobes, and five anthers surrounding a three-parted stigma. PHOTO: GERRY D. CARR

consistent among its members. The leaves aren't particularly helpful for family recognition because members have either alternate or opposite leaf arrangements (sometimes both on the same plant), and the leaves themselves can be either simple or compound. The fruits also are pretty non-distinct—dry capsules that dehisce (split open) when ripe. Polemoniaceae is most easily recognized by having flower parts in 5s (five sepals, five petals, five anthers), the petals are fused, the anthers are attached to the sides of the petal (i.e., not at the base), the ovary is superior, and the stigma is divided into three parts (Figure 1). Perhaps the best spring wildflowers in which to observe these traits are in species of *Phlox*, *Polemonium*, and *Collomia*, which have particularly large flowers that make close examination easier.

Speaking of *Phlox*, two of my favorite spring-blooming sagebrush species are in this genus, and at first glance they can be difficult to distinguish. *Phlox longifolia* (long-leaved phlox) and *P. speciosa* (showy phlox) share the same flower color (pink to white), growth habit, and habitat. You can find either of these species loosely growing among branches of sagebrush (*Artemisia tridentata*) shrubs or forming loose to dense patches in ponderosa pine forest openings. They both flower from late April to late May.

So how do we tell them apart? One difference that is often suggested is that *P. speciosa* has a notch at the tips of petals and *P. longifolia* is entire to irregularly notched. I've looked at enough plants in the wild and photos online to know that this distinction is not entirely reliable. You can see for yourself among the pictures of these two species at the Plants of Washington Image Gallery (<https://biology.burke.washington.edu/herbarium/imagecollection.php>). The easiest way to distinguish them is to pick a flower, pull the fused petals out of the sepals (the petals should come out as a unit), and examine the



Figure 2. *Phlox longifolia* with style about equal to the sepals. PHOTO: BEN LEGLER



Figure 3. *Phlox speciosa* with style much shorter than the sepals. PHOTO: ROBERT L. CARR

length of the style (the slender tube connecting the tip of the ovary to the three-parted stigma). In *P. longifolia* the style is long (as in the beginning of the species name)—nearly reaching or exceeding the tips of the sepals (Figure 2). In *P. speciosa* the style is short (“s” of short is for *speciosa*)—you’ll need to look down into the sepals to see the three-parted stigma (Figure 3). The flowers of these species are large enough that you shouldn’t need a hand lens to see these differences.

There are some other co-occurring, spring-flowering Polemoniaceae that might be confused and are also worthy of closer examination. *Microsteris gracilis* (annual phlox) might seem similar in appearance to *Collomia tinctoria* (yellow-staining trumpet-flower). However, *M. gracilis* has at least some opposite leaves near its base and the sepals are all of the same length, while *C. tinctoria* has alternate leaves throughout and sepals of different lengths.

Taking time to try and recognize plant families while out on spring hikes is a great way to add an additional dimension to your enjoyment, understanding, and appreciation of our native flora. If nothing else, it is simply a good reason to open up a flower and see how the parts are arranged inside!

David Giblin is Collections Manager and Research Botanist at the University of Washington Herbarium, where he conducts fieldwork throughout Washington to document the diversity and distribution of its flora. He also manages the Plants of Washington Image Gallery and Washington Flora Checklist.



Whitebark Pine Proposed for Listing as Threatened Under the Endangered Species Act

by Walter Fertig

“At first, as one ascends any of the Canadian and Montana Rockies, or the Cascades of Washington and Oregon, the white-bark [pine] is found in the company of western white and lodge-pole pines, alpine larch, alpine fir, alpine hemlock, and Engelmann spruce. One by one it drops them behind in its ascent, for of all the trees in its range it is the most completely alpine. And at last it stands, or rather creeps and struggles, alone, rooted in desolate mountain rocks, its limbs on the windward (western) side dismantled, its stems foreshortened to a height of three or four feet; its limber branches so intertwined you can walk upon them.”

This is how Donald Culross Peattie summarized the range, habitat, and growth form of whitebark pine (*Pinus albicaulis*) in his 1950 classic *A Natural History of Western Trees*. Peattie could not have foreseen at that time the current troubles that have befallen this iconic timberline tree. Although still widespread in the mountains from southern British Columbia and Alberta to California, and northwestern Wyoming, populations of whitebark pine have decreased by more than 50% in the past two decades from disease and beetle predation (USFWS 2020). Under additional threats from climate change, wildfire, and plant succession, the long-term prognosis for this species is



Whitebark Pine (*Pinus albicaulis*) at Ingalls Pass on the Okanogan-Wenatchee National Forest with Mt. Stuart behind. PHOTO: MARK TURNER

so poor that the US Fish and Wildlife Service proposed listing whitebark pine as Threatened under the US Endangered Species Act in December 2020.

Whitebark pine has white bark when it is young, but is best recognized by its fascicles of five needles and purplish cones which break up at maturity to release large, edible seeds. While its trunks can grow straight and up to 70 feet tall in sheltered, subalpine sites, whitebark pine is often stunted and crooked at timberline, forming “krummholz”, with branches all pointing in the direction away from the ever-present wind. Whitebark pine is an important component of the upper treeline in slowing the runoff from melting snow, holding soil, and providing shelter for wildlife. The edible nuts, rich in protein, are a critical food source for grizzly bears and Clark’s nutcrackers.

Stands of whitebark pine have been decimated by the double whammy of white pine blister rust (*Cronartium ribicola*), a non-native fungal pathogen, and infestations of mountain pine beetle (*Dendroctonus ponderosae*). Blister rust grows within the sugary phloem tissue below the bark of stems and trunks and can ultimately starve a 500-year-old tree by interrupting food transport between needles and roots. Mountain pine beetles are native in the west and usually occur at low numbers that are controlled by cold winter temperatures. As the climate has warmed, beetle outbreaks have become more common and large numbers of beetles can overcome a tree’s natural defenses. Holes bored in wood by the beetles also serve as a point of infection for fungi. The death of mature trees reduces the number of cones and seeds available to replenish the population (and feed hungry grizzlies and nutcrackers). Dead trees are also more vulnerable to wildfire, which in turn threatens surviving trees. Modeling of recent mortality rates and ongoing environmental stressors suggest that whitebark pines in western National Parks are likely to decrease an additional 25% in the coming century (Jules et al. 2020).

If listed, whitebark pine would only be protected from physical harm on federal lands. Interstate and foreign commerce in whitebark pine products (wood and nuts) would also be prohibited. Continued research and management of whitebark pine stands would be allowed on federal lands to promote habitat restoration and fire management. No critical habitat has been proposed as part of the rule. To learn more about whitebark pine and the listing proposal, consult www.fws.gov/mountain-prairie/es/whitebarkpine.php.

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Environmental Advocacy in the Biden/Harris Era

Clay Antieau, Past-President, WNPS, and Member, WNPS Conservation Committee

Becky Chaney, Director, WNPS, and Chair, WNPS Conservation Committee

As our country observes its every-four-years rhythm of changing administrations, how might we focus our collective and individual environmental advocacy in the months and years ahead? Our country has experienced challenges to the validity of scientific findings and inquiry over the past four years as the U.S. has become increasingly polarized. Through political appointments, executive orders, isolationism, erosive rhetoric, and other methods, the Trump administration attempted to constrain and politicize the free pursuit of knowledge and scientific inquiry and limited the use of science in informing national policy and strategies that serve the public good. The Biden/Harris administration has promised to respect the practice of science as it seeks to pursue evidence-based policy decisions. It is our responsibility to hold them to it.

Obviously, not all mis-understandings and mis-representations of science are malicious. Likewise, in a democracy, many diverse considerations belong at the decision-making table along with scientific insights. However, actions taken during the last four years have adversely affected native plants and the habitats and resources on which countless other organisms rely—including humans. While we have been buoyed by the depth of knowledge, diligence, and solidarity of the nation’s scientific community in resisting these efforts, real damage has been done and must be acknowledged.

Proposed and enacted reductions in federal agency budgets, including the Environmental Protection Agency (EPA), U.S. Forest Service, U.S. Fish and Wildlife Service (USFWS), and National Oceanic and Atmospheric Administration, among others, confirms an adversarial attitude toward sustainability science and environmental protections. Rollback of more than 125 environmental statutes, regulations, rules, and guidance has been closely tracked and analyzed by numerous and diverse organizations, including the Ecological Society of America (<https://www.esa.org/>), the American Institute of Biological Sciences (<https://www.aibs.org/>), and the Environmental Data and Governance Initiative (<https://envirodatagov.org/>). Those actions have weakened protections for wildlife, water, and air and the regulation of chemicals and greenhouse gases. Notable examples particularly relevant to plant and animal life include:

- re-definition of “waters of the U.S.” protected under the Clean Water Act and Rivers and Harbors Act that reduces the number and kinds of federally protected wetlands and watercourses;
- elimination of the cumulative and indirect impacts disclosure requirements of the National Environmental Policy Act,

which will have important ramifications for transparency, environmental justice, and the federal government's management of greenhouse gas emissions; and

- the 11th-hour decision by the USFWS to remove Endangered Species Act critical habitat protections from 3.4 million acres of Oregon old growth for the northern spotted owl, with an expected result of increased timber harvest in these irreplaceable forests and increased risk of extinction for the owl.

While the nation is being forced to confront and manage multiple challenges—from a worsening pandemic, to a devastated economy, to a civil rights reckoning—we believe we have much hope on the horizon with the arrival of the Biden/Harris administration. Writing on Inauguration Day, we are heartened that President Biden proposes new, bold, collective, and inclusive action to address these challenges. Particularly noteworthy is his promise to mainstream and integrate climate change issues into his agenda across all cabinet departments. His nominations of Michael Regan to lead the country's EPA and Dr. Deb Haaland to lead the DOI—highly qualified and credentialed candidates—demonstrate a compelling commitment to inclusion and environmental justice.

There is much discussion and analysis about how to correct course or reverse the environmental damage that has been wrought. Remedies might include legislative actions (Congressional Review Act), executive actions (such as executive order rulemaking that results in revised regulations or guidance), or judicial actions (such as litigation). While specific details are yet to come, all indications point to a federal government capably staffed and laser-focused to rapidly mobilize and act on climate change, protection of public lands, and conservation of biodiversity. This is contingent, as always, on the American people demonstrating strong support of these imperatives.

Respect for science is the foundation of WNPS's commitment to the appreciation and conservation of Washington's native plants and their habitats through study, education, and advocacy. Advocacy includes, but is not limited to, endorsements, statements, scientific research, and intervention activities that support the protection of native plant diversity, native habitats, and associated ecosystem services. We must continue to be ever vigilant and to advocate ever more strongly that scientists, science practitioners, and rigorous scientific analysis are essential to policy-making at all levels of government.

As an organization, WNPS has not, and will not, align itself with a particular political view or party; we recognize that a diversity of views exists among WNPS members. We hope many of you will find these reflections useful as you consider how to react to recent political and civil developments in the U.S. and as you contemplate how you can personally advocate for the protection of the natural resources and biological diversity on which all members of our global community ultimately depend.

The perspectives and opinions expressed in this article are the authors' and do not necessarily represent the official policy or position of WNPS.

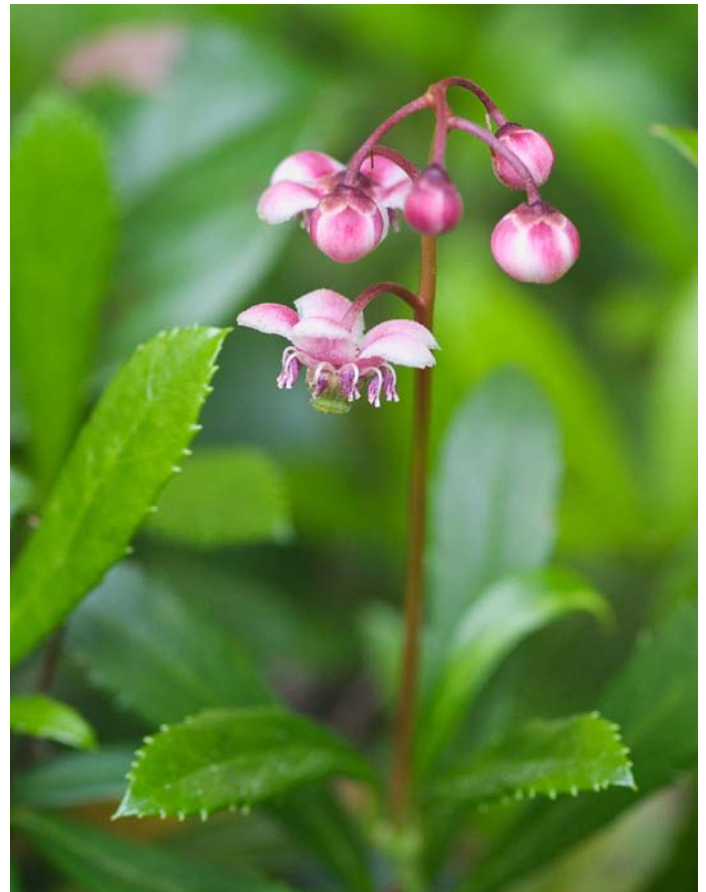


Sawtooth Ridge: Accessible Spine of the Wenaha-Tucannon Wilderness Area in Southeastern Washington

by Emil Doyle

The Wenaha-Tucannon Wilderness Area (like much of the northernmost Blue Mountains) consists of steep, basaltic, deep and rugged V-shaped canyons that, for the most part, gather together the headwater springs, streams and forks of the Wild and Scenic Wenaha River, itself a tributary to the Grande Ronde and Snake Rivers of the immense Columbia River Watershed. Truly, when one stands in a muddy spring's trickle high up in the Blue Mountains, it's hard not to get crystal visions of our earth's pulsing water cycle. Even though the ocean reservoir of it all is too distant to make out, you can somehow sense that your Vibram soles are gooshing into its very beach.

The interiors of this wilderness are remote, and of course that's the way it should be, but the Sawtooth Ridge trail traverses one of its taller ridgelines, as an undulating dogleg for 4 miles, of various elevations between 5,600' and 5,800', before its steady 10 mile, 3,000' descent to the Wenaha River. Subal-



Pipsissewa (*Chimaphila umbellata*). PHOTO: MARK TURNER

pine fir and Engelmann Spruce are the predominant conifers of the forested benches along the ridgeline, which alternately open up to rocky, wind-blown balds where hearty plants cling to basalt dust and cryptobiotic crusts, with east/west views and Oregon's Wallowa Range on the southeastern horizon.

During my first chilly visit here in November 2016 we hiked briskly, slogging through the occasional shaded snow drifts, while a pack train of successful elk hunters returned past us from the river valley bottom. While nothing was in lingering bloom, the persistent evergreen foliage of familiar favorites insured my future forays. The succulent whorl of striped rattlesnake plantain leaves (*Goodyera oblongifolia*), the slightly obdeltoid, toothed leaves and persistent stalks with fruit capsules of the sub-shrub pipsissewa (*Chimaphila umbellata*), and the cold adapted, still fragrant but curled-up leaves of snowbrush (*Ceanothus velutinus*), were just a few hooks that grabbed me. I was hoping to catch at least one of the very last asters of the season, but I missed that train. Normally there are at least two of these late-persisting lavender beauties, the densely methodically rayed glacier fleabane (*Erigeron glacialis*) and the more 'ragged' and sparsely rayed thick-stemmed aster (*Eurybia integrifolia*) with its reddish and sticky glandular upper stems and phyllaries.

I will not make claim that this location is the ultimate cornucopia of Washington's botanical diversity, yet in a recent issue of *Douglasia* (Summer 2020), Dr. Walter Fertig did point out that the Blue Mountains, the smallest of Washington's 9 ecoregions, has at least 848 native and 171 introduced plant species, 39 which occur only in the Blues. But this said, I think that the first thing a native plant lover will notice soon upon arrival, on a warm early summer day, will be the many welcoming patches of the phlox family member Nuttall's linanthus (*Leptosiphon nuttallii*), whose mats at first appear to be made up of whorls of many needle shaped leaves, but upon closer examination, the stems are actually composed of opposite, sessile, palmate leaves made of many tightly clustered narrow leaflets. Flowering persists at least until early August. And one thing I have come to expect is that each time I hike Sawtooth, just when I think that I have seen all its offerings, I spot something new that I'd previously overlooked.

While preparing to lead a WNPS field trip there in 2019, I decided to take the unmarked side trail leading to Lady Spring. Water, especially in the Blues, indicates the possibility of finding additional species. In a moist, grassy forest opening, I located what at first appeared to be our common giant-head clover. However this plant, wooly-head clover (*Trifolium eriocephalum* var. *arcuatum*) had a clearly erect stem without the leaf blotching pattern, and a smaller inflorescence but with similar, very noticeable plumose calyx bracts. While I repacked my *Flora* a reclusive pine marten hopped along a nearby down-fall, and when I rejoined the main trail, there was a chorus of yelping and barking which I want to believe was a pup from one of our wolf packs, but could have been a coyote. Surprises and possibilities!

Multiple trailside opportunities are presented to compare the two beardtongues that share the words "blue + mountain" in their common names. Blue Mountain penstemon (*Penstemon venustus*) has pointy-toothed leaves and the uniquely distinct character of hairs along the filament stalk, while Blue Mountain beardtongue (*P. pennellianus*) has entire pointed leaves. But beware, there are at least 5 additional blue/purple penstemons on Sawtooth, so review anther dehiscence in the *Flora* and observe carefully!

Lastly, the story of severe wind battering on the open, rocky balds is told by the stature of their plants. Krummholzed subalpine firs (*Abies lasiocarpa*) make little islands or line the forest edges like warped dock pilings. The thin patches of basalt soil are held in place by lichens and mosses such as the hair-cap moss (*Polytrichum pilferum*), as well as by wind and dry-adapted plants such as balloon milk-vetch (*Astragalus whitneyi*) with outrageously purple-speckled pods, and dense-leaf whitlow-grass (*Draba densifolia*) bearing curled-up clusters of leaves with stiff, branched hairs. The gorgeous double-bent awns of Lemmon's needlegrass (*Achnatherum lemmonii*) grab attention, but occasionally this pristine image will be shattered by a trailside sprig of the showier but invasive medusahead grass (*Taeniatherum caput-medusae*). After all, this is a trail traveled by humans. And in scattered clumps on these blustery slopes you will find sulfur buckwheat (*Eriogonum flavum*), and hitching a ride on some of these buckwheat sites, looking like towering steeples, will be stems of white coiled-beak lousewort (*Pedicularis contorta*), whose favorite hosts are in the genus *Eriogonum*.

Hopefully this little botanical tour along Sawtooth Ridge is adequate enough to entice you to make your own little journey down here and see for yourself. Trail traffic is minimal, and you'll likely have most of it to yourself, especially on weekdays.

IF YOU VISIT (June*-September — *snow conditions on FS64/46 will determine actual accessibility): Go South on S. 4th Street from Dayton which becomes North Touchet Road, leading into Umatilla NF as FS64 (aka Skyline Drive). Continue past the turnoff to Bluewood Ski Resort about 3 miles to the hairpin intersection with FS46 (go left/east). Proceed 2+ miles on FS46 and be attentive to some ruts and a couple of narrower sections that only allow passage of one vehicle comfortably. The trailhead kiosk and the wilderness boundary are up the short, south/right spur of FS420, just past a steep rocky incline. Park on the flat before this incline if you like, and walk the remaining 50 yards to the kiosk. Trail descriptions: See websites for WA Trails Assoc. or Less-traveled Northwest, as well as *Day Hiking Eastern Washington* (Mountaineers). Maps: (1) Walla Walla Ranger District Umatilla NF (North section), (2) USGS 7.5 minute topographic for Godman Springs.

Emil Doyle is a botanist and naturalist from Walla Walla who wrote about the "Botany in the Blues" program in the Summer 2020 issue.



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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.

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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.

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

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- Workplace giving is an easy way to support WNPS.
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Endowment gifts are kept as permanently restricted funds as designated by the donors. This fund provides annual distributions that support the WNPS Grant programs in Research and Plant Inventory, Conservation, and Education. Arrange your gift online or by mail:

- Online at www.wnps.org/donation/endowment (and review our Endowment Policy www.wnps.org/bylaws-and-policies/state).

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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

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** Ad hoc committees are formed to address society business and are not defined by WNPS bylaws, as are standing committees.

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Juana Jaime harvesting salal (*Gaultheria shallon*) on the Olympic Naitonal Forest.
PHOTO: KATHERINE DARROW