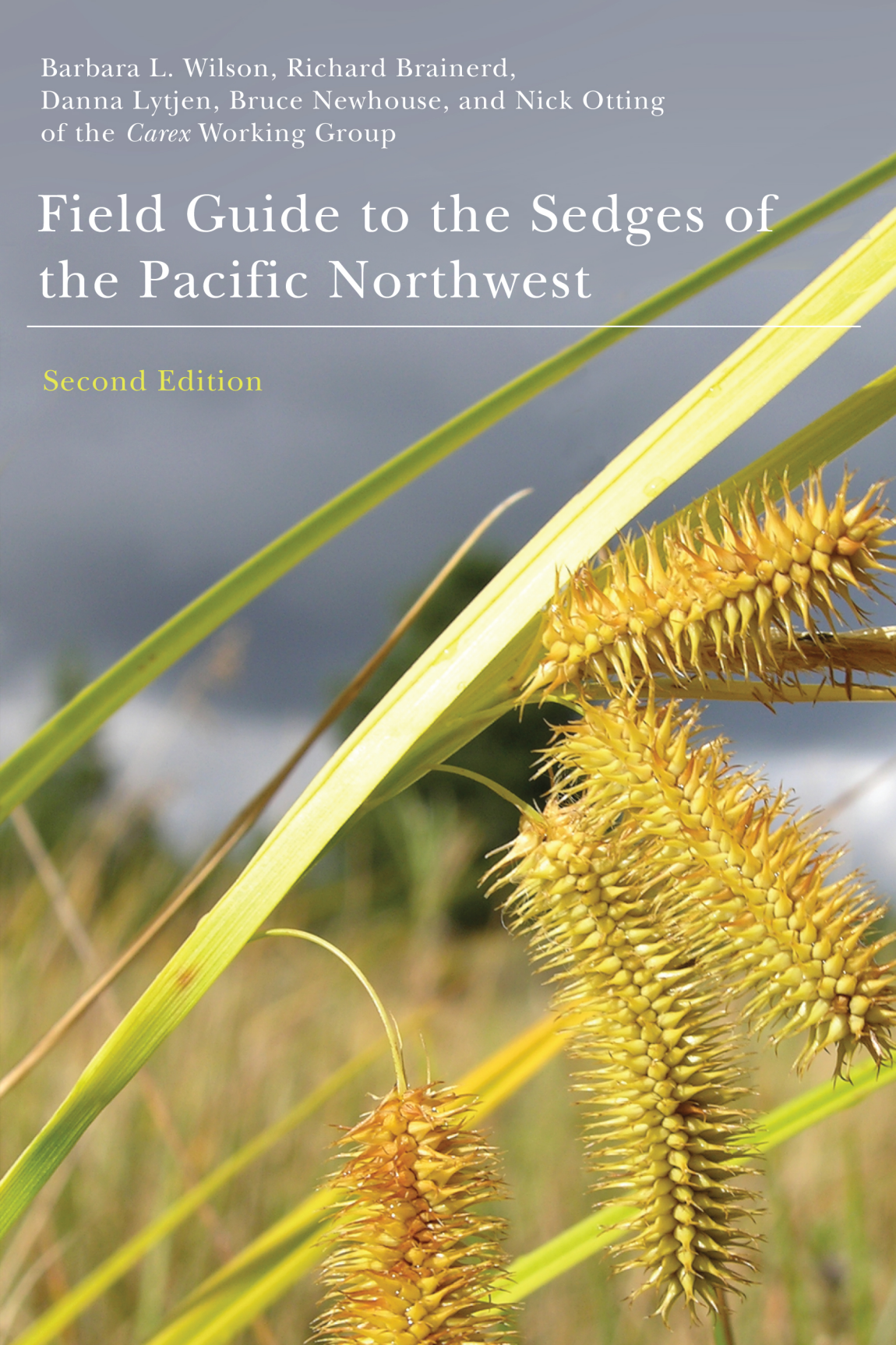
Barbara L. Wilson, Richard Brainerd,
Danna Lytjen, Bruce Newhouse, and Nick Otting
of the *Carex* Working Group

Field Guide to the Sedges of the Pacific Northwest

Second Edition



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Oregon State University Press
Corvallis

www.carexworkinggroup.com
the place to go for updates to the identification key
and for other news of Pacific Northwest sedges

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Field Guide to Sedges of the Pacific Northwest

is dedicated to

Danna Lytjen
(1947 - 2006)

Danna was a charter member of the *Carex* Working Group and was instrumental in bringing this book into existence. She was an insightful observer of nature, an accomplished field biologist, a mother, and a grandmother. Her abilities as a scientist, her love of nature, and her kindness are greatly missed, but they live on in the hearts of those who knew her.

“I would like to know the grasses and sedges—and care. Then my least journey into the world would be a field trip, a series of happy recognitions.”—Annie Dillard

“I would like to go into perfectly new and wild country. I wish to lose myself amid reeds and sedges and wild grasses that have not been touched.”—Henry David Thoreau

Botanically, where there’s sedge, there’s often confusion.—Anon.

Contents

Acknowledgments

The *Carex* Working Group (CWG) began in 1993 when botanists intrigued by taxonomic and ecological issues in the genus *Carex* met at the Oregon State University Herbarium to exchange ideas. At that initial meeting, Dr. Dan Norris suggested that we produce an Atlas of Oregon *Carex*. Peter Zika became the informal leader of the CWG. This careful observer of details inspired us, showed us identification tricks, and led us on field trips. Other early members included Keli Kuykendall, Dr. Francisco (Ankie) Camacho, Jim Oliphant, and Dr. Kate Dwire.

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Introduction

Sedges are fun! Repeat this mantra whenever you find yourself facing the challenge of identifying a really difficult sedge. As with many of the more difficult plant groups, a positive attitude and a good sense of humor can smooth the way when you're stuck. Good identification tools help a lot too. Hopefully this book will assist you in becoming more comfortable with identifying sedges.

Carex—sedge—is the largest plant genus in the Pacific Northwest (PNW) with 164 species, and a total of 171 taxa when all subspecies and varieties are counted. These plants play essential roles in a variety of ecosystems and habitats, ranging from the seacoast to alpine slopes, from marshes, lakeshores, and river edges, to dry forests and sagebrush steppe. Particularly in wetlands, sedges often are community dominants, keystone species essential for stabilizing soil, maintaining stream quality, and providing habitat for fish, wildlife and plants. Because of their importance, sedges are frequently used for habitat restoration and enhancement projects. Knowledge of native ranges, habitat requirements, and ecological functions of sedges is essential if these projects are to be successful. Such knowledge begins with identifying the species that are present or that you want to reintroduce.

Sedges have a reputation for being devilishly difficult to identify. Much of the challenge comes from the fact that the plant parts used to identify most sedges are tiny, show great similarity between different species, and have unfamiliar names such as "perigynium." But once you look carefully and master a bit of terminology and plant structure, it turns out that there are some useful "handles" you can use to make sedge identification a manageable, even enjoyable, activity. And having a name for your sedge is a starting point for learning about it and the places where it lives.

This book will be useful for professional botanists, ecologists, wetland scientists, wildlife biologists, and amateur plant enthusiasts. It contains an identification key and descriptions, range maps, photographs, and drawings of all *Carex* taxa known to occur naturally in Oregon and Washington. It also includes information on ecology, and morphology of sedges.

We hope this book will help you to identify most of the sedges that you encounter, and that you won't have to put unidentified "*Carex* sp." on your species list ever again.

Carex Ecology

Sedges perform important ecological functions in a variety of wetland and upland systems. They may be community dominants in an impressive diversity of habitats. They are most valued for stabilizing soil and as food for wild and domesticated animals. A few introduced species may spread as weeds, so understanding their methods of dispersal is important.

Diversity

Carex reach their highest diversity in the north temperate and boreal zones. In the Pacific Northwest (PNW), *Carex* are especially diverse in the alpine zone. Sedges can achieve high species diversity in small areas because they tend to be microhabitat specialists. A few have wide ecological tolerances, and grow in a variety of habitats across the region, but most grow best in a very specific substrate, range of acidity, water and light regime, and elevation. Perhaps most importantly, each species has particular needs for water: deep water all year, deep water in spring and then dry, more or less dry all year, etc. Different species can occupy different zones across the hydrologic gradient around a pond, forming concentric rings from *C. utriculata* in the water through *C. pellita* and *C. scoparia* in seasonally wet marsh, to *C. pachystachya* on the mesic fringes and *C. tumulicola* on the dry slope above.

Climate change will seriously affect the distributions of the many PNW sedges that have limited habitat tolerances. The most vulnerable may be local populations of species such as *C. anthoxanthea, C. circinata, C. pluriflora,* and *C. macrochaeta* that were probably widespread in the PNW at the end of the last ice age, 10,000 years ago. As the climate warmed, these species migrated north, leaving behind the few remnant PNW populations in small, isolated pockets of suitable habitat.

Carex Below Ground

Sedge roots are probably much more interesting than we know. The roots of wetland species are adapted to maintain aerobic metabolism even in water-saturated soils. Air spaces called aerenchyma occur between the cells and allow diffusion of oxygen throughout *Carex* roots, stems, and leaves. This diffusion is efficient enough that excess oxygen may leak from *Carex* roots into adjacent saturated soils, where it oxidizes iron to produce "rust" surrounding the roots (Figure 1).

Most plants depend on an extensive network of mutualistic mycorrhizal fungi to obtain nutrients from the soil and water. However, about half the species in the sedge family lack mycorrhizae and many others are only facultatively mycorrhizal.

Figure 1. Roots of *Carex scoparia* in mud.

In the *Carex* that have mutualistic root fungi, arbuscular mycorrhizae (AM) may be the most common type. Ecotomycorrhizal associations occur in some sedges, such as *Kobresia myosuroides*. Dark septate fungi (DSF) occur in many sedges, especially in habitats where AM do not thrive, such as alpine tundra. The relationship of DSF and their *Carex* hosts needs more study, but appears to benefit both parties. A single plant may host both DSF and AM. Some sedge roots host other fungal species whose role is unclear.

Carex of wetlands frequently lack mycorrhizae because water-logged soil has too little oxygen to promote growth of mycorrhizal fungi. Several sedge adaptations contribute to this independence from mycorrhizal fungi (Muthukumar et al. 2004). Long rhizomes can explore the soil, producing roots in nutrient-rich patches and transporting the nutrients to other parts of the plant. Some sedges obtain nutrients unavailable to mycorrhizal fungi through root clusters in the uppermost soil layer, which contains much litter that could decompose to release nutrients, but which dries out too suddenly and thoroughly to provide good habitat for mycorrhizae. Each season, some sedges transport 80% or more of the nitrogen and phosphorus from their dying leaves to growing shoots. Arctic and alpine sedges need not wait for completion of the slow process of decomposition in cold soils because they can absorb small amino acids such as glycine and use them as a nitrogen source. These sedges also have enzymes on their root surfaces that remove phosphate ions from organic compounds in soil.

Not all below-ground sedge parts are roots. In fact, the most consistently perennial part of a *Carex* is its rhizome, an underground stem that gives rise to both roots and leafy shoots. Rhizomes explore the habitat, transfer nutrients from areas of concentrated resources to the shoots that need them, and determine how sedges compete with neighboring plants.

Sedges, Streams, and Erosion

Sedges exert some of their most important effects on ecosystems by stabilizing soils in prairies, on streambanks, and in wetlands. In wet sedge meadows, 50–75% of the biomass is below ground. Rhizomatous, community-dominant sedges such as *C. nebrascensis, C. aquatilis, C. angustata,* and *C. utriculata* play an important role in stabilizing streamside soils east of the Cascades. Their long, strong

rhizomes and roots form a dense network that is tougher than that of dominant riparian zone grasses such as Kentucky Bluegrass (*Poa pratensis*) and Tufted Hairgrass (*Deschampsia cespitosa*). This network prevents both loss of small soil particles and mass wasting of streambanks. Along smaller streams, long rhizomes actually cross below the waterway, knitting the banks together. Even cespitose sedges can hold soil more effectively than one might expect (Figure 2).

Figure 2. Roots and soil-holding capacity of a small *Carex serratodens.*

Sedges are an important component of the streamside vegetation that provides habitat structure for diverse riparian invertebrates, which are part of the foundation of both aquatic and terrestrial food chains. Sedges also shade stream edges, providing cover for salmon, trout, and other cold-water species. This is especially important in relatively treeless reaches east of the Cascades, such as parts of Oregon's John Day River where *C. nudata* may provide the only shade for fish.

Streambank stabilization by sedges can be seriously decreased by grazing livestock or elk. Ungrazed or lightly grazed sedges translocate adequate organic carbon to strengthen and extend rhizomes and roots, but more heavily grazed sedges cannot support the below-ground tissue, and the network of rhizomes and roots deteriorates. In one experiment, ungrazed wet sedge meadows had 60% more below-ground biomass and the soil infiltration rate was more than twice as high as in comparable grazed meadows. Reduction of below-ground biomass can result in stream incision, and the lowered water table further decreases the vigor of the sedge stands, which leads to additional loss of below-ground biomass. Not only does the reduced below-ground biomass lead to stream downcutting, but it also reduces forage production, leading to a spiral of riparian degradation when the animals graze the remaining stubble more intensely. With loss of herbaceous vegetation, grazers may resort to browsing willows with similar effects on their root systems, leading to additional erosion and stream incision. Grazing in sedge meadows while soils are wet can cause soil compaction and churning, directly damaging rhizomes and roots, and reducing their ability to penetrate and stabilize the soil.

Restoring the healthy riparian sedge meadows that stabilize streambanks can be difficult. Along narrow, deeply incised streams, the water table often drops too low to permit seedling establishment.

Too often, projects intended to improve stream habitat include planting of willows in healthy riparian sedge meadows. The planted willows usually die because they are poorly adapted for growth in the deep, anoxic soils. Instead, willows should be planted in disturbed soils to which they are adapted and which would benefit from stabilization by their roots.

Sedges as Forage

Sedges provide nutritious forage for animals capable of digesting cellulose, and can be more nutritious or more easily digested than co-occurring grasses. They are especially important in early spring and late summer because many species green up earlier and remain green later than most grasses. Evergreen species such as *C. geyeri* are important in winter and early spring.

Grazing animals may selectively eat some sedge species, passing by other potential forage plants to do so. For example, cattle select *C. rossii* in sagebrush steppe in spring. Some bison herds consume mainly *C. atherodes* at all seasons of the year. However, many other sedges are tough or have serrate leaf margins that reduce palatability, and are consumed only when preferred forage plants are gone.

The animals that eat *Carex* are diverse. Caterpillars of some butterfly and moth species do so; most are thought to be generalists, eating several species of graminoids, but some are specialists, feeding only on *Carex*. Arctic geese and swans graze so intensively on *C. aquatilis* that they cause shifts in plant communities and in some places even denude the soil. Waterfowl, gallinaceous birds, and small seed-eating birds all eat *Carex* perigynia, sometimes in large quantities. *Carex* foliage is reported to be a significant food source for many mammals: voles, ground squirrels, prairie dogs, beavers, muskrats, pikas, rabbits, bears, bighorn sheep, bison, musk oxen, moose, elk, reindeer, deer, sheep, cattle, and horses. About a third of the diet of bison in Yellowstone National Park is wetland *Carex;* for some Canadian herds, *C. aquatilis* and *C. utriculata* form more than 70% of the winter diet, and for others, *C. atherodes* is the most important food plant at all seasons. Although bears are not specialized to digest cellulose, they may eat large quantities of wetland sedges, especially in spring, digesting mainly the shoot bases and starchy rhizomes. In uplands, bears eat *C. geyeri* in spring.

Effects of herbivory on *Carex* populations depend in part on the growth form of the plants. Cespitose species are dependent on seeds for reproduction. Therefore, although individual plants survive repeated grazing, populations eventually decline even on moderately grazed ranges. For example, *C. petasata,* a cespitose species of sagebrush steppe, declines with grazing and is considered an indicator of range condition, providing 2–3% cover on ranges in excellent condition, less under pressure of grazing. *Carex rossii* and its close relatives can maintain populations despite moderate grazing in part because many of their

perigynia are produced on basal spikes too short to be eaten by large animals. Cespitose *C. filifolia* is a source of high-protein forage for livestock and wildlife. It increases under moderate grazing that reduces grass competition, but declines under heavy grazing that prevents seed set or favors monocultures of very short, highly grazing-tolerant grass species. In alpine sites, even very light grazing (one day per year) may cause declines in abundance and cover of *C. filifolia*.

Rhizomatous sedges have the potential to persist and spread in the near-absence of seed production, and therefore withstand grazing better than cespitose species. Some are important forage species (e.g., *C. nebrascensis* and *C. utriculata*), at least after their habitat dries seasonally so that animals have easy access to them. Grazing in fall tends to reduce nutrient storage in rhizomes and may cause harm. Grazing in moist springtime conditions may do less direct harm to plants, but must be balanced against trampling damage to soil and rhizomes. Although the rhizomatous *Carex* may persist under moderately heavy grazing, both above-ground and below-ground biomass are reduced, with potentially harmful effects on their wetland ecosystems.

A few short, wiry, rhizomatous sedges increase on degraded ranges where heavy grazing has reduced competition from grasses. For example, *Carex praegracilis* becomes a community dominant on heavily grazed, seasonally wet, alkaline ranges. In the northern Great Plains, *C. duriuscula* and *C. obtusata* respond the same way in heavily grazed prairies. Dominance by these unusually grazing-tolerant species is accompanied by a reduction of plant diversity, particularly of native species.

Carex and Fire

Effects of fire have been studied in detail in few sedge species. Most *Carex* are well adapted to survive fire because of their growth form and, in many cases, their habitat. *Carex* foliage may burn but the growing points are protected below the soil surface. Survival and cover are greater after low-intensity fires than after high-intensity fires, with the qualification that the intensity that matters is at the rhizome level. Fire that consumes the duff layer can kill upland forest sedges with shallow rhizomes, such as *C. concinnoides*. Many *Carex* have long-lived seed banks that contribute to revegetation after fire and sedges can effectively stabilize soils in burned areas. For example, ten years after the North Waldo Lake fire in the Oregon Cascades, most of the ground cover in uplands is naturally regenerated *C. inops* and *C. rossii* and, in moist drainages, *C. kelloggii.*

Sedges are most susceptible to fire in late spring and early summer, when they are most physiologically active. Fall burns may harm sedges by interrupting storage of nutrients in rhizomes, but some species have responded better to fall burns than spring burns (e.g., *C. duriuscula* in northern prairies). Usually, early

spring fires do the least damage. Some species (e.g., *C. rossii*) seem unaffected by season of the fire. Prescribed burning of wet sedge meadows during drought years should be avoided because the dry litter layer and organic soil can burn, killing sedge rhizomes and roots.

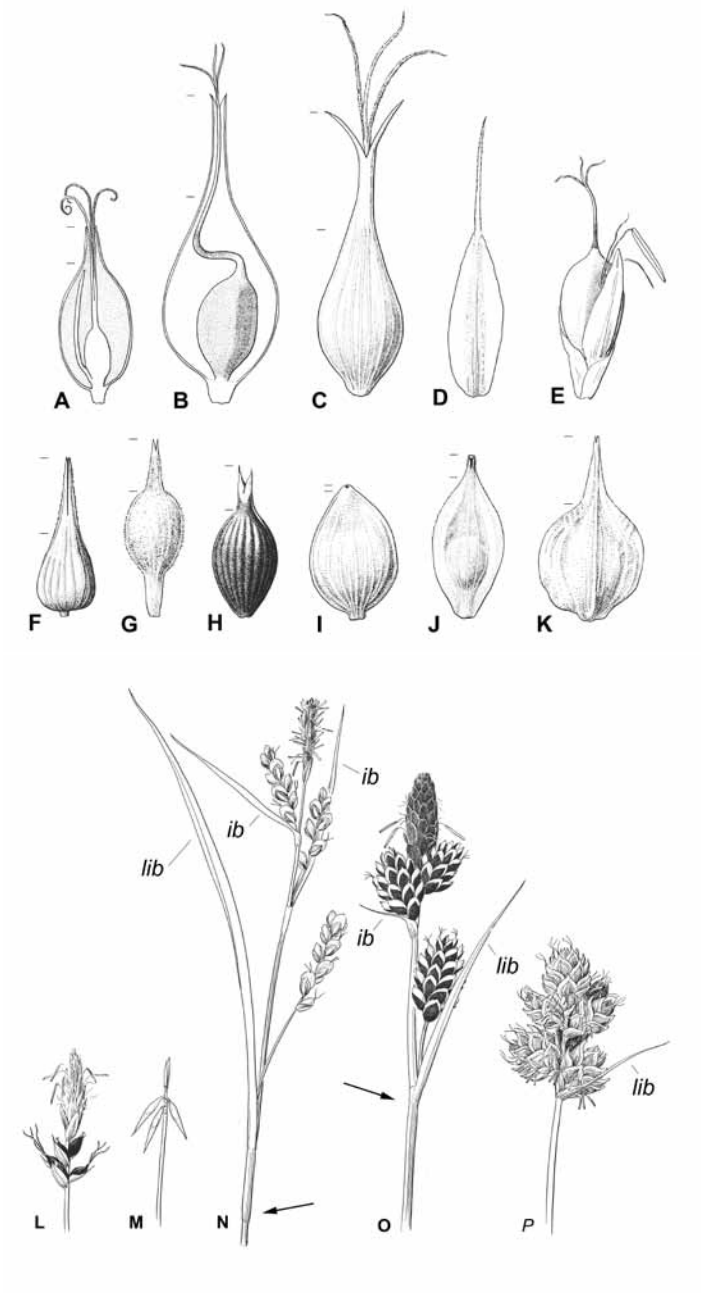
Some upland species, such as *C. deflexa, C. geyeri, C. inops,* and *C. rossii,* thrive after fire because of reduced competition and increased soil nutrients. Both survival of mature plants and recruitment from the long-lived soil seed bank contribute to these post-fire sedge populations. Germination of *C. rossii* seeds in the seed bank may be aided by exposure to heat from fires.

Carex geyeri is an upland community dominant in open conifer forest. Prior to settlement, many of its habitats had a history of frequent, low-intensity fires. Its rhizomes survive such fires well and plants may flower the first year after the fire. In the Blue Mountains of Oregon, seed germination also contributes to an overall increase in *C. geyeri* cover after a fire. At some drier sites, competing bunchgrasses may benefit from low-intensity fire more than *C. geyeri,* leading to a reduction in *C. geyeri* cover. Rhizome survival and recruitment from the seed bank both decrease after high-intensity fires, delaying a return to pre-fire cover for seven years or more.

Carex filifolia is an important "bunchgrass" sedge that lives at the dry edge of the ecological niches *Carex* can occupy, in short-grass prairie and sagebrush steppe. It is especially vulnerable if it experiences two or more stressors such as fire, grazing pressure, competition, low precipitation, and poor soil. Severe fires may reduce cover and productivity for fifteen years or more. The effects of low- and moderate-intensity fires vary. If adequate moisture is available, plants recover in two to four years, but low rainfall delays recovery. *Carex filifolia* should not be burned during drought. Recovery after fire depends much more on rhizome survival than recruitment from the seed bank, though both occur. Usually, flowering is reduced the year after a fire, but lower competition and post-fire influx of nutrients may result in unusually high seed production if enough moisture is available. Fire may benefit *C. filifolia* by setting back competing shrubs or grasses, but it may also encourage weed invasion. Resting burned sites from grazing for at least one year facilitates recovery.

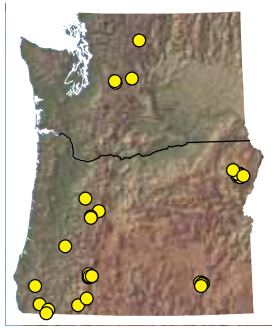
Wet sedge meadows may dry out enough to burn in summer or fall, but fire has little effect on deep-rooted wetland species such as *C. aquatilis*. This species may produce more foliage the year after a fire if competing vegetation is killed and additional nutrients are released into the soil. However, prescribed burns have damaged *C. aquatilis* populations already stressed by grazing. If prescribed burns are used as a management tool, pairing them with a rest from grazing will allow root reserves to build up. Ideally, the rest would extend from the season before the burn to two or three years after.

Sedge Parts



Carex abrupta Mack.

Common name: Abrupt-beak Sedge
Section: *Ovales* Key: J



Key features:

- Cespitose, with gynecandrous spikes & winged perigynia
- Perigynia brown and strongly veined on both faces
- Inflorescence a single dense head
- Meadows at moderate to high elevations in mountains

Description: **Habit**: Cespitose. **Culms**: 18-70 cm tall. **Leaves**: 1.5-3.7 (-4.9) mm wide. **Inflorescences**: Dense to slightly elongated heads 1.2-2.2 cm long, (6-) 9-20 mm wide. Spikes gynecandrous. ♀ **scales**: Reddish brown with lighter or green midstripe, 2.4-3.9 mm long, shorter than and as wide as or narrower than the perigynia. **Perigynia**: Reddish brown or dark brown, lacking metallic sheen, typically elliptic to lance-ovate, sometimes lanceolate and nearly wingless, usually planoconvex, (2.9-) 3.6-5.4 mm long, 1-2.1 mm wide, with 3+ conspicuous veins that reach or exceed the top of the achene on each face of the perigynium, with wing usually 0.2-0.3 mm wide and sometimes curved toward the ventral surface, making the perigynium boat-shaped. Beak tips coppery or reddish brown, usually unwinged, brown, and parallel-sided for the distal 0.5-0.8 mm; (1.6-) 2-2.3 mm from top of achene to tip of beak. Stigmas 2. **Achenes**: Lenticular, 1.2-1.8 mm long, 0.7-1.1 mm wide, (0.3-) 0.4-0.5 mm thick.

Habitat and Distribution: Moist meadows and streambanks at moderate to high elevations in mts; Siskiyous, Cascades, Wallowas, and Steens Mt., OR, and north Cascades, WA. OR to ID, S to CA and NV.

Identification Tips: *Carex abrupta* resembles *C. pachystachya* but has more strongly veined perigynia, especially on the ventral surface, and perigynium wings that may bend in toward the ventral surface more and narrow irregularly toward the beak. *Carex pachystachya* perigynia have a metallic sheen and usually lack veins on the ventral surface; if ventral veins are present, they end at or below top of the achene, or rarely 1 or 2 of them may extend onto the beak. *Carex microptera* has perigynia flat except over the achene, proportionately smaller achenes, and a green and black inflorescence. On Steens Mt., both *C. haydeniana* and *C. microptera* have unusually prominent ventral veins, similar to those of *C. abrupta,* but have either longer or more clearly defined beaks.

Comments: Many SW OR plants that have been identified as *C. abrupta* are odd. They may represent one of the NW CA species such as *C. subbracteata*, but more research is needed.

top left: pistillate scales, perigynia
top right: inflorescence
bottom: habit

Carex albonigra Mack.

Common name: Black-and-White Sedge
Section: *Racemosae* Key: F

Key features:

- Inflorescence black or dark brown, the ♀ scales with hyaline margins
- Lower spikes on short peduncles
- Rocky alpine ridges and meadows

Description: **Habit**: Cespitose. **Culms**: 10-40 cm tall. **Leaves**: 2.5-5 mm wide. **Inflorescences**: 2-4 spikes, each 0.8-2 cm long, the lateral spikes ♀ and erect on short peduncles, the terminal spike gynecandrous. ♀ **scales**: Brown to blackish, about equal to the perigynium, tip acute, the midrib dark like the rest of the scale, margins hyaline, contrasting with the rest of the inflorescence. **Perigynia**: Ovate, more or less flattened except over the achene, dark brown, 3-3.5 mm long, 2-2.5 mm wide, papillose, with a small beak 0.3-0.4 mm long. Stigmas 3. **Achenes**: Trigonous, nearly filling bodies of perigynia.

Habitat and Distribution: Dry, windblown alpine and subalpine rocky slopes and meadows where little snow accumulates in winter; mts of N WA. AK to NT, S to WA and NM.

Identification Tips: *Carex albonigra* inflorescences are dark except for pale margins of ♀ scales. Spikes are on stalks so short that they can superficially seem sessile, like the sessile spikes of *C. media* and *C. pelocarpa*. *Carex media* has more contrast between dark scales and greenish or lighter brown perigynia. *Carex pelocarpa* has a shorter, more uniformly dark inflorescence. *Carex atrosquama* has obtuse ♀ scales that are shorter than the perigynia and less conspicuously pale-margined, and its perigynia are a golden brown except at the dark tips.

Comments: Plants previously called *C. albonigra* in the White Mountains and central Sierra Nevada of California have recently been described as a distinct species, *C. orestera* Zika.

top left: perigynia
top right: inflorescence
center left: inflorescence
bottom left and right:
habit