Botanizing Along the East Side of Steens Mountain: Some Lessons Learned on a Field Trip to Southeastern Oregon

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Steens Mountain and the western edge of the Alvord Desert from East Steens Road. The desert is a remnant of Alvord Lake that extended for 100 miles to the north and south during the Pleistocene. Photo by author.

It's why those of us who write about landscape are so interested in science, too. It's not in order to categorize the wildflowers, to make lists of things, but to make our vision...go deeper and deeper. The more I learn, the more I see. And the more I see, the more I learn." –Gretel Ehrlich, quoted in Trimble (1988)

The vans are not yet one block from Murdock Hall when bags of chips and cookies are ripped open, a sure sign that the field trip has officially begun.

For most of the 27 years I taught at Linfield College, I made a five-day road trip to southeastern Oregon with students in my biology majors class, Systematics of Flowering Plants. Our destination was the east side of Steens Mountain (9,733 ft.), the northern-most fault block mountain in the Great Basin, 50 miles south of Burns in Harney County.

Why drive this distance, nearly 500 miles from our home in McMinnville? For one thing, many of my students have no knowledge of what lies east of the Cascade Mountains. The country is spectacularly beautiful, and the Shrub Steppe and Desert Scrub Vegetation Zones offer a sharp contrast to the Willamette Valley and west side forests so familiar to us. Like all such field trips, the experience provides an unparalleled opportunity for scientific study and for reflection on the value of native species and landscapes. The students are required to make a plant collection and, in early May, the floral diversity along the east side of the escarpment is much greater than what we could see in the northern Willamette Valley at that time of year.

On the Road

Our itinerary takes us across five ecoregions, each one characterized by relatively homogeneous ecological factors, such as climate, physiography, soil and vegetation. I instruct the students to keep their eyes open for the dramatic changes in vegetation we will see as we traverse the state, from McMinnville (with an average annual precipitation of 44 inches) to our destination at Fields (less than 7 inches). Once on the road, we leave behind the agricultural fields and oak groves (*Quercus garryana*) characteristic of the Willamette Valley Ecoregion, travel up in elevation into the Western Cascades, over the crest of the range, and drop down through the Eastern Cascades and onto the High Lava Plains before we reach our destination in the Basin and Range Ecoregion. Along the way, we make a few stops, notably at the Maples Rest Area where a winding trail leads us along the Santiam River through a typical low elevation (1,000 ft.) temperate forest of western hemlock (*Tsuga heterophylla*), Douglas fir (*Pseudotsuga menziesii* var. *menziesii*), and western red cedar (*Thuja plicata*). We make another stop at the Little Nash Crater lava flow consisting of basaltic rocks that are surrounded by forests of true fir and harbor pockets of golden chinquapin (*Chrysolepis chrysophylla*), the showy *Penstemon davidsonii* var. *menziesii*, vine maple (*Acer circinatum*), and parsley fern (*Cryptogramma crispa*). We pass through forests of mountain hemlock (*Tsuga mertensiana*), subalpine fir *(Abies lasiocarpa*), and Engelmann spruce (*Picea engelmannii*) before dropping down along one of the steepest precipitation gradients in the world. Over a distance of only 20 miles of relatively flat terrain, precipitation decreases by 60 inches, a fact reflected in the equally dramatic changes in the vegetation. Forests of true fir (*Abies* spp.), lodgepole (*Pinus contorta* subsp. *latifolia*) and ponderosa pines (*Pinus ponderosa*) quickly give way to stands of almost pure ponderosa pine, then, western juniper (*Juniperus occidentalis*). In Bend, we turn east on Highway 20 and head out across the High Lava Plains before reaching the Basin and Range Ecoregion, where trees give way to shrubs, such as big sagebrush (*Artemisia tridentata* ssp. *tridentata*) and rabbitbrush (*Ericameria* and *Chrysothamnus*). Amazing state, Oregon! All this diversity of landscape in our first day's drive from McMinnville.

Catlow Valley with arrowleaf balsamroot *(Balsamorhiza sagittata)* growing on the Catlow Rim. Photo by author.

Into the Great Basin: Glass Butte, Wright's Point, and the Catlow Rim

Traveling at 65 mph on the highway east of Bend, it's easy to miss the incredible floral diversity concealed by the dominant sagebrush. So, about 70 miles east of Bend, we make a short stop at Glass Butte, long a favorite hunting ground for those seeking the beautiful obsidian unique to this rhyolitic dome. We spot a single yellowish-white lupine among the blue-flowered desert lupine (*Lupinus lepidus* var. *aridus*) growing abundantly at the site. The students want to know whether this is a different species of lupine or a mutant form of the desert lupine. I ask them to consider what evidence favors one hypothesis or the other. At this point, the answer to their question is not yet fully apparent to them, but they will work it out before the trip is over.

Having stocked up on provisions at the supermarket in Burns, we head south along Highway 205, and make a stop at Wright's Point, an inverted topography representing an ancient river bed filled with sediments, then lava, and now elevated by erosion of the surrounding softer

A flat near Fields dominated almost exclusively by winterfat (*Krascheninnikovia lanata*). Winterfat is a member of the Amaranth Family (*Amaranthaceae*) many of whose members are halophytic. Photo by author.

sediments. It offers a sweeping view of the Harney Basin, a major ranching and farming area and home to the 187,000-plus acre Malheur National Wildlife Refuge. A colleague who joined us on one trip commented as she gazed out over the vast, flat, treeless landscape, "I guess this is what is meant by *stark beauty*." We continue south, passing the turnoff for the Malheur Field Station, stopping for R & R at Frenchglen, a charming town consisting of not much more than a gas station, general store, and historic hotel, and continue into the Catlow Valley. Along the Catlow Rim, we find arrowleaf balsamroot (*Balsamohriza sagittata*) growing in abundance and in full bloom, and students want to collect some.[1] "See if you can get the root," I instruct them. After about three feet of digging and the root apex nowhere in sight, they abandon the

According to Mansfield (2000), the silvery tailcup lupine (*Lupinus argenteus* var. *heteranthus*) is "a northwestern Great Basin variety of a large, complex, western lupine." Photo by author.

1 We follow the Native Plant Society of Oregon's *Conservation Guidelines and Ethical Code* for collecting plants (http://www.npsoregon.org/documents/ethics.pdf).

Lithosol with Nevada onion (*Allium nevadense*). Photo by author.

charge, marvel at this adaptation for life in an arid environment, and are content to collect some leaves and inflorescences. Shortly thereafter, the Catlow Valley Road turns east, taking us up over Long Hollow, a pass between Steens Mountain and the Pueblo Mountains to the south, and as we descend the east side, we are treated to breathtaking views of both the Trout Creek and Pueblo Mountains.

Just before the Catlow Valley Road intersects the East Steens Road, a sign alerts us to "congestion" ahead, and a few tenths of a mile later, another sign announces that we've arrived at our destination, Fields, Oregon, population six. We've arranged to take over the four-room Fields Motel, and Charlotte Northrup, whose family owned the motel and small café at the time, greets us with large plates of spaghetti, salad, and her famous chocolate milkshakes.

Saline Soils, Lithosols, and the Alvord Desert

After a good night's sleep, we are met by Rick Hall, Natural Resource Specialist (now retired), from the Burns District of the Bureau of Land Management (BLM), who will accompany us on our journey in this part of the Basin and Range Ecoregion, named for the series of north-south uplift mountain ranges between which are basins with no drainage to the sea. Our first stop is just three miles north of Fields. About 100 feet west of East Steens Road, we spot a flat dominated almost exclusively by winterfat (*Krascheninnikovia lanata*). This low, scrubby, dense-wooly plant provides us with our first exposure to one of two vegetation zones we will encounter along the escarpment. The Desert Scrub Vegetation Zone is found typically in old lakebeds (*playas*) where evaporation greatly exceeds precipitation and consequently the soils are highly saline. Winterfat is the most salt tolerant of the many shrubs we will encounter and is a typical representative of the Amaranth Family (*Amaranthaceae*) many of whose members are halophytic, capable of tolerating salty soils.

We venture up on a rocky hillside immediately to the west. Rick warns us that there are rattlesnakes here, so we step carefully. Nevertheless, one student is buzzed, the snake retreats from view, and we are on alert to take extra care where we place our hands and feet. Students collect yampah (*Perideridia bolanderi*), bitterroot (*Lewisia rediviva*), Nevada onion (*Allium nevadense*), and biscuitroot (*Lomatium canbyi*) and come to understand why these rocky soils (lithosols) are often referred to as "Indian grocery stores." Each of these species served as an important food source for Native Americans who once lived here.

Twenty-two miles north of Fields, we stop at Pike Creek, ford the stream, and climb up on the hillside for a sweeping view of the Alvord Desert, a dry lakebed that is inundated in early spring and in wet years to form a shallow lake. The Desert itself is a remnant of the Pleistocene Alvord Lake that once extended 100 miles to the north and south. The Alvord is rimmed by geothermal features and, from the top of the hill, we look north toward Mickey Hot Springs, our next stop. On our climb back down the hillside, we spot ballhead waterleaf (*Hydrophyllum capitatum* var. *alpinus*) one

White crust indicative of saline soils at Mickey Hot Springs ACEC. Photo by author.

of the many herbaceous perennials whose beautiful showy flowers stand out dramatically against the numerous wind-pollinated shrubs with their inconspicuous flowers.

Thirty-one miles north of Fields, we turn east on a narrow unimproved dirt road. On the sandy soils by the roadside, we find sharp-leaved penstemon (*Penstemon acuminatus* var. *latebracteatus*). Proceeding east, we round a point and arrive at the Mickey Hot Springs Area of Critical Environmental Concern (ACEC) created by the BLM to protect its geothermal features: bubbling mud pots, steam vents and hot springs. Wherever we look, a white crust reveals the presence of saline/alkaline soils, and we are introduced to a suite of halophytic desert shrubs, each with a different adaptation for tolerating the salts. Winterfat roots exclude salts at the point of entry; the fleshy leaves of greasewood (*Sarcobatus vermiculatus*) dilute the salt; and, with the naked eye, we can see the glistening salt crystals excreted from the leaves of shadscale (*Atriplex confertifolia*). Nine species of *Atriplex* can be found in the Steens Mountain area, and most possess an efficient form of photosynthesis that enables them to minimize the evaporation of water from leaf surfaces, which is critical in this environment where the average annual precipitation is a mere seven inches. These plants possess an enzyme that can bind to CO_2 under very low concentrations of the gas, so they are able to keep their stomates nearly closed during the heat of the day. They store the CO_2 as a four-carbon compound (hence, their name C4 plants) in special cells in their leaves where they use the normal C3 photosynthetic pathway to fix it into glucose.

The glabrous and glaucous sharp-leaved penstemon (*Penstemon acuminatus* var. *latebracteatus*) growing on sandy soil near Mickey Hot Springs ACEC. Photo by author.

The More I Learn, the More I See, and the More I See, the More I Learn

On the better-drained soils, we find budsage (*Artemisia spinescens*), catclaw horsebrush (*Tetradymia spinosa*), and little leaf horsebrush (*Tetradymia glabrata*). At first glance, these and the other shrubs we've seen look alike: low, scrubby, nondescript plants with inconspicuous flowers, and small leaves covered with white hairs. Moreover, several of the shrubs are dioecious, making identification doubly difficult: when in bloom or in fruit, male plants look decidedly different from female plants of the same species. "We will never be able to tell the species apart," lament the students. But it doesn't take long for them, first, to get a feeling for the different species, to detect each one's *gestalt*. Then, on closer inspection, the students begin to see more detail, and soon they are adept at distinguishing among them.

More questions arise: "Why do so many of the herbs seem to be buried in or under the shrubs?" The students have detected a pattern, an observation calling out for an explanation. Every sagebrush

The clustered broomrape (*Orobanche fasciculata*) is parasitic on roots of sagebrush (*Artemisia tridentata*). Photo by author.

seems to have a desert paintbrush (*Castilleja chromosa*) growing up through its branches. A short distance away, they find a pale pink clustered broomrape (*Orobanche fasciculata*), a plant lacking any evidence of chlorophyll, concealed underneath a sagebrush. Then we see the tangled branches of a mustard (*Thelypodium flexuosum*) entwined within the branches of a greasewood shrub. When I ask the students what might account for this pattern, they venture guesses: cattle can't reach them in the shrubs (cattle evidence is ubiquitous); the specific epithet of the thelypody suggests that its stems are weak and in need of a shrub for support; and, they know that some plants without chlorophyll are parasitic: all good working hypotheses. (Later, on an exam, I ask them to come up with ideas for how they might discriminate among their hypotheses).

Stems of the weak thelypody (*Thelypodium flexuosum*) entwined within branches of a greasewood (*Sarcobatus vermiculatus*) at Mickey Hot Springs ACEC. Photo by author.

We walk a short distance south of the ACEC and find ourselves on a bare, hard surface that looks much like an exposed aggregate patio. Known as desert pavement, the surface is composed of small, densely packed and interlocking angular rocks on which few plants can take root. Several theories have been offered for how these pavements form, but the end result is that they minimize wind erosion in desert environments.

Rocks provide opportunities for moisture to accumulate, creating microhabitats for ephemeral mosses such as *Grimmia anodon*. Photo by author.

Our Vision Goes Deeper: Floral Diversity and Microenvironments

Back on the road, we continue north. Thirty-six miles north of Fields, on the east side of the road, at a site overlooking Mann Lake, we spot a pale yellow lupine growing abundantly and luxuriously within the sagebrush. Here on the well-drained soils of this gently inclined hillside, we get a look at a good example of the Sagebrush Steppe Vegetation Zone. Dominated by big sagebrush and some budsage and horsebrush, the space between the shrubs is occupied mostly by short native bunchgrasses, including bluebunch wheatgrass (*Pseudoroegneria spicata*), and numerous flowering herbaceous perennials such as the lupine. The bunchgrasses possess extensive fibrous root systems, which anchor the soil and allow the plants to rapidly absorb surface water after a rain. Unfortunately, many of the native perennial bunchgrasses have been replaced by Eurasian annual grasses, primarily cheatgrass (*Bromus tectorum*) and crested wheatgrass (*Agropyron cristatum*). Like many desert shrubs, big sagebrush is a xerophyte, a general term describing plants that possess numerous adaptations for living in arid conditions. The grey color of its leaves results from their dense covering of silvery hairs, which trap moisture and reflect heat, and from their waxy surface that retards water loss. Big sagebrush is also developmentally plastic: when water is plentiful in spring, it puts out relatively large, succulent leaves; in summer, it replaces them with smaller leaves. And, like many other desert shrubs, big sagebrush possesses a taproot that reaches for groundwater sometimes as deep as 25 feet.

But, what is this beautiful pale yellow lupine we spotted? Recalling the similarly colored solitary lupine we saw at Glass Butte, the students conclude correctly that this extensive stand of lupine must be a distinct species while the solitary specimen at Glass Butte was likely a flower-color mutant. Indeed, here we have found a patch of *Lupinus biddleyi*, a relatively rare species found in only a few locations roughly 30 miles apart but whose populations are considered stable enough not to warrant protection. In fact, we observe many young seedlings (with considerable variation in leaf morphology).

The floral diversity at all of these sites is remarkable. I overhear two students, standing as if transfixed by the display and by the snow-covered Steens in the background, whisper to one another, "Take it all in; you never know if you'll get back to see this again." One student picks a bouquet of stems from the desert paintbrush to illustrate for us the incredible variation in flower color (from scarlet, to peach, to pink and pale yellow) characteristic of this one species.

Other students are surprised to notice a rather lush growth of mosses and lichens on rocky outcrops at this site. Despite the meager rainfall that falls along the eastern escarpment of Steens Mountain, such microhabitats provide opportunities for moisture to accumulate. Mosses that occupy such sites are ephemeral; by late spring, they desiccate and go dormant. For example, when dormant, the stiff silvery awns of *Grimmia anodon* reflect sunlight, and the black pigments found in its cell walls prevent unreflected sunlight from entering the cells. When the rains return in the fall, the awns relax, the pigment becomes transparent, and the plant begins to photosynthesize and reproduce. On closer inspection, we find mosses and lichens growing as epiphytes on shrub stems and on the ground beneath the shrubs as well.

As the day winds down, we make our way back to Fields, our home away from home. After another hearty meal, we stroll in the black cottonwoods (*Populus trichocarpa*) nearby and spot a couple of great horned owl fledglings sitting as still as can be on branches almost at eye level, their fluffy skirts of down feathers still intact. But there's work to be done, so we return to the motel where we spend the evening pressing specimens and doing

Clusters of "naked seeds," surrounded by bracts, at the stem nodes of green ephedra (*Ephedra viridis*). Photo by author.

Riparian grove of narrowleaf cottonwood (*Populus angustifolia*) along Cottonwood Creek in the Pueblo Foothills RNA/ACEC. Photo by author.

Desert pincushion (*Chaenactis stevioides*), a diminutive annual growing on a steep, rocky slope in the Pueblo Foothills RNA/ACEC. Photo by author.

independently of one another.

We carry on, hiking up a draw, until we find, on a steep, rocky slope, a diminutive rather non-descript annual, the desert pincushion (*Chaenactis stevioides*). Again, the initial student response is to wonder why I've hiked them all the way up there to see this little plant. But Rick informs them that the Pueblo Foothills RNA/ACEC was created to protect an ecosystem characterized by this *Chaenactis* and other species. In fact, the Oregon National Areas Program recognizes this site as the best example of a narrowleaf cottonwood/ephedra community in the Basin and Range ecosystem and includes this species of *Chaenactis* on its List 4 (a taxon of conservation concern, which requires monitoring but not listing as threatened or endangered).[2] We linger: the view is expansive, even sublime, and it's hard not to appreciate even this little plant's contribution to our overall sensibility. I ask the students to consider why we should protect ecosystems and species such as these. In *A Sand County Almanac*, Aldo Leopold (1949) wrote (about a now extinct plant) that we grieve only for what we know. We came to know *Chaenactis stevioides* that day; the plant "became a personality" to us, and we were gratified to know that somebody cared enough to protect it.

Backtracking now, a little over three miles south of Fields we turn west onto Domingo Pass Road and drive another mile or so until we see the bright green stems of green ephedra (*Ephedra viridis*) dotting the landscape in among the sagebrush. Now Rick presents us with a challenge: find the lonesome milkvetch (*Astragalus solitarius*). Hint: it hides in sagebrush.

It takes us the better part of a half hour to find it, its white flowers, grey stems and linear leaflets perfectly camouflaged in the shrub, a disguise that serves, perhaps, to protect it from predators. We add yet another hypothesis to our list of possible explanations for why so many herbs are found tucked inside and underneath shrubs.

our best to key them out. In this part of the state, until relatively recently, no flora was available to guide our efforts. The *Flora of the Pacific Northwest* (Hitchcock and Cronquist 1973) does not cover this part of the state, and *The Jepson Manual* (Hickman 1993) is good only in so far as the distributions of California species extend into Oregon. The publication of the *Flora of Steens Mountain* (Mansfield 2000) made identification of species much more reliable.

Unusual Plants, Protected Plants and Landscapes

The next morning, we head south about nine miles to Cottonwood Creek and the Pueblo Foothills Research Natural Area (RNA)/ACEC. The ribbon of green trees that decorates this otherwise pale brown landscape is a welcome sight. We meander through the riparian area, shaded by a grove of narrowleaf cottonwoods (*Populus angustifolia*) and find fragrant golden currant (*Ribes aureum*) blooming in abundance. I spot Nevada ephedra (*Ephedra nevadensis*) and explain to the students, rather excitedly, that this is perhaps the northernmost limit of this species, which is more abundant throughout other parts of the Great Basin. But, to the students, the shrub looks pretty much like a bunch of dead stems: dull in color and without leaves or flowers. "You brought us all this way to show us this?" they exclaim. I continue, "Look at these reproductive structures. You can see clearly the exposed seeds: small clusters, surrounded by bracts, found at the stem nodes." These plants are gymnosperms, plants whose seeds are not contained in an ovary as they are in the flowering plants (angiosperms). The students are, of course, familiar with other gymnosperms such as conifers, but *Ephedra* (which looks nothing like a conifer) brings home the fact that the word gymnosperm means "naked seed," and that the large morphological diversity of plants with naked seeds reflects the fact that the various groups likely do not represent one evolutionary line but instead several lines that evolved

Return to Western Oregon

By lunchtime, we are on the road back to the west side of the mountain. About three miles south of Frenchglen, on the east side of the Catlow Valley Road, we spot a flat dominated by low sagebrush (*Artemisia arbuscula*), a mounded shrub about 12 inches tall. We agree to make one last stop. On the shallow, rocky, clay soils we find a suite of plants we had not encountered earlier, including several species of *Lomatium*, toothed balsamroot (*Balsamorhiza serrata*), and an extensive population of the beautiful, delicate desert violet (*Viola beckwithii*) with its dark purple upper petals, light purple (or sometimes pink or white) lower petals and striking bright yellow throat.

2 This species was later delisted; *Chaenactis macrantha,* also found at this site, remains listed.

For the rest of the afternoon, we turn our attention away from plants. We drive Center Patrol Road through the Malheur National Wildlife Refuge, watching birds and stopping only at the Buena Vista Overlook for a final look back at Steens Mountain. We spend the night at the Malheur Field Station and return to McMinnville the following day. As we descend the forested western slope of the Cascades, we feel the muscles around our eyes begin to soften and our skin rehydrate.

The next two weeks before the end of the spring semester, students spend their time drying their specimens, identifying them, pulling together the information to complete their herbarium labels, and mounting the plants for housing in Linfield's herbarium. Every year, after the semester is over, the data are entered into a computer database and sent electronically to the Oregon Flora Project at Oregon State University. Thus, the work the students have done that spring semester becomes part of the larger statewide effort to prepare a comprehensive account of the vascular plants of Oregon.

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The author on the Alvord Desert with Steens Mountain (9,733 ft.) in the background. Photo by Barbara Drake.

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At the end of a hike up a draw above Cottonwood Creek at the Pueblo Foothills RNA/ACEC, students celebrate finding the desert pincushion (*Chaenactis stevioides*).