WETLAND SEDGES *of* ALASKA

Gerald Tande
and
Robert Lipkin

Alaska Natural Heritage Program
Environment and Natural Resources Institute
University of Alaska Anchorage
707 A Street, Suite 101, Anchorage, AK 99501

Prepared for the
U.S. Environmental Protection Agency
Phil North, EPA Project Officer
514 Funny River Road
AOO/Kenai, AK 99669

2003

Contents

Acknowledgments

This guide was funded by the U.S. Environmental Protection Agency (EPA) with the oversight of Phil North, EPA Project Officer of the Kenai Field Office, as part of an ongoing effort to increase the awareness and appreciation of Alaskan wetlands. His efforts and coordination are much appreciated.

Robert Lipkin, Alaska Natural Heritage Program (AKNHP) botanist, and Keith Boggs, Program Manager (AKNHP), were essential in developing the original proposal for this project. Much of the early literature searching was conducted by Susan Klein, Assistant Ecologist, AKNHP; her assistance, and that of Michelle Sturdy, University of Alaska Anchorage Student Intern, are gratefully acknowledged.

Keys were prepared by Dr. David F. Murray, Professor Emeritus, University of Alaska Museum (UAM) Herbarium, and Robert Lipkin (AKNHP). Species distribution maps were produced by Julie Michaelson (AKNHP) with ARC/INFO and ArcView software and are based on data from the UAM Herbarium databases provided by Alan Batten. The final prepress document was prepared by Wanda Seamster, Graphic Designer for the Environment and Natural Resources Institute, University Alaska Anchorage.

Grateful acknowledgment is made to the photographers and publishers, agencies and institutions, for the use of or adaptation of materials produced or controlled by them. Front cover photographs of *Carex lyngbyei* were provided courtesy of Logan Sander, Oregon State University. Complete credits are listed under the Photo and Illustration Credits section at the back of the guide.

Sincere thanks also goes to the many botanists of previous taxonomic treatments of sedges that have provided the basis for this abbreviated version to the wetland sedges of Alaska. Finally, we appreciate the critical review of the manuscript by botanists Dr. Matthew Carlson (AKNHP), and John DeLapp of the U.S. Fish and Wildlife Service Anchorage.

About This Guide

Overview of the Genus *Carex*

Alaska's wetlands occupy 43.3 percent of its 403,247,700 acres (163,188,554 ha). Most regions of the state have extensive areas of bogs, fens, wet and moist arctic and alpine tundra, lakes and ponds, wet forests, mudflats, and fresh and saltwater marshes. As a result, there are many plants within Alaska that are adapted to wetlands or that are associated with wetland ecosystems.

Many of the most common and important plants of Alaska's wetlands are sedges (the genus *Carex*). They are the predominant plants in many wetlands, with some species forming nearly pure stands over large areas. Sedges are also the largest genus of plants in the state and constitute the most diverse and important member of the plant family Cyperaceae, which also includes the cotton-grasses, bulrushes, clubrushes and spikerushes. The USDA-NRCS (2003) National Plants Database recognizes 155 species, subspecies, and varieties of sedges in Alaska, of which 113 may be found in wetlands.

Within Alaska, the sedges are not only diagnostic of different wetland types but also serve as the preferred food for many wetland animal species and provide important hydrologic and landscape modifying functions. Knowing the sedges and being able to identify them is, therefore, fundamental in the identification of wetlands as well as for understanding the functioning and importance of Alaskan wetland ecosystems.

Sedges are, however, often regarded as difficult to identify and can be intimidating to non-specialists, as well as to many professional biologists and wetland scientists who conduct wetland studies. Popular picture guides to common plants are generally inadequate for accurate species identification, and typically include few, if any, sedges.

Many of the existing technical guides to Alaska's flora, such as Hultén (1968) and Welsh (1974), may also be of limited use to non-botanically trained workers because of their technical nature, lack of adequate illustrations and descriptions, and the fact that they are in need of taxonomic revision. In some cases, the identification keys in these works contain errors, resulting in mis-identifications and frustration to inexperienced workers. In the 25 to 30 years since their publication, new species have been identified, their taxonomy has changed, and our knowledge of the habitat and ranges of many species has been expanded.

We prepared this guide to provide a treatment for some of the more common and ecologically important Alaskan wetland sedges likely to be encountered by wetland

scientists and naturalists. We also hope that this guide will further involve the public in wetland protection by furnishing them an accessible means to help appreciate, identify, and evaluate wetlands.

The Role of Sedges in Wetlands

Sedges are ecologically important and can be found in many habitats. They have adapted to living in both wet and dry environments, and although many species occur over a range of environments, most Alaskan taxa tend to live in wet areas.

Wetlands are "lands where saturation with water is the dominant factor in determining the nature of soil development and the types of plant and animal communities living in (an) area" (Viereck et al. 1992). They include areas influenced by fresh, saline, and brackish (slightly saline) waters. Fresh water environments include river and stream banks; lake and pond margins; marshes and wet meadows; nonforested bogs and fens; open and closed forested woodlands; swamps; and grasslands and alpine tundra. Saltwater and brackish environments include seashores, estuaries and tidal marshes.

Characteristic attributes of a wetland, including vegetation (particularly species composition and canopy structure), water (hydrology and water quality), soils (nutrient regime, pH, and organic content), and wildlife use, are functionally interconnected. For example, wetland vegetation is integral in supporting food webs, creating habitats for a variety of animal species, removing sediments and toxic compounds from storm water, stabilizing river and streambanks and providing erosion control. Many of the sedges discussed in this manual play these roles to varying degrees as part of the wetland ecosystems in which they are found. Many of these functions are useful for wetland restoration, creation, and enhancement.

Sedges play a significant role in supporting food webs by recycling nutrients and using energy for photosynthesis to produce biomass for consumers such as grazing animals, the animals that feed upon these higher organisms and, ultimately, also decomposers (Sather and Smith 1984). Sedges function under both aerobic (oxygen-rich) conditions, above and within the water and air columns, and anaerobic (oxygen-deprived) conditions, rooted in wet soil or muck. They provide the opportunity for nutrient cycling between these extremes and create an energy flow in wetland ecosystems— pumping nutrients to other organisms as they grow, die and provide detritus to other plants and animals inhabiting wetland ecosystems. In bogs, nutrient turnover is slow because of low nutrient input from the litter and slow decomposition rates in the waterlogged substrate. In these habitats, sedges serve to cycle nutrients faster than most mosses characterizing these systems (Damman and French 1987).

Sedges are the dominant vegetation associated with highly productive systems such as coastal salt marshes, freshwater sedge marshes, and highly productive floating

vegetation mats of sedges and forbs in groundwater discharge areas. The latter include such areas as the floating fens of the Tanana Flats of interior Alaska, fens restricted to shoreline edges, and oxbows lakes that receive periodic imports of silt (Racine and Walters 1991).

Waterfowl and fur-bearing animals abound in these active and productive wetlands, and wildlife is distinctly concentrated in these areas of the vast boreal and arctic ecosystems. Sedge-dominated wetlands occupy a unique position in a transitional zone between aquatic and terrestrial environments, providing fertile environments, which provide habitat for a diverse range of plants and animals, supporting a complex web of energy transfers. Biotic density and diversity of this transition zone are frequently higher than that in the adjacent uplands. (Rubec et al. 1988).

Wildlife values associated with these environments have been a prime reason for the recognition and protection of wetlands. Sedges provide the dominant source of energy during critical stages in the life cycles of many species of birds and mammals. They provide feeding, breeding, nesting, escape, and staging habitat for waterfowl, shore birds, raptors, and songbirds. In addition to these roles, sedges also provide habitat structure for production of macroinvertebrates (invertebrates, crustaceans, insect larvae) that many other species of animals are dependent upon.

Most wetland sedge species produce a large crop of water-dispersed fruits. These are eaten by a variety of animals, such as insects, water birds, passerines, and some mammals. The leaves are often used as nesting material, and some mat-forming species provide shelter and nesting sites (Cooke 1997). Sedge and graminoid meadows (a mixture of sedges and grasses) in western Alaska (Yukon-Kuskokwim Delta) provide critical habitat for nesting sites and protection from mammalian predators for nearly the entire populations of cackling Canada and emperor geese and more than half of the continental black brant and Pacific flyway population of western white-fronted geese. These habitats provide a practically unlimited supply of highly nutritional forage for these species (Lensink and Rothe 1986).

On the Copper River Delta, trumpeter swan nesting habitat is highest in plant communities dominated by emergent sedges and horsetails (*Equisetum* spp.); seeds of sedges provide approximately 75 percent of metabolizable energy for the rare dusky Canada geese during incubation; and the seeds and leaves of sedges from the edge of fresh water meadows provide critical fall forage for dusky and migrant Taverner's Canada geese (Lensink and Rothe 1986).

In southeast Alaska, coastal sedge marshes are important staging and feeding habitat for migrating snow geese, Canada and white-fronted geese (Lensink and

Rothe 1986). These authors further state that,

> "...Of habitat types occurring in Alaska, the " vegetated intertidal", usually associated with major river deltas, is of key importance wherever it occurs. Although used by most species of waterfowl and shore birds, intertidal habitats are uniquely important to geese as both nesting and staging areas, and it seems likely that the favorable habitat and geographic isolation of major coastal wetlands contributed to the evolution of many subspecies of geese unique to Alaska, and on which entire populations remain dependent, e.g., the tule white-fronted goose and cackling, dusky and Vancouver Canada geese...."

In the Yukon Flats, gradually sloping shorelines with extensive shallow areas support emergent sedges and are bordered by expanses of wet meadows of sedges and grasses. These areas are favored by dabbling ducks for feeding habitat where sedges are eaten and also provide habitat for abundant macroinvertebrates populations that they also feed upon (Lensink and Rothe 1986).

Numerous mammals are adapted to the water and hydrophytic vegetation of the wetland habitat, while other upland species use wetlands for food, escape cover, and reproductive habitat. Sedges serve as a food for many mammals. The widely distributed muskrat is the most common furbearer occurring in a variety of wetland types of the boreal forest; they feed heavily on sedges in water bodies with marsh margins. Muskrats in turn support other furbearers such as mink. Many other small and large mammals such as mice, voles, water shrews, weasels, and hares, moose, deer, caribou, and bears are common beneficiaries of the wetland environment. Estuaries further support numerous marine species.

Longawn sedge (*C. macrochaeta*) is an important summer forage species for mountain goats in Alaska and British Columbia (Pojar and MacKinnon 1994), and is also reportedly the most important component in the alpine diet of Kodiak brown bears (Atwell et al. 1977). Brown bears also rely upon the coastal sedge marshes along the Cook Inlet shoreline of Lake Clark and Katmai National Park and Preserves (Bennett 1996). Musk oxen are very dependent on wetland habitats, where they feed almost exclusively on wet sedge meadows (Tarnocai and Zoltai 1988).

Fish also rely on sedge dominated wetlands. Marshes provide spawning grounds, escape and feeding habitat for many important freshwater species. Coastal estuarine marsh habitats are used by young salmon for seawater adaptation, feeding, refuge from predators and staging areas for migration. Detritus from Lyngbye's sedge (*C. lyngbyei*) is an important food source for juvenile salmon in British Columbia estuaries (Glooschenko et al. 1988).

Sedges improve water quality by acting as filters to remove pollutants and sediments (Sather and Smith 1984); some (e.g. *C. echinata*) have even been documented to remove heavy metals by plant uptake.

Sedges also provide hydrological functions such as flow stabilization and erosion control. Peak floods are reduced by water retention in wetland basins or by temporary storage in slope wetlands. This is especially true of riverine or channel wetlands that are linked by overflow channels (Adams 1988). More specifically, sedge-dominated wetlands may control erosion of shorelines by: 1) stabilizing substrates; 2) dissipating wave and current energy; and 3) trapping sediments. Erosion control is of greatest importance on riverine marshes, shore marshes, and large, shallow-water wetlands. The most suitable vegetation for erosion control includes tall robust perennials with extensive rhizome systems (e.g. *C. aquatilis*, *C.lyngbyei*, and *C. utriculata*) that can anchor shoreline materials (Adams 1988).

When the production of plant biomass exceeds decomposition, organic matter builds up creating peat ecosystems such as bogs and fens. Sedge species play a pivotal role in the production of peat and peat soils in specific wetland types. The sedges are second in importance only to *Sphagnum* moss in peatland formation in the boreal zone (Glaser 1987b). *Sphagnum* mosses are the primary peat formers in bogs, whereas sedges, (along with the "brown mosses"), are the primary peat formers in fens. Sedges, along with rushes and grasses, are the primary peat formers in marsh wetland environments (Johnson et al. 1995).

The hydrological and peat-forming functions of sedges lead, in turn, to various roles in landscape-level processes such as pioneering species in vegetation succession and the formation of distinctive wetland patterns on the landscape such as levees, strangs and flarks, pools, water tracts, and streamlined bog islands.

Kellogg's sedge (*C. lenticularis* var. *lipocarpa*) has been identified as an indicator of early plant successional stages of Northwest Territory sedge (*C. utriculata*) and water sedge (*C. aquatilis*) riparian vegetation types in the western U.S. It is also described as a pioneer species that invades water edges in Utah. In water sedge vegetation types, Kellogg's sedge, along with water sedge, appear to function as colonizers of exposed mineral substrates that will persist indefinitely in such areas as those created when a beaver dam breaks. High water tables and a vigorous network of roots of these species successfully limit the establishment of most other species (USFS 2002).

Pure communities of sedges modify open water habitats (especially lakes and ponds with shallow margins) by their slow production of sedge peat. The general developmental trend of sub-arctic wetlands is an evolution from a depression, to open water, open fen, shrub fen, and finally to treed fens and bogs (Zoltai et al. 1988).

By dissipating the energy of waves, currents, and tides along freshwater and marine shores, sedges modify the flow and capture of silt and detritus loads leading to the building of levees and the filling in of ponded basins and channels in coastal

marsh systems, and lead to the stabilization of stream and river banks in freshwater systems. In this regard, a number of species have found uses in reclamation work where areas within wetlands have been disturbed by human activities or natural events such as flooding (e.g., *C. ramenskii, C. subspathacea, C. aquatilis, C. lenticularis,* and *C. mertensii*).

Wetland landscapes possess many patterns. Among these are raised parallel ridges and flooded depressions commonly referred to as strangs and flarks. As described by Drury (1956), "...movement of water across very gentle wetland slopes creates steps and falls whose steep places occur in festoon patterns. Crescentic riffles are formed upon which the growth of sedges further slows the velocity of seasonally flowing waters, further capturing sediments, and creating parallel ridges of detritus and sediment that with time are elevated by further accumulation and low deterioration allowing for other wetland plant establishment and the creation of well-defined raised ridges called strangs, and alternating flooded depressions called flarks at right angles to the slope...." These landscape-scale patterns resemble waves and riffle marks when viewed from above or on aerial photographs.

Woolyfruit sedge (*C. lasiocarpa*) reportedly reproduces vigorously by vegetative means, establishing extensive networks of rootlets and rhizomes. The permeability of this rhizomatous peat is largely responsible for the channeling of water movements and the development of water tracts in some peatlands (Glaser 1987b).

The formation of streamlined bog islands (Glaser 1987a) may also owe their origins to sedge peat formation and subsequent landscape modification. The formation of porous peat by woolyfruit sedge (*C. lasiocarpa*) and denser peat by *Sphagnum* moss species, leads to a peatland being divided into contrasting vegetation types of bog and fen. Runoff is progressively channeled through the more porous sedge peat in the water track drainages, and a sharp vegetative boundary develops between the bogs and fens. Drainage networks form in which water tracts fragment the lower bog flanks into streamlined globe's and islands (Glaser 1987a).

The peat developed by mud sedge (*C. limosa*), dominant in flarks, is less fibrous because of the weakly rhizomatous nature of this species. The more decomposed peat formed by this species may contribute to the low infiltration capacity of the peat underlying flark landforms and to the formation of pools, a habitat characteristic of mud sedge (Glaser 1987b).

Some wetland sedges (e.g., *C. glareosa, C. livida*) tolerate very specific conditions such as high salinity or pH. Their presence or absence can help determine the type of wetland, and indicate the health of a specific wetland. Sedges help determine the type of wetland based on a species optimum tolerance of pH- acidic and basic

conditions. Some of the rarest sedges are calciphiles (plants preferring high pH, limestone-derived soils; Anderson et al. 1996).

The relative sensitivity of the major sedge species to water chemistry enhances their importance in distinguishing different peatland types, at least on a regional basis (Glaser 1987b). Many species reach their maximum abundance along gradients represented by the position of the water table and the water chemistry. Some species reach their maximum abundance in one bog or fen type versus another. For example, mud sedge (*C. limosa*) may reach its maximum abundance in oligotrophic bogs or poor fens, and in turn it may give way to creeping sedge (*C. chordorrhiza*) and woolyfruit sedge (*C. lasiocarpa*) in the richer fens (Glaser 1987b).

Wetland sedges serve a major role as wetland indicators. Wetlands vary in size, shape and characteristics. They may include waterbodies and stream courses, all of which are bounded by dry land. Not all wetlands are obvious however, and it is often difficult to determine where a wetland ends and drier land begins. The wetland boundary is defined by the soils, plants and the presence of surface water or saturated soil.

Because of their presence in wetland habitats, sedges may act as important wetland indicators in conjunction with soils and hydrological information. The National Wetlands Inventory Program of the U.S. Fish and Wildlife Service (USFWS 1996) has developed a list of wetland indicator plant species that include sedges. Each species has been reviewed by a panel of professionals and assigned a code that indicates the frequency of the species, from almost always present in a wetland; to occurring in non-wetlands; and present in wetlands of one part of the country and not present in wetlands of other areas.

Definitions of wetland indicator status are as follows (abstracted from the National List of Vascular Plant Species that occur in wetlands USFWS 1996):

OBL- Obligate Wetland Species. Occurs almost always under natural conditions in wetlands (estimated probability 99%).

FACW- Facultative Wetland Species. Usually occurs in wetlands, but occasionally found in non-wetlands (estimated probability 67%-99%).

FAC- Facultative Species. Equally likely to occur in wetlands or non-wetlands (estimated probability 34%-66%).

FACU- Facultative Upland Species. Usually occurs in non-wetlands (estimated probability 67%-99%), but occasionally found on wetlands (estimated probability 1%-33%).

UPL- Obligate Upland Species. Occurs in wetlands in another part of the country, but occurs almost always under natural conditions in non-wetlands in the region under consideration (estimated probability 99%). If a species does not occur in wetlands in any part of the country, it is not on the National List.

NA- No agreement. The regional panel of professionals has not able to reach a unanimous decision on this species.

NI- No indicator. Insufficient information is currently available to determine an indicator status.

NO- No occurrence. The species does not occur in that region.

The user is referred to USFWS (1996) for elaborations on these definitions. All of the sedges in this guide are wetland indicator species to varying degrees; a listing of all wetland sedges for Alaska is provided by USDA-NRCS (2003).

Sedges also have social, economic and ethnobotanical values for humans. The leaves of many species have been used as thread by Native Americans and sewn into hide garments as decoration. The leaves and stems of many sedge family species are still used today for basketry (Cooke 1997). Sedge stems and fruits have have been used as food and have helped in times of famine (*C. macrocephala*).

Sedges also play an indirect but critical role in furbearer production, waterfowl and big game hunting, and commercial and sport fishing by providing essential habitat for these species, as noted above.

Sedges are an important source of forage for livestock as well as wildlife. The large water sedges form a major part of the "swamp hay" that has been traditionally harvested from large Alaskan wetlands such as the Palmer Hay Flats and the Fox River Flats. These sedges contain more protein, fat, and carbohydrates, and less crude fiber than grasses, resulting in a nutritious but light-weight hay (Roberts 1983). Kellogg's sedge (*C. lenticularis* var. *lipocarpa*) is commonly grazed by domestic livestock when other feed is scarce, and sheep reportedly thrive on it. Mud sedge (*C. limosa*) has a high nutritional value and is grazed by horses, cattle and sheep.

In general, sedges contribute to the diversity and aesthetics of Alaska wetlands. Wetlands, particularly sedge-dominated types at the interface between open water and more closed upland habitats, concentrate wildlife use and provide for extensive nonconsumptive uses of wildlife such as bird watching, wildlife photography and education (Rubec et al. 1988).

Overall Format of the Guide

This guide begins with a brief description to help the non-specialist separate the different grasslike families, as well as a brief introduction describing features of sedge morphology and their use in identification. It also includes keys to the genera within the family Cyperaceae.

A key is provided to 41 of the most common and ecologically important wetland sedges in Alaska. These are described in detail and accompanied by range maps, illustrations, summaries of habitat preferences, wetland indicator status, and notes on distribution and values. An additional 36 species having similarities to these common species are covered in lesser detail.

We have tried to use simple, non-technical language in the text and keys, and have emphasized characters readily seen by the naked eye. Some species, however, are distinguished by characteristics that can only be seen with a handlens or microscope.

A full glossary is provided for all technical botanical and ecological terms used in this guide as well as those that may be encountered when using the other sources for sedge identification cited below and in the bibliography.

Both scientific and common names are provided in this guide. Scientific names are generally more widely accepted and stable than common names. Those used in this guide follow the recent treatment for the sedge family in Volume 23 of the Flora of North America (FNA 2002). The few exceptions are noted in the text. We used USDA-NRCS (2003) as a standard for common names.

The major species treated in the guide are listed alphabetically in the Table of Contents. Scientific names of these and similar species referred to in the text as well as common names are listed alphabetically in the index at the end of the guide.

References

We have drawn upon many sources to prepare this guide. These include taxonomic treatments of the flora of Alaska (Hultén 1968, Welsh 1974); neighboring British Columbia (Douglas et al. 2001, Roberts 1983), Yukon Territory (Cody 1996); the Pacific Northwest (Hitchcock et al. 1969); the Intermountain West (Hurd et al. 1998); and, perhaps most importantly, the recently published treatment for the sedges in Volume 23 of the Flora of North America (FNA 2002).

In addition, we have referred to popular guides for the boreal forest, British Columbia and the Pacific Northwest (Cooke 1997, Johnson et al. 1995, Pojar and

MacKinnon 1994, Taylor and Douglas 1995). Finally, we have incorporated our own extensive taxonomical and ecological experience with the sedge taxa of Alaska.

Since the information provided here is restricted to the most common wetland sedge species, the guide is insufficient to identify all the sedges that may be found in Alaska, although the key and text will refer the reader to many of the similar species. The references indicated above provide a more complete and technical treatment of the sedge species in Alaska. Identifications of taxa for critical studies should always be confirmed by checking with knowledgeable botanists or with the floras listed above.

Page Format of the Species Descriptions

Plant Names
The species' accepted name, as well as synonyms, misapplied names, and common names, are listed at the top of the page. Plant names used in this guide follow the recent treatment for the sedge family in Volume 23 of the Flora of North America (FNA 2002). The few exceptions are noted in the text.

NWI Status
National Wetland Inventory (NWI) wetland indicator status is located in the upper left corner. Definitions for the codes are found above, in the section on the "Role of Sedges in Wetlands".

Species Description
Technical descriptions include notes on the plant's habit, that is, the general form, or what the whole plant looks like, including height, root type, and the presence of rhizomes (below ground runners) or stolons (above ground runners); leaf arrangement, shape, length, width, and surface texture; bract; spike (unbranched inflorescence) and flower (e.g., pistillate scales); perigynium (saclike structure surrounding the ovary/fruit); and fruit (achene).

Illustrations and Photographs
Color photographs and line drawings accompany the text for most species to illustrate habitat, growth habit, spikes, pistillate scales, perigynia and achenes. They were provided with the permission of the sources cited at the end of this guide.

Habitat Description
The habitat preferences of each species are described. This information comes from the literature, as well as the field experience of the authors, other scientists and reviewers.

Distribution
A map is included to show where the plant has been found in Alaska. Plants may also be found in areas not reported here. No range lines are provided; rather, the distribution is illustrated by a spread of known collections across the state. The distribution is based on records and collections stored and maintained at the University of Alaska Museum's Herbarium (ALA), with additional records from Hultén (1968). The distribution of similar species is included where distribution ranges may assist with species identification.

While this book is specific to the state, many of the species described have a wider distribution, ranging from Alaska to Newfoundland and south into the lower 48 states or west, across the Bering Straits to the Russian Far East and Eurasia. Many boreal and arctic sedges are found around the world and are noted as "circumboreal" or "circumpolar", and some are even found in the southern hemisphere (bipolar).

Similar Species
This section notes related species that may be confused with the species being described and helps to differentiate them using morphological characters and habitat preferences. Illustrated comparisons of many similar species may be found in the recently published volume on the sedges of North America (FNA 2003). Some rare species and species with limited distributions in Alaska are also listed here (and in the keys) with the hope that their inclusion may lead to new discoveries and clarifications of their range.

Notes
This section provides information about wildlife use, ethnobotanical use, revegetation potential, etc. To varying degrees, most of the plants discussed in this guide provide many of the functions discussed in the earlier section on T*he Role of Sedges in Wetlands*. Information from the literature on species with specific wetland functions are identified here. Ethnobotanical information has been added to describe human uses of a species (e.g., shelter, basketry, food, medicine, horticulture, agriculture, reclamation) and any other use that may be known.

Measurements
All measurements are given in metric units:

10 millimeters (mm) = 1 centimeter (cm), 1 cm = 0.394 inches
1 meter (m) = 100 cm = 39. 4 inches or slightly longer than 1 yard

Differentiating Between Different Grasslike Families

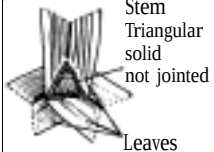
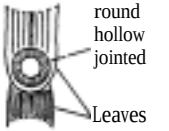
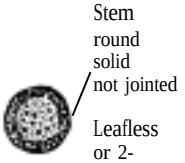
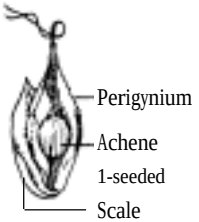
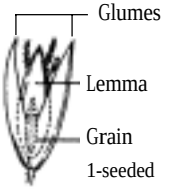
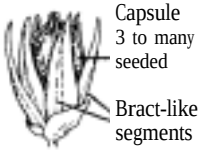
Several families of plants may appear grass-like and are grouped together as graminoids. These include the Cyperaceae (sedges), Juncaceae (rushes) and the Poaceae (grasses). Species of all three families feature long, narrow, parallel-

veined leaves and inconspicuous flowers (the petals and sepals highly modified or lacking) with scalelike **bracts**—specialized leaves arising directly below a flower or inflorescence.

These families are most easily distinguished through an examination of their stems: those of sedges are generally triangular in cross-section and solid (not hollow), with the leaves in 3 rows; those of rushes are round and solid ('pithy'). Remember: 'sedges have edges and rushes are round'. Grass stems are round, jointed, often hollow, and with the leaves in two rows.

Sedges can be further isolated from other graminoids by their unique flowering structure and fruit: each sedge fruit (**achene**) is housed in a tear-shaped sac (**perigynium**), opening only at the tip and subtended by a single **scale**. The following table points out a few characteristics which can be used to distinguish sedges from rushes and grasses.

Comparison of Sedges to Other Grasslike Families

	Sedges	***Grasses***	***Rushes, Woodrushes***
Simplified Cross Section of Stem, Leaves			
Flower, Fruit			

(Adapted from Roberts 1983)

Guide to Sedge Morphology

Sedges are complex and diverse in their habitats and growth forms and can be daunting to non-botanists because of their specialized structures and the terms used to describe them. Knowing a few distinguishing characteristics, however, makes the group quite manageable. Descriptions in this guide will be more readily understood if the reader will take the time to become familiar with some of these characteristics illustrated on the following pages. Photos accompanying the species descriptions also help to clarify these morphological characteristics.

Sedges are grass-like, perennial herbs that may grow either in clumps (**tufted**) or having stems that grow laterally underground (**rhizomatous**) or above ground (**stoloniferous and mat-forming**).

Leaves are 3-ranked (appearing to arise from all 3 sides of the stem) and have closed **sheaths** (the leaf bases are fused around the stem). Some species have a notched appendage (**ligule)** at the juncture of the leaf and leaf sheath.

Sedge stems (**culms**) are generally solid and triangular in cross section, but the culms of some species can be obtusely angled or, occasionally, round. Each culm bears one to many **flower spikes** or smaller secondary spikes (**spikelets**) that are either attached directly to the culms or are borne on a side stalk (**peduncle**).

A leaf-like **involucral bract** is usually attached to the base of the flower spikes. The bracts vary from large and leafy to small and inconspicuous or absent, and they may or may not be wrapped around the stem (**sheathing**) at the base.

Individual flowers are attached directly to the flower spikes and have small bracts (**scales)** attached at the base. The scales of the female flowers are helpful in distinguishing between species.

In *Carex*, individual flowers are either male or female, never containing both stigmas and stamens in the same flower. Individual plants are usually monoecious (having *both* male and female flowers on the same plant), but a few species may be dioecious (having *only* male or *only* female flowers on the same plant). Similarly, individual spikes on a plant can have all male or all female flowers, or be mixed with either sex above the other in the same spike. Androgynous spikes have male flowers above the female flowers, while gynecandrous spikes have flemale flowers above the male.

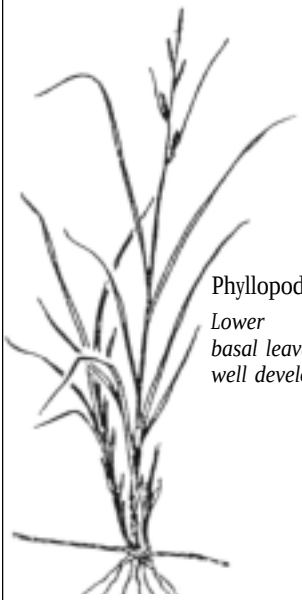
The distinctive fused sac enclosing the female flowers is called the **perigynium** (plural = **perigynia**). It has an apical opening through which the style or stigmas protrude. A neck (**beak**) at the top and a stem (**stipe**)at the base may also be evident. The size and shape of the mature perigynium is often essential for identification.

Growth Habits

Tufted (cespitose)
Culms tufted or clumped

Rhizomatous
Culms arising singly or a few together

Basal Leaves

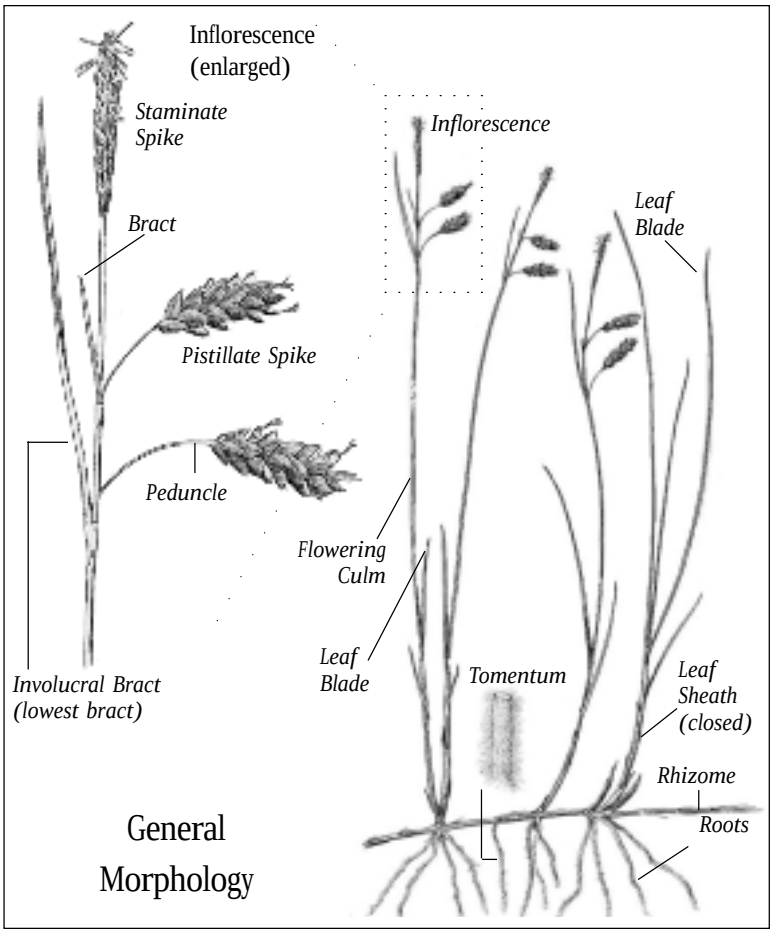


Phyllopodic
Lower basal leaves well developed

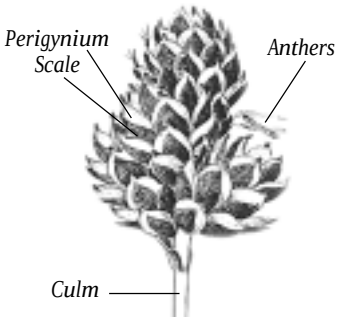
Aphyllopodic
Lower basal leaves reduced to scales

The number of stigmas on each flower is an important and often used character in keying out sedges. A handlens is often necessary to see this character and several flowers should be examined since stigmas may break off, especially on older material. Stigmas may number 2 or 3, depending on the species. Those with 2 stigmas usually have an achene (fruit) that is 2-sided with convex sides (**lens-shaped** or **lenticular**), while those with 3 stigmas usually have achenes that are 3-sided (**triangular** or **trigonous**). Most species are consistent in always having either 2 or 3 stigmas. Male flowers often have 2 stamens but can have 3 or 1.

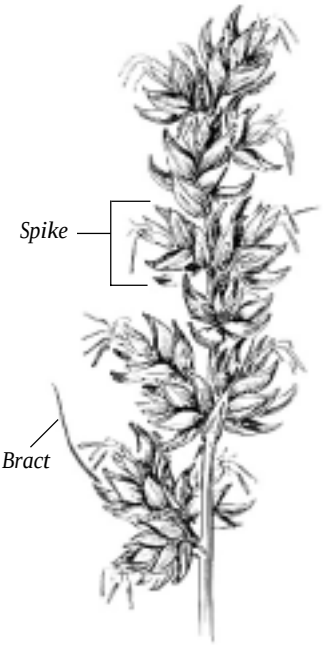
The pistillate scales, perigynia and achenes come in many sizes, shapes, colors and textures. A rather large, but very specific vocabulary has evolved to describe this variability. A glossary has been provided to get the user started. Good illustrated guides to plant identification terminology (e.g., Harrington 1977, Harris and Harris 1994) can also prove invaluable when starting out into the world of sedge identification!



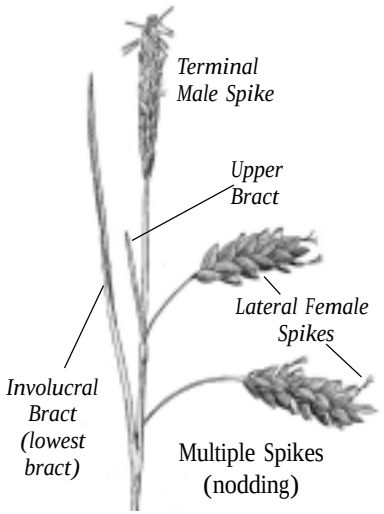
Inflorescence



Mutiple
(aggregate) Spikes

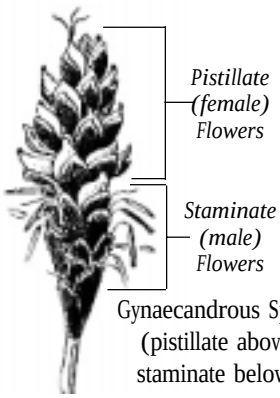


Multiple Spikes
(sessile or nearly so)

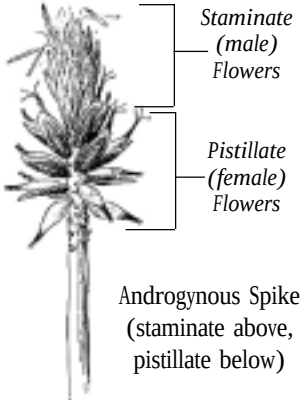


Multiple Spikes
(nodding)

Solitary Bisexual Spikes

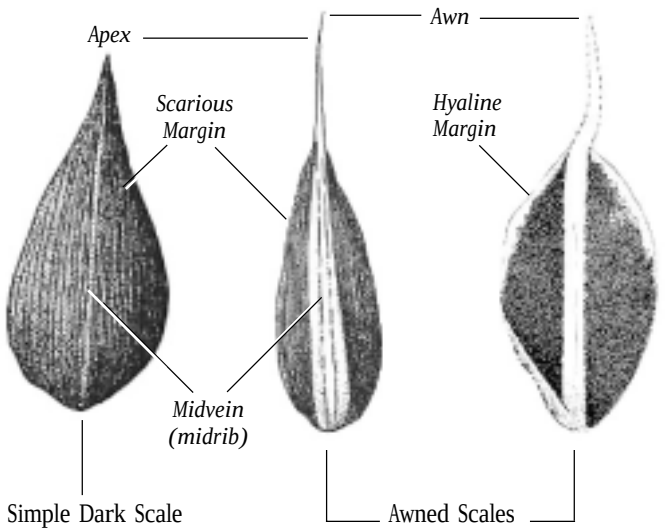


Gynaecandrous Spike
(pistillate above,
staminate below)

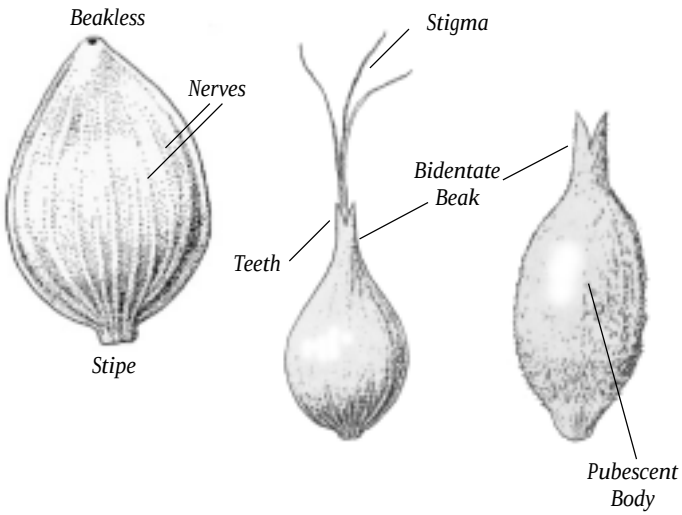


Androgynous Spike
(staminate above,
pistillate below)

Pistillate Scale Morphology



Perigynia



Taxonomic keys are tools for identifying plants. The keys in this guide are written as a series of paired, mutually exclusive statements that divide the available information into smaller subsets until all possibilities but one have been dismissed. For sedges, a technical key is necessary for positive identification. We have provided keys, with specialized terms kept to a minimum. These are simple, two-branched keys that rely on both vegetative and floral characteristics. When flowers or fruits are minimal, a bit of imagination and reconstruction may be necessary to determine the path to follow in the key. When confusion arises at a branch in the key, examine both options, then determine which looks more plausible for your specimen. Drawings and illustrations may prove useful. Verification of species identifications should be done by comparing a specimen that has been identified by a qualified botanist. Herbaria are repositories of plant specimens that have been accurately identified. Herbaria are generally found at major universities in Alaska and elsewhere and are usually open to the public.

Key to Genera of the Sedge Family

1a Flowers unisexual (either male or female); achenes enclosed or wrapped in a sac (the perigynium) and subtended by a scale

2a Perigynia closed except for a small opening at the tip through which the style and stigma protrude; always with only 1 pistillate flower
. . . . . ***Carex*** **(the sedges)**

2b Perigynia open on one side, not sealed but merely wrapped around the achene; perigynia sometimes enclosing staminate flowers in addition to a pistillate flower . . . . . ***Kobresia***

lb Flowers bisexual (both male and female); achenes not enclosed in perigynia

3a Scales of spikelets in 2 opposite rows . . . . . ***Dulichium***
3b Scales of spikelets arranged in a spiral

4a Spikelets with 1 (rarely 2) achenes
. . . . . ***Rhynchospora*** **(the beak-rushes)**
4b Spikelets with several to many achenes

5a Styles thickened at the base, forming a conspicuous tuber-cle on the achenes . . . . . ***Eleocharis*** **(the spike-rushes)**
5b Styles not thickened to form a tubercle

6a Flower bristles 10 or more
. . . . . ***Eriophorum*** **(the cotton-grasses)**
6b Flower bristles 8 or fewer

7a Spikelets atop leafy bracts ***Scirpus*** **(the bulrushes**--
including ***Blysmus, Bolboschoenus, Schoenoplectus***)
7b Spikelets atop slightly modified, not leafy, scales
. . . . . ***Trichophorum*** **(the clubrushes)**

Keys to the Common Wetland Sedges of Alaska

Prepared by
Dr. David F. Murray, UAF Museum Herbarium
Robert Lipkin, Alaska Natural Heritage Program

Introduction to the Key

This key is designed to aid the identification of selected sedges—ones that make up wetland vegetation in Alaska, in both brackish and fresh water habitats. These species are not necessarily restricted to wetlands, although many are. Several with broad ecological tolerances are also found in more upland situations. Some taxa are uncommon in Alaska (e.g., *C. adelostoma*, *C. parryana*), either because they are rare or have been overlooked (e.g., *C. holostoma*); they are included in the keys in hopes that their inclusion may lead to new discoveries or clarifications in their distributions.

These keys are artificial in that they do not attempt to reflect either evolutionary relationships or the subgenera or sections that one may encounter in other more thorough treatments of the sedges. Rather, they are an analytic device that allows the user to distinguish any one species from all others of this particular set of species. The intent is that with one of these plants in hand, one can consistently and accurately apply a name. Synonyms are supplied for cross-referencing to such important references as The Flora of Alaska and Neighboring Territories (Hultén 1968) and Volume 23, Cyperaceae, Flora North America (FNA 2002). Very closely related taxa that are more difficult to distinguish are discussed under Comments in the species accounts.

Clearly, some magnification must be used to see the details of the leaves, perigynia, and scales. Familiarization first with a binocular dissection microscope will make it easier to recognize diagnostic features with a 10X hand lens when in the field.

The keys work best when the plants are well enough developed that the perigynia are nearly mature and have achieved their final size, shape and distinctive surface characteristics. Among the single-spiked (unispicate species, Key 1), plants that

are wholly staminate cannot be determined; for example, such plants occur in *C. gynocrates* and occasionally in *C. capitata*.

The versatility of the following keys will be greatly increased as the users acquaint themselves with sedge terminology in the glossary, sedge morphology, and individual species characteristics provided in their respective pictures and illustrations.

Master Key _____

1a Plants with a single, terminal spike or compact terminal cluster of spikes that appears as if one . . . . . **Key 1**
1b Plants with multiple spikes

2a All spikes bisexual (androgynous or gynecandrous) . . . . . **Key 2**
2b Some spikes unisexual; terminal spike staminate or gynecandrous

3a Terminal spike gynecandrous (in the case of ***C. parryana***, there may be only two or three perigynia at the summit of the otherwise staminate spike), lateral spikes pistillate . . . . . **Key 3**

3b Terminal spike staminate, lateral spikes staminate, pistillate or androgynous

4a Uppermost 1-3 lateral spikes staminate . . . . . **Key 4**
4b Uppermost lateral spikes not staminate

5a Lateral spikes with peduncles as long and longer than the spikes, spikes pendent . . . . . **Key 5**

5b Lateral spikes with peduncles shorter than the spikes, spikes erect (lowermost spike may be long-pedunculate and pendent in ***C. microchaeta* subsp. *nesophila***) . . . . . **Key 6**

Key 1 _____

1a Plants generally growing submerged in ponded water . . . . . ***C. chordorrhiza***
1b Plants terrestrial or aquatic, but not growing submerged

2a Terminal spike (or compact cluster of spikes) 3 cm long or longer . . . . . ***C. macrocephala***
2b Terminal spike (or compact cluster) 2 cm or shorter

3a Plants forming dense tufts or cushions . . . . . ***C. ursina***

3b Plants not forming dense tufts or cushions

4a Perigynia awl-shaped, strongly reflexed at maturity

5a Rachilla extends through perigynia, beyond styles . . . . . ***C. microglochin***

5b Rachilla absent . . . . . ***C. pauciflora***

4b Perigynia not awl-shaped, not strongly reflexed (spreading to slightly reflexed in *C. gynocrates)*

6a Perigynia spindle-shaped, lanceolate to narrowly elliptic . . . . . ***C. anthoxanthea***

6b Perigynia not spindle-shaped

7a Perigynia beakless, spikes of 4-5 perigynia . . . . . ***C. leptalea***

7b Perigynia beaked, spikes of more than 10 perigynia

8a Perigynia with veins

9a Perigynia with many conspicuous veins, otherwise smooth . . . . . ***C. gynocrates***

9b Perigynia with few inconspicuous veins, papillose . . . . . ***C. media*** ***(C. norvegica* subsp. *inferalpina)***

8b Perigynia without veins

10a Perigynia papillose and serrulate along distal margins and beak . . . . . ***C. media*** *(C.* ***norvegica* subsp. *inferalpina****)*

10b Perigynia not papillose

11a Perigynia circular in cross section, abruptly beaked, beaks smooth . . . . . ***C. capitata***

11b Perigynia lenticular in cross section, gradually beaked, margins and beaks serrulate . . . . . ***C. maritima*** (including ***C. incurviformis*)**

Key 2 _____

1a Pistillate scales less than half as long as the perigynia; perigynia many-veined . . . . . ***C. loliacea***

1b Pistillate scales half as long as perigynia or longer; perigynia few-veined or veinless

2a Perigynia beakless . . . . . ***C. marina***

2b Perigynia beaked

3a Perigynia minutely short-beaked, less than 0.25 mm long . . . . . ***C. tenuiflora***

3b Perigynia with distinct beak, longer than 0.25 mm

4a Perigynia abruptly beaked . . . . . ***C. canescens***

4b Perigynia gradually beaked (occasionally somewhat abrupt in ***C. laeviculmis***)

5a Beaks smooth . . . . . ***C. mackenziei***

5b Beaks serrulate

6a Perigynia ovate, circular in cross section, 1.5 mm long . . . . . ***C. laeviculmis***

6b Perigynia lanceolate, lenticular in cross section, 2–4 mm long

7a Perigynia erect, veinless . . . . . ***C. diandra***

7b Perigynia spreading, veined . . . . . ***C. echinata***

Key 3 _____

1a Pistillate scales with midvein raised and usually projecting from the apex; apices mostly mucronate or awned

2a Body of pistillate scale distinctly shorter than the perigynia; perigynia short-beaked, 0.5 mm long or longer . . . . . ***C. gmelinii***

2b Body of pistillate scale as long as and longer than the perigynia; perigynia beaked, less than 0.5mm long

3a Pistillate scales as broad as perigynia, slightly shorter to slightly longer than perigynia

4a Perigynia conspicuously serrulate along distal margins and beaks . . . . . ***C. parryana***

4b Perigynia not serrulate . . . . . ***C. adelostoma***

3b Pistillate scales narrower and longer than perigynia . . . . ***C. buxbaumii***

1b Pistillate scales not apiculate, mucronate, nor awned

5a Pistillate scales distinctly shorter than perigynia

6a Pistillate scales less than half the length of the perigynia, with acute apices; midvein lighter in color than the body of the scale, conspicuous . . . . . ***C. mertensii***

6b Pistillate scales greater than half the length of the perigynia, with obtuse, rounded apices, midvein inconspicuous

7a Pistillate scales light-brown with hyaline margins; lateral spikes on peduncles often as long as the spikes, spikes pendent . . . . . ***C. krausei***

7b Pistillate scales black to the margins; lateral spikes on peduncles shorter than the spikes, spikes erect ***C. enanderi (C. lenticularis* var. *dolia)***

5b Pistillate scales varying from slightly shorter to slightly longer than the perigynia

8a Pistillate scales with midvein lighter in color than the body of the scale, conspicuous; perigynia beakless

9a Perigynia sparingly papillose, weakly nerved, greenish; stems erect . . . . . ***C. garberi*** **(see description under *C. aurea*)**

9b Perigynia densely papillose, nerveless, white or gray; stems decumbent . . . . ***C. bicolor*** **(see description under *C. aurea*)**

8b Pistillate scales with midvein inconspicuous; perigynia beaked

10a Pistillate scales narrower than perigynia, purple-black to the margins . . . . . ***C. eleusinoides***

10b Pistillate scales as wide as the perigynia, enclosing them, brown with hyaline margins . . . . . ***C. glareosa***

Key 4 _____

1a Perigynia pubescent . . . . . ***C. lasiocarpa***
1b Perigynia not pubescent

2a Perigynia inflated, veined, smooth; beaks long, greater than 0.5 mm, bidentate; stigmas 3

3a Beaks of perigynia with long teeth, 1.5 mm or longer ***C. atherodes***
3b Teeth short, 0.5—1.0 mm

4a Upper surface of leaves glaucous, papillose . . . . . ***C. rostrata***
4b Upper surface of leaves green, scabrous or smooth
. . . . . ***C. utriculata (C. rhynchophysa)***

2b Perigynia not inflated, veined or not veined; papillose or smooth; beaks short, less than 0.5 mm long, emarginate; stigmas 2

5a Perigynia veined, smooth . . . . . ***C. lenticularis***
5b Perigynia not veined, papillose . . . . . ***C. aquatilis***
(including ***C. sitchensis*****)**

Key 5 _____

1a Plants tall, mostly 3 dm or taller; lateral spikes 3 cm and longer; stigmas 2

2a Perigynia thin walled (papery), flattened, sessile, a species of freshwater marshes and meadows ***C. sitchensis (C. aquatilis* var. *dives)***
2b Perigynia leathery, stalked. Plants usually in brackish water ***C. lyngbyei***

1b Plants short, mostly 2.5 dm or shorter; lateral spikes 2.5 cm or shorter; stigmas 3

3a Perigynia beakless

4a Perigynia smooth, obscurely veined, fleshy, orange at maturity
. . . . . ***C. aurea***
4b Perigynia papillose, not fleshy or orange

5a Pistillate scales narrower and longer than the perigynia
. . . . . ***C. magellanica* subsp. *irrigua***
5b Pistillate scales as broad and as long as the perigynia
. . . . . ***C. rariflora*** (including ***C. pluriflora)***

3b Perigynia beaked

6a Pistillate scales aristate . . . . . ***C. macrochaeta***
6b Pistillate scales not aristate

7a Perigynia strongly papillose over entire surface; roots covered with rust-red felt-like hairs . . . . . ***C. limosa***
7b Perigynia not papillose (sometimes minutely papillose on margins in *C. podocarpa*)

8a Perigynia long-beaked, 0.6-0.8 mm, glossy purple . . . . . ***C. saxatilis* subsp. *laxa***
8b Perigynia short-beaked, 0.5 mm or shorter, not glossy purple

9a Lowest bract sheathless (the stalk of the lowest spike free) . . . . . ***C. podocarpa***
9b Lowest bract long-sheathing (sheath enveloping stalk of lowest spike)

10a Perigynia veined, otherwise smooth

11a Perigynia abruptly beaked; beaks dark brown . . . . . ***C. vaginata***
11b Perigynia gradually beaked; beaks hyaline-tipped . . . ***C. williamsii*** **(see description under *C. capillaris*)**

10b Perigynia not veined, beaks serrulate . . . . . ***C. capillaris***

Key 6 _____

1a Lateral spikes shorter than 1 cm

2a Perigynia obovate, beakless; plants of freshwater marshes and bogs . . . . . ***C. holostoma***
2b Perigynia ovate, short-beaked; plants of coastal shorelines and saline meadows . . . . . ***C. subspathacea*** **(see description under *C. Ramenskii*)**

1b Lateral spikes long, greater than 1 cm

3a Pistillate scales distinctly shorter than perigynia

4a Perigynia lenticular in cross section; stigmas 2

5a Perigynia veined, green
. . . . . ***C. kelloggii (C lenticularis* var. *lipocarpa)***
including ***C. hindsii (C. lenticularis* var. *limnophila)***
5b Perigynia not veined, greenish-yellow or light brown
. . . . . ***C. aquatilis***

4b Perigynia circular in cross section; stigmas 3 (very rarely 2)

6a Perigynia greenish brown, style persistent at summit of perigynium, typically as a short stub, but also longer
. . . . . ***C. stylosa***
6b Perigynia chestnut to glossy reddish purple

7a Leaves flat, 2.5–6 mm wide; basal sheaths usually red; stems triangular . . . . . ***C. membranacea***
7b Leaves folded, narrow (< 2.5 mm wide); basal sheaths brown; stems rounded . . . . . ***C. rotundata***

3b Pistillate scales slightly shorter to longer than perigynia

8a Lowest bract with a distinct, well-developed sheath

9a Perigynia beakless or with a minute beak, distinctly papillose . . . . . ***C. livida***
9b Perigynia with a distinct beak, not distinctly papillose . . . . . ***C. vaginata***

8b Lowest bract without a distinct sheath

10a Pistillate scales mostly blunt at the apex, purple black, midvein not lighter in color than the body of the scale
. . . . . ***C. bigelowii* subsp. *lugens***
10b Pistillate scales mostly acute at the apex, black and brown; midvein mostly lighter in color than the body of the scale

11a Perigynia obovate, pistillate scales mostly narrower than the perigynia
. . . . . ***C. aquatilis***

11b Perigynia ovate, pistillate scales as wide as the perigynia

12a Perigynia gradually beaked; midvein of pistillate scale broad; plants of coastal shorelines and saline meadows
. . . . . ***C. ramenskii***

12b Perigynia abruptly beaked; midvein of pistillate scale narrow; plants of freshwater wetlands and moist tundra–not in saline marshes or meadows

13a Pistillate scales black, midvein not projecting beyond the apex of scale; lowermost spike erect
. . . . . ***C. bigelowii*** **subsp.** ***lugens***

13b Pistillate scales dark brown, midvein projecting beyond the apex of scale as a short point; lowermost spike often pendent
. . . ***C. microchaeta*** **subsp.** ***nesophila***