

Land Lines

Big Sagebrush: Fine Variations on a Winning Theme

By Cindy Salo

"I'd be walking along Fifth Avenue, feeling utterly urbane, when suddenly I'd catch a whiff of sage and go weak in the knees." – Ode to Sage, Guy Hand

Immigrants on the Oregon–California Trail saw the Sagebrush Sea as a monotonous, monochromatic ordeal on their way to opportunities in the West. Some current residents go weak in the knees over its fragrance. But few of us fully appreciate the remarkable diversity of these widespread plants or really listen to what they have to tell us.

Sagebrush is arguably the most successful and dominant plant in the Intermountain West, swathing landscapes in gray-green from subalpine peaks to low desert flats between the Columbia Basin and the Colorado Plateau. Although well known, sagebrush is often unrecognized when it hides in plain view. It provides a subdued backdrop of small, dusky leaves and tiny, green flowers against which buttercups, larkspur, balsamroot, and lupines parade. Sagebrush is a quiet plant, singing its song so quietly it does not block views of the serene Owyhee Mountains or the almost impossibly beautiful Lost River Range.

Sagebrush is self-sufficient and does not need insects to pollinate its flowers; it simply releases pollen for the wind to carry. Instead of relying on birds or mammals to disperse its seeds, sagebrush just drops them to the ground or skids them across firm snow like tiny curling stones.

Sagebrush perfumes the Intermountain West with an aromatherapeutic mix of camphor and terpenes. The tiny seeds are the most fragrant part of the plant. When I arrived in Boise my first work vehicle still carried the odor of the seeds it had stored the fall before. The scent lingered until the next year. I tried to recreate it by crushing sagebrush branches on the floor mats, but the branches could not provide the same deep scent.

The differences among taxa of big sagebrush (*Artemisia tridentata*), the most widespread species of sagebrush, are subtle. The species has an excellent eye for detail, but has not abandoned its winning approach to thriving in the arid Intermountain West. The region is a fine-scale three-dimensional patchwork of parent materials, topographic variation, and microclimates. These produce a complex

mosaic of dozens of types of big sagebrush that support intricate communities of associated plants and animals.

Far from monolithic and monotonous, the big sagebrush group encompasses bewildering variations. I will introduce you to a few types of big sagebrush here; you can enjoy discovering the rest on your own.

A Day With Al Winward on the Curlew Grassland

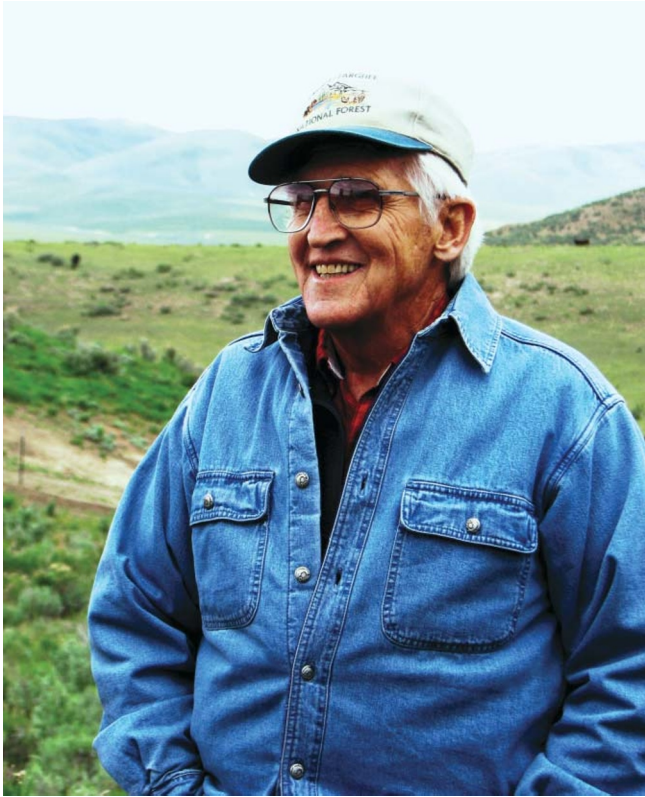
Most of us were bundled in bulky jackets, swaddled in hoods, and protected by gloves when we gathered at Curlew campground. We clutched mugs of quickly-cooling coffee and frowned into the wind. Sometimes June mornings only sound warm in Idaho. Dr Alma (Al) Winward, clad in a red flannel shirt, navy fleece vest, jean jacket, and Caribou–Targhee National Forest cap, seemed oblivious to the weather as he described his latest project on the Curlew Grassland.

After retiring in 2002 from a career that included 10 years as a professor at Oregon State University and over 20 as an ecologist with the US Forest Service, Al began updating the vegetation map of the Curlew. He and his grandson, who served as his field assistant, mapped the locations of the different taxa of big sagebrush and noted the distribution of forbs used by sage-grouse (*Centrocercus urophasianus*).

Curlew National Grassland is named for the mottled brown shorebirds with the improbably long, curved bills. The birds winter on tidal flats and wetlands in Mexico and summer on grasslands the Great Plains and Intermountain West. The grassland is administered by the Caribou–Targhee National Forest and lies on the Idaho–Utah border: Pocatello is 60 miles north and Salt Lake City is 120 miles south.

Although the area is called a grassland, it was originally sagebrush steppe. As we loaded up and headed to our first stop, Al described seeing the shrubs removed twice, first by iron and then by fire. He first visited the Curlew in 1956 as a Utah State University undergraduate. Livestock grazing was the main focus of the area at that time and sagebrush was being plowed under so that the land could be seeded to crested wheatgrass.

When he saw the Curlew again in 1980, Al found that sagebrush had reclaimed some of the seeded pastures. Later



Dr Al Winward on the Curlew National Grasslands. Photo by author.

fires killed many of the shrubs, but he was greeted by extensive stands of sagebrush when he began his retirement project. When we toured the Curlew in 2008, the valley was a mix of sagebrush stands and grasslands where recent fires had occurred. Crested wheatgrass was still a common understory plant across much of the area.

Al first introduced us to Wyoming big sagebrush (*A. t.* subsp. *wyomingensis*), which covers large stretches of the driest sites and shallow soils of the Intermountain West. These communities include a smattering of hardy native perennial grasses and forbs. This sagebrush is not a prolific seed producer, which makes collecting Wyoming big sagebrush seeds a challenging, but necessary task, if we are to successfully reseed our driest sites.

What Happened to Lake Bonneville?

About 15,000 years ago, Lake Bonneville overflowed, then quickly eroded an alluvial deposit at its northeast corner, near Red Rock Pass north of Malad City, Idaho. The lake swiftly drained through the opening, flooding the Snake River Canyon and Hells Canyon before flowing down the Columbia River to the Pacific Ocean. Lake Bonneville drained for weeks and released a total of 1,000 cubic miles of water. The flood carved scablands and dramatic waterfalls into Idaho's Snake River Plain and left deposits of gravel, boulders, and "melon gravels," boulders worn to oblong shapes by the abrasive action of debris carried by the flood. The Bonneville Salt Flats and Great Salt Lake are remnants of Lake Bonneville.

As we moved on to meet the next member of the big sagebrush group we left the center of the valley and slowly gained elevation. Al explained that we were traveling in the bed of ancient Lake Bonneville, which once covered much of Utah and portions of southern Idaho and eastern Nevada. Since the lake had no outlet to the ocean, precipitation and glacial melt accumulated during the cooler and wetter Pleistocene.

Late morning was warmer and many of us abandoned jackets in vehicles when we got out at the next stop. Al never added or removed layers, as sure and steady in his wardrobe as he is in his science.

Lighter-colored Wyoming big sagebrush occupying the central part of the valley contrasted with the darker stand of sagebrush in which we stood. The second type of sagebrush was Bonneville big sagebrush (also called *A. t.* taxon B), which grows on the slopes of ancient Lake Bonneville. Large stands are also found on the east side of Bear Lake, which straddles the Idaho-Utah border, not far from where it intersects Wyoming.

Bonneville big sagebrush grows on slightly more mesic sites than Wyoming big sagebrush. Sage-grouse and other sage-obligate species prefer the former stands because of their richer diversity of grasses and forbs. Bonneville big sagebrush is also more palatable than other types of sagebrush and provides ideal sage-grouse nesting habitat beneath its low-hanging branches.

Al said that it took some time for him to recognize where Bonneville big sagebrush grows and to realize the importance of Lake Bonneville in shaping the soils and plants of the Intermountain West. It was not the change in elevation or a change in soil type that Al noticed first; it was the plants themselves. "The sagebrush told me," he said.

Al believes that Bonneville big sagebrush is a hybrid between Wyoming and mountain big sagebrush (*A. t.* subsp. *vasayana*). Although he stops short of calling it another subspecies, he mapped it on the Curlew because of its importance for wildlife.



Bonneville big sagebrush provides excellent wildlife habitat. Photo by author.

Mountain big sagebrush grows on well-drained soils on foothills and mountains surrounding the Curlew Valley and throughout the Intermountain West. This subspecies produces tall seed heads laden with huge numbers of seeds. These tempt weary collectors struggling to fill orders for the more elusive Wyoming big sagebrush seed. However, mountain big sagebrush simply refuses to grow on the dry sites where its cousin thrives. Poorly adapted seed, no matter how easy it is to collect, is never a bargain.

Heather Garrison, at Utah State University, found that many populations of Bonneville big sagebrush (taxon B) are not stable hybrids. These plants appear to be Wyoming big sagebrush that is being introgressed by mountain big sagebrush. Rather than crossing exclusively among themselves, as stable hybrids do, the plants are backcrossing with a parental species. Al sees evidence of backcrossing to both parents in the field and calls Bonneville sagebrush a highly variable taxon. Although introgressed crosses may lack the panache of full-fledged hybrids, they contain a great deal of genetic variability that can provide novel genotypes for variable sites.

A series of papers in the 1990s examined the ecology and genetics of other big sagebrush hybrid zones in Utah. At each site, mountain big sagebrush has crossed with basin big sagebrush (*A. t.* subsp. *tridentata*) growing downslope. Between the two parental habitats lies a narrow zone containing a stable hybrid. Hybrids perform best in hybrid zones, and do much better there than either parental subspecies, indicating that the hybrids fill a unique niche.

Recent work in these big sagebrush hybrid zones has uncovered another layer of complexity at work. Dr Carl Freeman and his graduate students at Wayne State University in Detroit, Michigan, have found that endophytes appear to play a major role in allowing big sagebrush to adapt to a wide variety of conditions.

Endophytes are fungi or bacteria that live within plants without causing disease. They have been found in every

plant species examined, but are poorly understood. A notable example is the fungus that lives within Pacific yew trees and produces the drug Taxol. In many plants, including big sagebrush, these organisms are believed to improve the host's ability to tolerate environmental stress.

By way of explanation, Dr Freeman likens plant genes to the keys on an organ. "The endophyte seems to be the organist that plays the diversity of the keys and that's just kind of wild," he told me.

After lunch on the Curlew, Al showed us a basin big sagebrush site. This is the subspecies that early settlers knew indicated the deep, well-drained soils that are best for agriculture. As we looked out across the plants, we could see how the uneven green crowns of basin big sagebrush contrasted with the almost blue-green, fairly smooth crowns of a nearby Bonneville big sagebrush stand.

The temperature dropped as we neared the end of our field trip. Many of us were bundled up and frowning again. Al did not seem to notice; he went on translating what the plants had told him.

Why Do Subspecies Matter?

Big sagebrush taxa have a remarkable ability to interbreed and create novel genotypes, from which locally adapted types can develop. Endophytes further refine each taxon's ability to thrive in stressful environments. Understanding the plants' responses to variations in soil, topography, and climate helps us recognize the underlying variation in these abiotic factors. A better understanding of the abiotic variation across the Intermountain West allows us to recognize how different sites respond to weather patterns, natural disturbances, and management actions. This allows us to fine tune our management actions for best results on different sites.

Getting acquainted with the many different types of big sagebrush takes some time. We need to listen to the plants and to our local experts: range managers, ranchers, ecologists, botanists, and wildlife biologists. Roger Rosentreter,



Dr Al Winward helps tour participants learn to recognize different kinds of big sagebrush. Photo by author.

Other Notable Sagebrush Species

Absinthe contains the leaves and flowers of *Artemisia absinthium*, native to the Old World. The green, anise-flavored alcoholic drink was popular with French artists and writers in the mid-19th century. Its reputation as a hallucinogenic and highly addictive drink that leads to violent behavior resulted in its ban in the United States and most of Europe by the early 20th century. It is now believed to be only as dangerous as other spirits. It has been produced in Europe since the 1990s and became available again in the United States in 2007.

Artemisinin is derived from *Artemisia annua*, native to Asia and naturalized throughout the world. The compound is highly effective against malaria parasites, including those that have developed resistance to chloroquine, a standard treatment beginning in the 1940s.

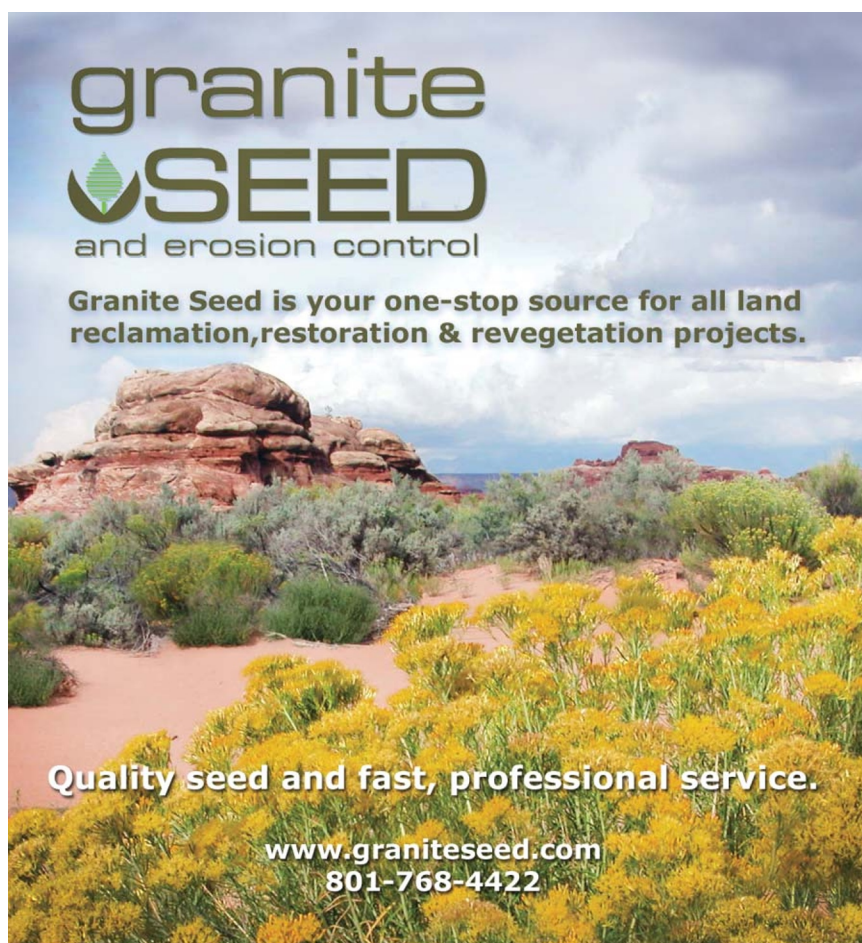
Idaho Bureau of Land Management State Botanist, reminds us that sagebrush is loveliest and the taxa are most distinctive in the late summer and fall, when many of us are back indoors after the summer field season. Sagebrush is also at its most fragrant when producing seeds in the fall.

Let's resist the urge to stay indoors this fall and instead enjoy the full glory of the big sagebrush bloom while we get to know some of the members of this fascinating group.

Additional Reading

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