

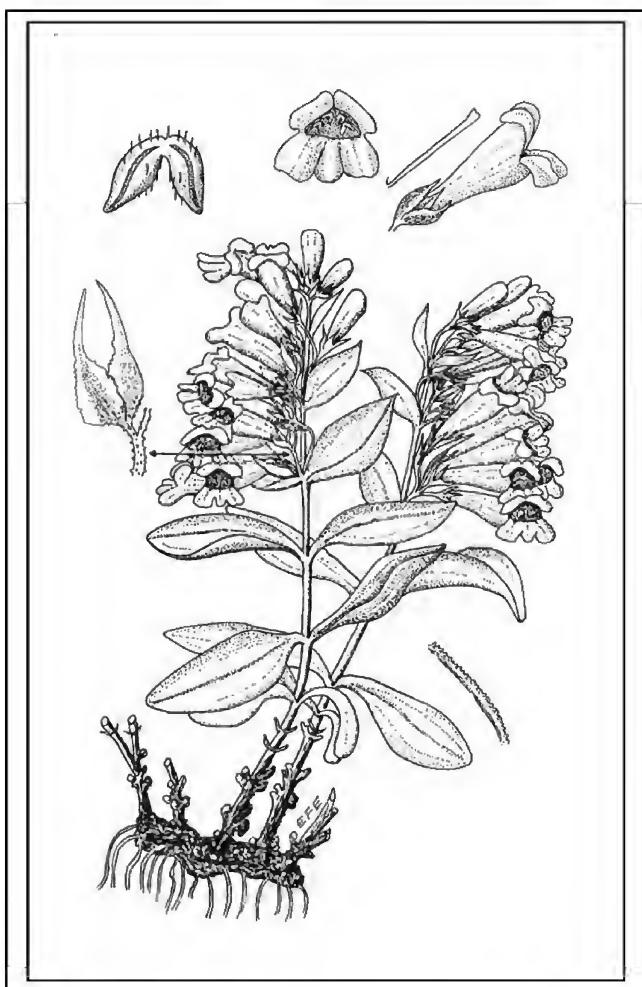


Castilleja

Publication of the Wyoming Native Plant Society

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Above: Absaroka beardtongue (*Penstemon absarokensis*). Illustration by E. F. Evert. Reprinted with permission from *Madroño*.

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Life on the Rocks:

Greater Yellowstone Endemics

Absaroka beardtongue (*Penstemon absarokensis*) is one of four Greater Yellowstone endemic plant species described by Erwin Evert, founding member of Wyoming Native Plant Society. Rupert Barneby and Dwight Ripley made the earliest collections of this Wyoming endemic in the 1940s, but failed to recognize it as a distinct species. Evert first noticed the species in 1974 and described it as new to science in 1984 (Evert 1984).

This striking beardtongue is typically only 4-5 inches tall with fleshy leaves and over-sized purplish-blue flowers crowded in a terminal inflorescence. It grows mostly on barren, volcanic scree in the Absaroka Range of Park and Fremont counties. Absaroka beardtongue was formerly a potential candidate for listing under the Endangered Species Act, but was dropped when surveys found populations to be larger and less threatened than original suspected. It is still managed as Sensitive by the Bureau of Land Management and U.S. Forest Service. WF

Reference

Evert, E. F. 1984. *Penstemon absarokensis*, a new species of Scrophulariaceae from Wyoming. *Madroño* 31 (3): 140-143.

This issue features a suite of Greater Yellowstone endemics and their discoverer.

Living on the Edge

If you missed the state workshop on the management of range margin populations, you can still view the outcome (presentations, bibliography, and discussion report) posted on-line:
<http://sites.google.com/site/rangemarginworkshop/>

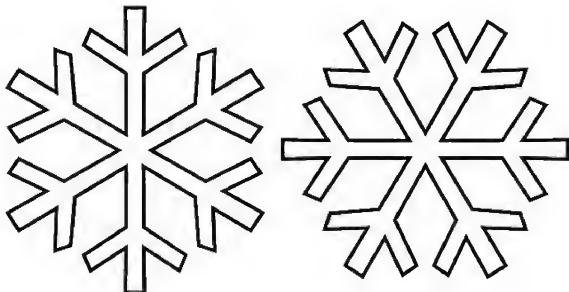
WNPS News

In this Issue: Stand up and be counted! Please renew for 2011 if you have yet to do so, and check out the slate of Board candidates!

New Membership Option: A lifetime membership option was created with passage of the 2010 By-Laws amendments. The lifetime membership fee is \$200, of which \$50 is directed to the Scholarship Fund.

New Paperless Option: Are you WIRED? If you would prefer receiving an email notice about the newsletter rather than a mailed copy, this option will be available on a trial basis in 2011. Please check off this option on the enclosed renewal form, or email Ann (amb749@yahoo.com) to make this arrangement if you have already renewed for 2011.

New Members: Please welcome the following new members to WNPS: Sara Brown, Laramie; Bureau of Land Management – State Office, Frances Clark, Lincoln, MA; Rachel Lavach, Cheyenne; Teton Conservation District, Jackson; Jennifer Walker, Buffalo.



Homepage links: Check out new internet links at the Wyoming Native Plant Society homepage, www.uwyo.edu/wynndd/wnps/wnps_home.htm.

Treasurer's Report: Balance as of 27 Nov - Scholarship = \$1,917.50; General = \$2,264.72; Total = \$4,182.22 .

Contributors to this Issue: Ann Boelter, Walter Fertig, Ronald Hartman, Bonnie Heidel, Bob Lichvar, Phil White.

Dedication: The New Year holds the promise of new beginnings, and it marks losses. This issue is dedicated to Erwin Evert, a founding member of Wyoming Native Plant Society.

Announcement: 2011 Markow Botany Research Scholarship applications are due by 18 February 2011. The application form is in this issue and also posted on the WNPS homepage at: www.uwyo.edu/wynndd/wnps .

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Having a hard time finding the perfect present for certain people in your life? Look at the book reviews in this issue, and consider giving a gift membership in Wyoming Native Plant Society.

The next newsletter deadline is February 18. Articles, announcements, and suggestions are welcome any time! *Every newsletter issue marks a challenge – how to reflect the breadth of Wyoming plant life and member interests.*

Botanist's Bookshelf

Skinner, Quentin D. 2010. **A Field Guide to Wyoming Grasses** (ISBN 978-0-615-38762-8, paperback). Available through University of Wyoming Cooperative Extension Service, (http://www.uwyo.edu/uwag/Ag_Resource_Center.html) (Click on the publication title then the Request Hard Copy link for Publication No. RJ-215.) To order by phone, contact the UW CES Resource Center at (307) 766-2115.

Review by Bonnie Heidel

Just in time for Christmas, Santa has exciting new Wyoming merchandise: "A Field Guide to Wyoming Grasses." The Grass family (Poaceae; Graminae) is the second largest family of vascular plants in Wyoming, comprising nearly 10% of the entire flora (274 species and varieties; among 2800 in Dorn 2001). Grasses are common, if not dominant, in all elevations, geographic areas and habitats of the state, both natural and disturbed as well as planted. Perhaps no other family evokes such terror when it comes to their identification, with "no-frills" flower structure and superficial similarities, as well as the number of species.

Taking the terror out of grass taxonomy, Dr. Skinner has added visual clarity and portability to the core information contents from the previous, nearly out-of-print manual (Skinner et al. 1999). Each of the 270 species is represented by a page of high quality color photographs showing labeled close-ups of diagnostic characteristics, as well as growth form and habitat; taken by the author. It benefits by the robust distribution maps that represent collections at the Rocky Mountain Herbarium and Renewable Resources Department Herbarium.

If you crave pictures to go with your use of Dorn (2001), or if the taxonomic treatments and technical terms of the *Flora of North America* (Volumes 24, 25) seem obscure, this book is the

perfect companion. It belongs on the shelf of every biologist in the state who manages range or wildlife habitat, every agency and public library that carries Wyoming field guides, and the mildly interested to the fanatic of agrostology.

It is a field guide in every sense, though this moniker is usually applied to taxonomically truncated treatments with limited information and technical detail. It weighs in at 1 lb. 7 oz., not a light-weight, but a field reference of merit.

Helpful ecological context is presented for each species, indicating whether the species is introduced or native, cool-season or warm-season, its range of habitats including seral conditions, management comments, and special added remarks, e.g., if it is frequently confused with another species.

The paired pages of text and graphics for each species are clearly organized and identified by common name, the nomenclature used in the *Flora of North America*, all synonyms cited in previous Wyoming grass manuals, and the traditional grass tribes. Species are sequenced first by the traditional tribes, and then by placement of each genus and species in genus- and species-level keys. This makes the user dependent on keys and index at some level.

In reality, Quentin Skinner's book is at least the seventh generation in a series produced by University of Wyoming authors that hails back to "Studies in Wyoming Grasses" printed in a series by C. L. "Ted" Porter from 1939-1946, followed by "The Grasses of Wyoming," a 1950 mimeograph by Porter, the first complete treatment. It builds on the cumulative expertise of earlier authors like Porter and A. A. "Doc" Beetle as well as the author and his colleagues; almost as though one could pack along consultation with these illustrious Wyoming authorities, past and present. Plus, the new graphics, maps, information and redesign for field use give it an even greater versatility and utility. (References – continued on p. 12)

Botanist's Bookshelf:

Evert, Erwin F. 2010. **Vascular Plants of the Greater Yellowstone Area: Annotated Catalog and Atlas** (no ISBN, paperback). Published by author (Orders: yolandaevert@yahoo.com, by phone 01-847-8231501), \$45.00 by check payable to "Yolanda Evert," 1476 Tyrell Ave., Park Ridge, IL 60068; 751 pp., 8 1/2" x 10 7/8".



Review by Ronald Hartman

Vascular Plants of the Greater Yellowstone Area: Annotated Catalog and Atlas is a tome that represents the most complete and scholarly coverage of the flora to this diverse region, an area that attracts hundreds of researchers and millions of tourists annually.

A total of 2,082 species are treated across an area of more than 24,000 mi², including Yellowstone and Grand Teton National Parks, with four counties represented in Wyoming, six in Montana, and two in Idaho. For a taxon, a dot is placed in each county for which there is documentation. In addition to the more than 40,000 specimens amassed by Erwin, the holdings of the RM, MONTU, and YELLO were also consulted.

This publication is one of the most lasting legacies of Erwin. The story behind the publication is also the story of its author, as told in the pages that follow.

A Tribute to Erwin Evert

By Walter Fertig

This past June I learned through the botanical grapevine that Erwin Evert's long-anticipated book *Vascular Plants of the Greater Yellowstone Area: Annotated Catalog and Atlas* had finally been published. It seemed that Erwin had been working on his tome for at least 20 years, or nearly as long as I had known him. I well remember visiting with Erwin and his wife, Yolanda, on their annual or biennial visits to the Rocky Mountain Herbarium where the Everts would spend several days poring over specimens from northwest Wyoming and adjacent Idaho and Montana. As a botanist with my own interest in the flora of Yellowstone and vicinity, I always anticipated these visits as an opportunity to learn of Erwin's latest interesting finds and to catch up on botanical gossip. Erwin was always generous in sharing his discoveries and hopefully didn't mind spending an hour or two away from his research.

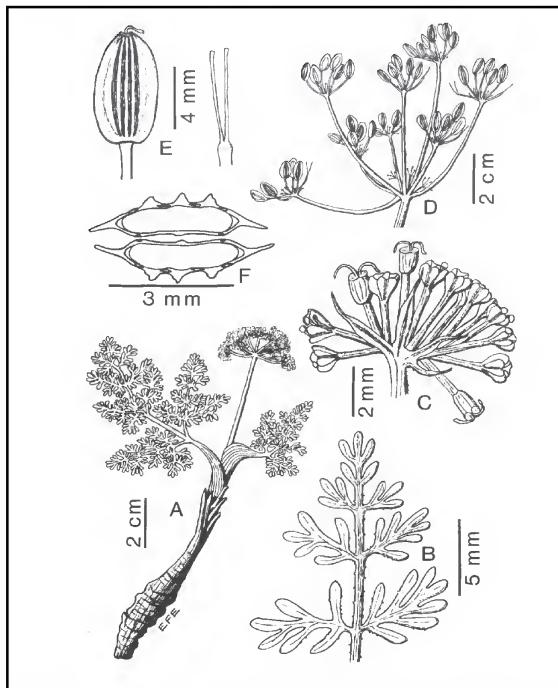
Erwin Evert was a native Chicagoan, born on the northwest side in February 1940. From an early age he had a keen interest in nature and botany, fostered by a great uncle who took him on

jaunts to the zoo and park, and a grandmother who let him create his own garden at the age of four. As a youngster the Evert family would visit a relative's summer home in the North Woods of rural Wisconsin where they would catch fish and pack them with fern fronds for the trip home. Perhaps gathering these ferns instilled a lifelong interest in collecting plants.

Evert graduated from Roosevelt University in Chicago with a degree in Zoology/Chemistry and Education. For many years he taught high school science, biology, and chemistry in the Chicago public schools. He also studied art at the Art Institute of Chicago and became an accomplished painter and pen-and-ink illustrator. Erwin also had a great interest in music, and studied voice at the American Music Conservatory with thoughts of becoming an opera singer. Evert could also speak German and Italian and would sing in these languages while playing the piano to entertain family and friends.

Botany remained Evert's primary love throughout his career. He and his wife maintained a native plant garden at their home in Park Ridge, Illinois, that was famous in the Chicago area and frequently featured in gardening magazines and on garden tours. Erwin particularly liked to grow unusual native species, such as his beloved ferns and *Carex*.

Erwin Evert's life trajectory changed in the 1960s when he visited Yellowstone National Park and the mountains of northwestern Wyoming on a family vacation. Although the flora of the greater Yellowstone area had been surveyed by several prominent botanists for nearly a century, Evert must have been surprised to find so many areas that were still unexplored and so many species that had still not been catalogued. On a trip in 1974 Evert collected a short, bright blue-flowered penstemon from the Absarokas that did not match any species descriptions or fit any keys. It turned out to be a new species and one he would name a decade later as *Penstemon absarokensis*. A year later, he would find a peculiar umbel on volcanic rubble in the Absarokas that didn't match anything either (he would name this *Lomatium attenuatum* in 1983). With so many new discoveries to be made and so many beautiful mountains to climb and explore, Erwin clearly had found his niche.



Above: Absaroka biscuitroot (*Lomatium attenuatum*). Illustration by E. F. Evert. Reprinted with permission from Madroño.

The Everts purchased a summer cabin along Kitty Creek in the midst of the Absaroka Range in the mid 1970s and used it as a base camp for western explorations over the next four decades. Erwin began documenting the flora of the North Fork drainage of the Shoshone River which parallels the east entrance road to Yellowstone

National Park through Shoshone National Forest. At the time, the Absarokas had received surprisingly little attention by botanists, perhaps due to their rugged, slippery volcanic peaks, dense forests, sparse road and trail network (much of the area is designated wilderness), and density of grizzly bears. Evert produced an annotated checklist of the flora of the drainage in 1991 and periodically re-issued it every few years. This document was the foundation on which he would build his comprehensive catalog of the greater Yellowstone flora.

Evert did not just work in the Yellowstone area though. He made several important collecting trips in the Black Hills where he discovered the first Wyoming population of Trailplant (*Adenocaulon bicolor*) and several other species. In the Bighorns, Evert was the first botanist to explore the boggy swamp forest at Preacher Rock, where he discovered the state's first population of Woodland horsetail (*Equisetum sylvaticum*) – ironically just one day before Bob Dorn discovered it independently in the Black Hills. He also made important botanical discoveries at the Story Fish hatchery and in the Cloud Peak Wilderness Area.

Erwin Evert was one of just 23 charter members of the Wyoming Native Plant Society when it was founded in early 1981 and later served as President for the 1983-84 term. During the 1980s he was a frequent contributor to the *Wyoming Native Plant Society Newsletter* (the original name of the *Castilleja*). Many of Evert's articles addressed new species discoveries for the state and the flora and ecology of northwestern Wyoming, especially the Beartooth Range. Evert also had a strong interest in plant conservation and in a series of articles in 1983 and 1984 proposed that Wyoming develop a system of protected natural areas analogous to the Illinois Nature Preserve System. Along with Bob Lichvar and Ellen Collins, he proposed Preacher Rock Bog and Sawtooth Palsa (the only domed peatland underlain by permafrost in the lower 48 states, found on the Beartooth Plateau) as initial components of such a system. Evert's idea for a natural areas system was adopted by The Nature Conservancy and several federal and state agencies in November 1984 at the first Natural Area Needs Workshop, held in Riverton.

Perhaps Erwin's greatest botanical discovery came in June 1984 while he was scouting out areas to visit for the upcoming WNPS annual field trip to the Beartooths. Always interested in sedges and peatlands, Evert stopped along the highway leading to Cooke City and Red Lodge to explore a large lake at the base of the Cathedral Cliffs, better known today as Swamp Lake. This remarkable area contained 8 new state records and some 25 rare plant species associated with the White spruce muskeg forest, marl wetlands, and floating mat vegetation. Most of the species were widely disjunct from their primary range in boreal Canada and Alaska. Red Manzanita (*Arctous rubra*), had never been found in the contiguous United States. To this day, Swamp Lake remains one of the five Wyoming sites with the highest concentration of rare plant species (along with Dugout Gulch/Sand Creek of the Black Hills, Medicine Bow Peak, Beartooth Pass, and the vicinity of Jenny Lake in the Tetons). Needless to say, the stop at Swamp Lake was the highlight of the 1984 meeting!

Since the mid 1970s Evert collected over 40,000 vascular plant specimens from Wyoming, Idaho, and Montana while researching his catalog of the greater Yellowstone flora. Most of these are deposited at the University of Wyoming's Rocky Mountain Herbarium or the Morton Arboretum in Chicago, where Erwin was a long-time research affiliate. Remarkably, Evert didn't seem to keep a field book and hand wrote copious label information on each set of newspapers containing his prized specimens. (Fortunately, he had very legible script.) These collections included dozens of first records for each state and four new species to science. In addition to Absaroka biscuitroot (*Lomatium attenuatum*) and Absaroka beardtongue (*Penstemon absarokensis*) mentioned previously, Evert named Aromatic pussytoes (*Antennaria aromatica*) and Shoshonea (*Shoshonea pulvinata*). The latter species, co-named by umbel expert Lincoln Constance, also represented a previously unknown genus and was named to honor its limited range in the Shoshone drainage of northwestern Wyoming and adjacent southern Montana. Another new umbel species from the Owl Creek and southeastern Absaroka ranges was named *Cymopterus evertii* (Evert's spring-parsley) in Erwin's honor by Ron Hartman and Rob Kirkpatrick in 1986.

Evert's lasting legacy will be his massive (751 page) *Catalog*. The book begins with an outstanding overview of the greater Yellowstone area, including a summary of its vegetation, climate, and geology. Other sections review the flora of each mountain range within the study area and the history of botanical exploration in the region. The bulk of the book contains a brief discussion of each of the 2082 vascular plant taxa known from the greater Yellowstone area that includes a description of its range, habitat, conservation status, and comments on taxonomic problems, as well as a dot map. The book captures Evert's four decades of field experience and knowledge of the Yellowstone area and is a critical update to the classic (but long out of print) floristic studies of Frank Tweedy, Per Axel Rydberg, and Aven Nelson.

I was preparing to leave for 10 days of my own fieldwork in southwestern Wyoming and the Black Hills this past June when I learned of Evert's book. I planned to write Erwin and order my own copy as soon as I returned. Sadly, in that short span of time, Erwin died, at age 70, not far from his beloved Kitty Creek Cabin on his daily sojourn of botanical discovery. I'm sad for the loss of a colleague and friend, and for the sorrow of his wife and daughter. I'm sad for the missed opportunity of catching up again on botanical news and gossip, and for not being able to personally give Erwin the credit he so richly deserved for his book. I am thankful that he did finally publish the book after so many years – it would have been an even greater tragedy if the work was to lay unfinished. But I'm grateful too for all of his contributions to science and his unflagging enthusiasm for Wyoming botany. I'm grateful too, that he was able to get in that one last hike, despite the consequences – to be out of doors in the wild Absarokas that he loved so well.



"I have resolved for the future, as long as God grants me life, to ascend diverse mountains every year, or at least one, in the season when vegetation is at its height, partly for botanical observation, partly for the worthy exercise of the body and recreation of the mind."

From a letter written by Conrad Gesner to a friend in 1542, reprinted in Evert (2010).

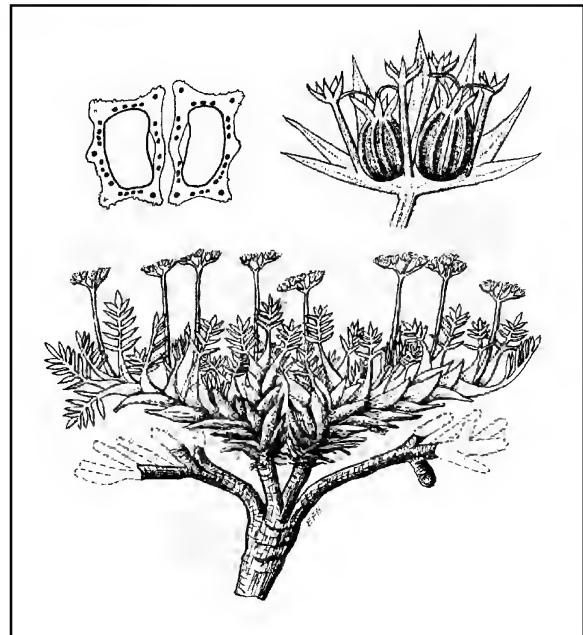
Memories of Erwin Evert

Interview of Bob Lichvar by Phil White

I had the privilege of meeting Erwin F. Evert in about 1979 or '80. I was with Don Despain in Yellowstone and he asked me, "Ever heard of a fellow named Erwin Evert? He keeps wanting to get into our herbarium." So Don gave me his address for his cabin on Kitty Creek and later I met him at his cabin. We became friends and through the years my family sometimes stayed at his place in Chicago and he sometimes stayed at our place in Cheyenne.

He was a self-taught botanist but you would never know it. He discovered four new species to science from Wyoming. I visited him once in Chicago early in our acquaintance. He showed me his 500-species rock garden. Later we looked at one of his specimens from Wyoming and could not identify it. We thought it might be a new species and he asked me how to go about describing it for science. I mentioned that some botanists count chromosomes to include in descriptions. He worked on that all winter. He amazed me when he bought a compound microscope and taught himself how to count chromosomes. He teamed up with an expert in Umbelliferae, Lincoln Constance, and they described it - *Shoshonea pulvinata* in 1982.

My most vivid memory is one spring morning he arrived at our house in Cheyenne on his way to his summer cabin near Cody and we immediately started talking about plants. We walked around the yard and talked about every plant. We looked at my neighbor's tulips and he told me all about tulips, the wild ones, the cultivated ones. This went on all day. My wife Patty made a supper and we talked plants all through supper, on into the evening. Patty finally went to bed. Around midnight one of us mentioned *Carex*. And he started into the characteristics of alpine *Carex*, their distribution. And so on. Finally it got to be about three in the morning and my head starts nodding. He said, "Am I boring you?" I said, "No, but we are way past my bedtime." Erwin was one of those guys who could live on about four hours of sleep. I finally said, "Erwin, I gotta go to bed." So a while later in my sleep I hear, "*Carex, Carex* (in a



Above: Shoshonea (*Shoshonea pulvinata*). Illustration by E. F. Evert. Reprinted with permission from Systematic Botany.

ghostly like voice)" and I thought it looked like Erwin was standing by my bed still talking to me. But I woke up and realized it was me shouting "*Carex*" in my sleep. I thought I better shut up or Erwin would be in there joining the conversation.

He appeared fairly quiet and reserved and introspective if you didn't know him. I remember at one of the early Wyoming Native Plant Society meetings near Lysite people were straggling in to the campsite and I was in another long conversation with Erwin when botanist from another state said hello to me and asked who my friend was. So I introduced Erwin and the guy said, "What do you do?" And Erwin replied, "I am a student of the flora of North America." The guy was left speechless and asked no more questions.

We went on numerous field trips together. On one memorable early trip I was driving my brand new '81 Ford pickup. We were following a primitive road up one fork of the Shoshone along a sliver of land which was not part of the Absaroka Wilderness. At one point we were going along the

river - not knowing it had undercut the bank - and suddenly the road collapsed and we went into the river and were washed backwards downstream a bit. I had a chain and a come-along and we managed to wench that thing back up onto the road. A little farther along on this bulldozer road that was cut at an angle going up this scree slope to the alpine, we encountered a small little bridge across an avalanche chute. Erwin went ahead to check out the primitive bridge and he signaled me to come on across. We spent a couple of days up there botanizing and on the way down I saw that bridge from the opposite side and noticed it was supported by about a 3" lodgepole. I said, "Erwin, you let me go over that???" He said, "We made it didn't we?" So I said, "Well, this time you're riding in the truck with me so if we roll down the mountain we roll together." But we made it again.

Our last adventure on that same trip we were going to the Beartooths to a swampy area marked on a quad map to find out later it was a palsa-fen. We were on a two-track going through subalpine forest through a boulder field and I finally bent the rear fender on my new truck a boulder. I said, "Erwin, that's it. I can't do this anymore. We went into a river. We almost rolled down a mountain, and now we hit a boulder. We're walking from here." No big deal to Erwin since every Saturday he walked 14 miles all winter long staying in shape.

The next day we were back at his cabin at Kitty Creek and I was telling Yolanda about the trip. She said, "You should have asked me before you went." I said, "Why?" She said, "Because a few years ago he rolled his Karman Ghia off Pikes Peak while looking at plants instead of the road."

By the way, in 1984 Erwin was one of the three authors of an article in Arctic and Alpine Research entitled "Description of the Only Known Fen-Palsa in the Contiguous United States."

I remember one excursion with Erwin and his daughter Mara, who was about 12 at the time. He was giving her some devices to remember the plants. To help with *Penstemon whippleanus* he conjured up the Mr. Whipple from the old TV commercial for Charmin Bathroom tissue ads, who said, "Please don't squeeze the Charmin." So Erwin

could be heard saying "Don't squeeze the Charmin" when they saw the *Penstemon* and Mara couldn't remember the name.



Above: Erwin Evert, by Mara Evert Domingue

You meet many people in your life's journey, but not all leave a lasting impression on you. In my life's journey, Erwin not only left a rich botanical memory with me, but he was one of the few people who enriched my life by just being who he was, and I feel honored to have had the fortune and pleasure to have known him. He was a big part of my fond Wyoming days and I will miss him in many ways.

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Ten Things You Might Not Know About Grasses (But Wish You Did)

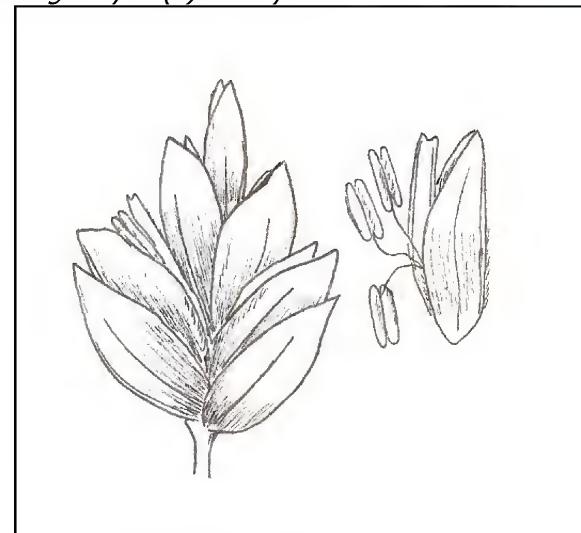
By Walter Fertig

(Reprinted with permission from *Sego Lily* 32(4). 2009)

Grasses are nearly ubiquitous, but like many familiar things, they are often taken for granted. The following collection of factoids explores some of the basics of grass morphology, ecology, and natural history. Use these kernels of agrostology (a.k.a. the study of grasses) to impress your friends, co-workers, and loved ones.

1. They may not *look* like much, but grasses have flowers. Grass flowers do not have showy petals to attract visually-oriented animal pollinators, such as butterflies, bees, and hummingbirds. Each flower consists of a minute pair of sepals (called lodicules), 3 stamens, and an ovary derived from 2 fused carpels. Furthermore, the grass flower is wrapped in a series of green or straw-colored scales or bracts (actually modified leaves). A single grass flower, called a floret, is enclosed by two bracts: a large (relatively speaking), many-veined lemma and a smaller, 2-veined palea. Each floret is further enclosed by a pair of larger scales called glumes. A set of one or more florets and their associated pair of glumes is called a spikelet. Grass spikelets vary in size, number of florets, presence of long, spine-like extensions (awns), degree of venation, presence of hairs, size of glumes, etc., but all are built on the same fundamental design. Once this basic pattern is learned, grass identification becomes a lot simpler. Spikelet characteristics provide the best means for identifying grasses to genus or species.

2. Grass flowers are pollinated via the wind - which is why many people suffer from hay fever. Grasses, many trees and shrubs, and some weedy plants are pollinated by the wind, rather than animals, and so do not need to advertise themselves with large, colorful petals (indeed, these would interfere with the dispersal and capture of pollen). At maturity, grass spikelets often dangle on thin stalks, allowing them to dance about in the slightest breeze and shake their pollen loose. Wind-borne pollen grains tend to be very small and light-weight, so as to better float through the air. The odds of any single pollen grain reaching the receptive stigma of another flower of the same species are quite low, so wind-pollinated (or anemophilous) plants must produce exceptionally large numbers of pollen to saturate the market.

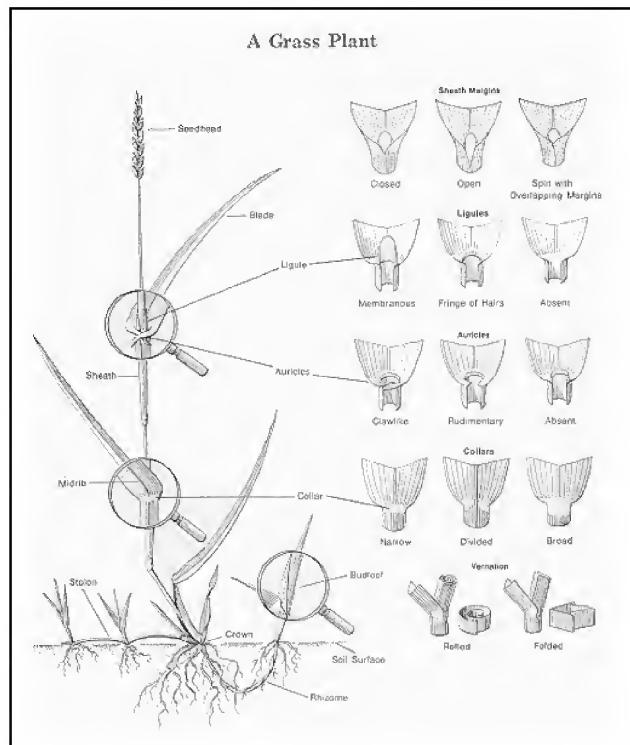


Above, left: Spikelet of Alpine bluegrass (*Poa alpina*), consisting of two glumes (lowest pair of bracts) and 5 florets. Above, right: a single floret with 3 stamens, a membranous palea, and a large lemma. Illustration by W. Fertig.

One in fourteen Americans suffer from hay-fever, and many are allergic to grass pollen. Hay-fever results from the bodies' own immune system over-reacting to the presence of proteins on the surface of pollen grains that have floated on the wind into the nasal passages. Specialized cells in the immune system respond to the foreign proteins by releasing histamine and other chemicals to fight off the invaders. These compounds cause the symptoms of hay fever – itching, sneezing, congestion, and fatigue.

3. Vegetatively, grasses all kind of look alike, but there are some good (though subtle) characters for identification. Grass leaves are typically long and linear and attached to the stem (called the culm in technical botanical jargon) at a knob-like, swollen node. The blade or lamina of the leaf wraps around the culm to form a long sheath which may be fused below the base (forming a V, like a V-necked sweater), open the entire length, or overlapping. Most grass plants have a membranous structure called a ligule, inserted at the juncture of the leaf blade and culm. The size, shape, and form of the ligule (especially whether the tip is squared off, pointed, lacerated, or split into numerous hairs) is useful for identifying grass species in the

absence of flowers. The presence of a ligule is a unique feature of the grass family. Some grasses also have auricles, ear-like flaps of tissue at the top of the leaf sheath, that can be helpful for identification.



4. Not all grass-like plants are true grasses. Sedges (family Cyperaceae) are close relatives of grasses with flowers enclosed by bracts and a grass-like appearance, but differ in having 3-sided stems, leaves in 3 ranks, no ligules, flowers being enclosed by a single bract, and fruits being 1-seed achenes rather than caryopses. Rushes (family Juncaceae) have brown or greenish petals and sepals and capsule-like fruits with numerous, tiny seeds. Despite their appearance, they are not especially closely related to grasses. A number of other species have the word "grass" in their name (blue-eyed grass, grass of Parnassus, arrowgrass, cottongrass, beargrass), but none are in the grass family (Poaceae or Gramineae).

5. The grass family is one of the most species-rich groups of plants. Worldwide, the Poaceae is the fourth largest family of vascular plants. Grass specialists (agrostologists) recognize 650-700 genera in the Poaceae and 10,000-11,000 species^{1*} in the world. Only the orchid (Orchidaceae), sunflower (Asteraceae or Compositae), and pea (Fabaceae or Leguminosae) families have more species. In North America and Wyoming, grasses are second only to the sunflowers in species richness. The third edition of Dorn's *Vascular Plants of Wyoming*

includes 274 native and introduced grass species. By comparison there are 483 species in the sunflower family in Wyoming.

6. Economically, the grass family is the most valuable of any group of vascular plants. The majority of our most important food crops belong to the grass family. These include: Corn or maize (*Zea*), Wheat (*Triticum*), Rice (*Oryza*), Oats (*Avena*), Barley (*Hordeum*), Rye (*Secale*), Sorghum (*Sorghum*), and Sugar cane (*Saccharum*). Several alcoholic beverages are derived from fermentation of malted grasses, as well as grain alcohol (an additive in gasoline). The grass family also provides forage for the majority of our domestic livestock – either on native rangelands or as hay or grain in feedlots. Bamboos are woody grasses of tropical areas and the Old World (poorly represented in North America) that are an important source of construction materials (pipes, scaffolding, flooring, furniture) and also food (bamboo shoots). Native Americans used pliable grass stems and leaves for basketry. Cultivated grasses are grown widely for lawns, parks, playing fields, and landscaping.

There is increasing interest in using cultivated corn and native grasses (especially switchgrass, *Panicum virgatum*) as biofuels to augment dwindling petroleum reserves and potentially reduce greenhouse gas emissions. This is not without controversy, as cultivation of these crops is less efficient than often touted. A recent study suggests that 35% of the surface area of the United States would need to be devoted exclusively to raising biofuel crops to meet the country's energy needs.

7. Ecologically, grasses are among the most important species in many native ecosystems. Grasses are often the dominant vegetation in the world's prairie and grassland habitats and a significant component of arctic and alpine tundra, wetlands, savanna, forest, and desert habitats. Members of the grass family are an important source of food for numerous grazing animals, ranging from insects to rodents, rabbits, and hooved animals. These in turn are food for carnivores. Grasses are significant for reducing soil erosion and providing material for nesting animals.

8. Grasses have a lot of tricks up their sheaths for avoiding herbivory and for dispersal. Most plants try to avoid being grazed by producing bad-tasting or poisonous chemical compounds, growing low to the ground (too low for many grazers to reach), or having sharp spines. Grasses typically lack all of these defenses and instead choose to simply grow faster than herbivores can eat them. Grass leaves are unusual in that they can continue to grow after they mature. In

¹ Grass experts don't agree on the number of genera and species and lots of other things. Best to only invite one to a party.

most plants, all the cells of a leaf are produced in the embryonic bud and growth is simply a matter of these cells expanding to their mature size. Any damage to such a leaf is usually permanent. By contrast, the active growing center of a grass leaf (called the meristem) is located near the base of the blade and continues producing new cells, even as the upper parts of the blade might be damaged or lost to grazers. So long as an herbivore does not pull out the entire grass plant or eat down below the meristem, a grass can continue to grow under grazing pressure. This ability also explains why a mowed lawn quickly grows back. Grass leaves actually grow in much the same way as our hair – thus it would be more correct to say someone has grassy rather than bushy hair if they are overdue for the barbershop.

While grass leaves are edible, they are tough on the teeth of grazing animals. This is due to the presence of specialized cells in the leaf epidermis called phytoliths (literally 'leaf stones') that are rich in silicon dioxide, the main ingredient in sand. Chewing grass leaves all day is not unlike nibbling on sand and long-term exposure can result in a lot of abrasion to tooth enamel. Many grazing animals have evolved high-crowned teeth that continue to grow from their base as they get progressively worn at the tips (not unlike the grass leaves themselves with their basal meristems).

Grasses have several strategies for reproduction and dissemination. While most grasses reproduce by seeds, a few species have replaced their ordinary florets with asexually-produced bulb-like structures called bulbils or bulblets. These look like miniature plants (which in a sense they are) and can immediately sprout into new individuals when they reach the ground, bypassing the seed stage. Being asexual, the new plants are genetically identical to their parent. Grasses can also spread clonally by above-ground stem-like stolons or below-ground rhizomes. Rhizomatous grasses often grow in lines or form dense turfs, making them well-suited for our lawn. Bunchgrasses do not spread widely by rhizomes but instead form dense tussocks. Annual grasses do not form large clumps or spread by rhizomes, but instead put all their reproductive energy into producing large quantities of seed during their short life span (just a few months). Annuals are designed to withstand periods of drought, fire, or other extreme events by living underground as seeds until conditions improve again.

9. Grasses have invented two forms of photosynthesis – one form specially adapted for desert environments. Photosynthesis is the chemical process by which green plants, algae, and certain bacteria and cyanobacteria convert solar energy into food. Most plant species (including a majority of grasses) utilize the

C3 pathway of photosynthesis, so-named because the first stable product produced during the process is a sugar with 3 carbon atoms. Some desert grasses utilize the C4 photosynthetic pathway, named for the four-carbon sugar created in the first step. More significantly, C4 species are able to efficiently store carbon in their cells to always keep the concentration of CO₂ gas low in the internal air spaces of the leaf, allowing CO₂ to be more readily taken up from the atmosphere. By being more efficient at carbon uptake (CO₂, water, and sunlight are the raw materials in making simple sugars in photosynthesis), C4 grasses are able to close the pores in their leaves (called stomates) during the hottest parts of the day, thereby reducing loss of water via transpiration and evaporation. Thus C4 grasses are better adapted for survival in hot, arid climates than their C3 cousins. C4 grasses are often called warm season grasses because they tend to reproduce and do most of their growth during the warmest seasons of the year (as opposed to C3 or cool season grasses, which reproduce and flourish in the spring when soil water is not limiting).

10. The composition and abundance of grasses in the environment is changing. While nothing stays the same forever, our native grassland communities are undergoing a number of changes, many of which are not desirable. Many grasslands, such as those of the Great Plains, Washington's Palouse Prairie, and California's Central Valley, occur on rich soils that are well suited for agriculture (especially the culture of edible grasses like wheat and corn). Few areas of native prairie remain in these regions. In the more arid parts of the west, grass communities have been historically used as rangelands for domestic livestock. Too often these lands have been subjected to prolonged grazing with inadequate rest or rotation, grazed in inappropriate seasons (such as the critical window in spring when perennial grasses produce flowers and seed), been grazed by too many animals, or been converted from native grasslands to short-lived seedlings of exotic species prone to failure in periods of extended drought. The consequences of such management are rangelands with decreased grass cover, accelerated soil erosion, replacement of edible cool season perennial bunchgrasses with less palatable warm season or annual species, or shifts in abundance of native grasses towards less edible shrubby species. Predicted climate changes (more drought, higher temperatures) will likely exacerbate the trends towards woodier vegetation and annual grasslands that are more prone to wildfire and less productive. While few grass species are in danger of extinction, major shifts in the abundance and distribution of important grasses can significantly diminish the value of rangelands for commercial use and as habitat for wildlife.

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