

Systematic Botany. 3. Graminoids

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Outline

Gramineae or Poaceae—Grass family

Description

Diversity of Gramineae

Poales: grass-like plants and some others

Cyperaceae—sedge family

Juncaceae—rush family

Typhaceae—cattail family



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Gramineae or Poaceae—Grass family

Description



Gramineae, or Poaceae—grass family

- ▶ $\approx 8,000$ species distributed thorough all the world, but most genera concentrate in tropics
- ▶ Prefer dry, sunny places
- ▶ Often form tussocks—compact structures where old grass stems, rhizomes and roots are intermixed
- ▶ Grasses form grasslands—specific ecological communities widely represented on Earth. North Dakota prairies are grasslands.

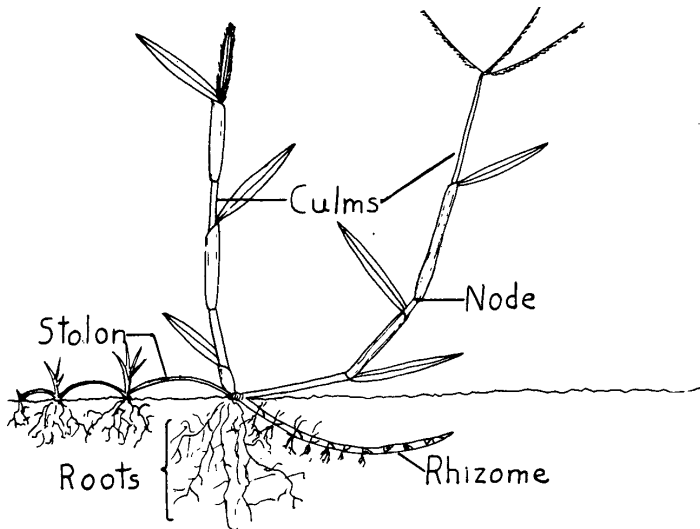


Morphology of grasses

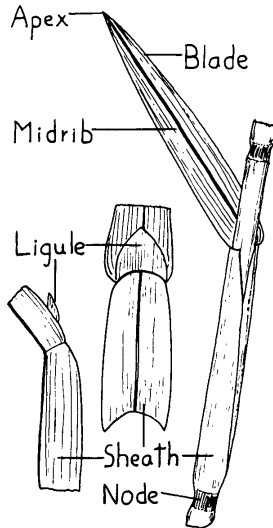
- ▶ Stems usually hollow and round
- ▶ Leaves flat, in two ranks
- ▶ Flowers reduced, wind-pollinated, usually bisexual, form complicated spikelets
- ▶ Each spikelet bear two glumes; each flower has lemma and palea scales
- ▶ Perianth is reduced to lodicules
- ▶ Stamens from 6 to 1 (most often 3), with large anthers
- ▶ Fruit is a caryopsis, it includes flower scales
- ▶ Seed has a specific embryo with coleoptile, coleorhiza and scutellum



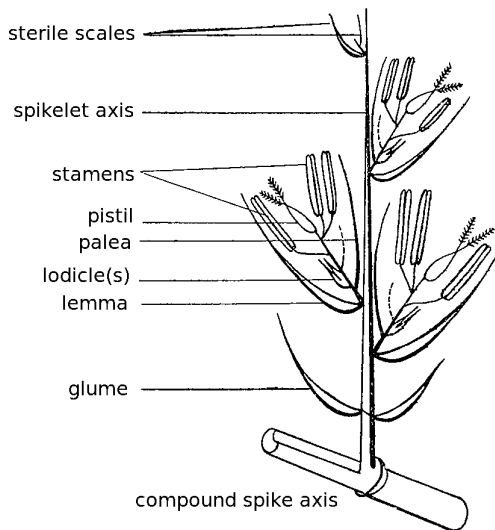
Grass branching



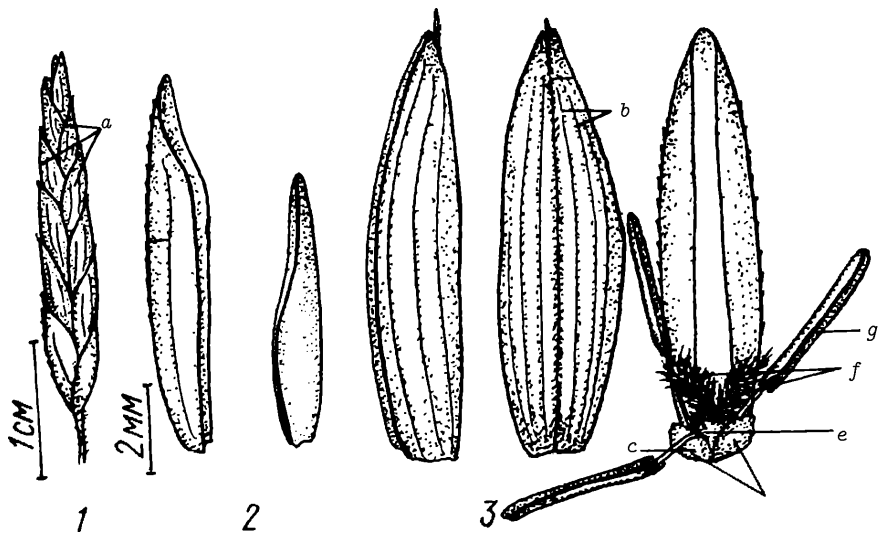
Grass leaves



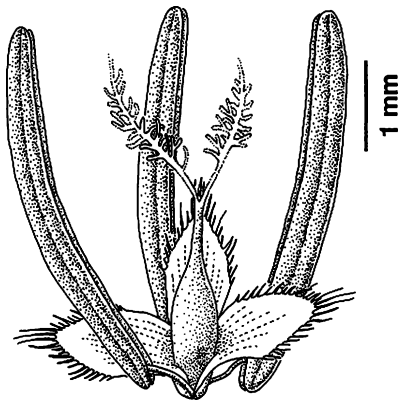
Scheme of grass spikelet



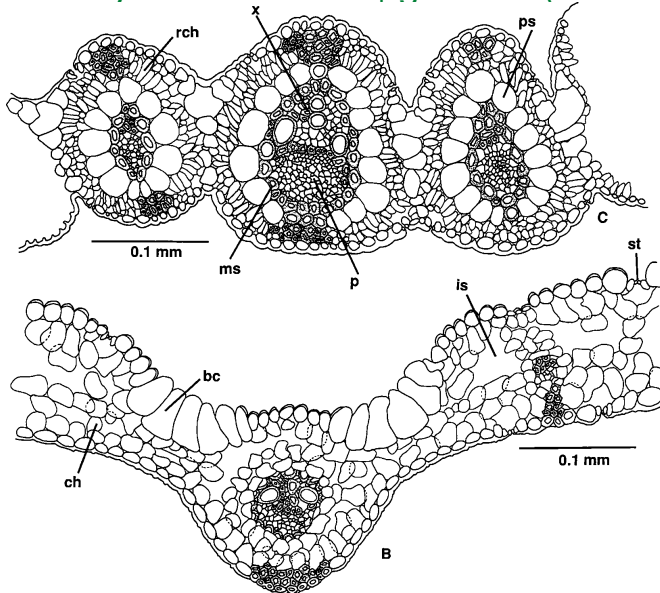
Bromegrass (*Bromus inermis*) spikelet and flower



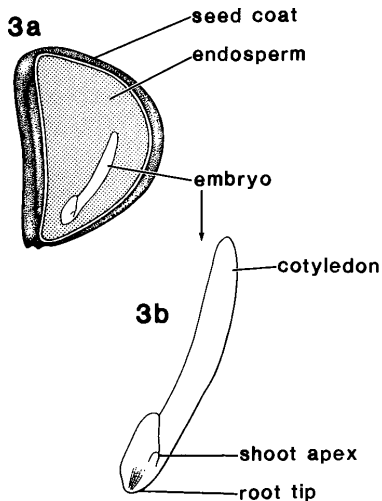
Grass flower: bamboo



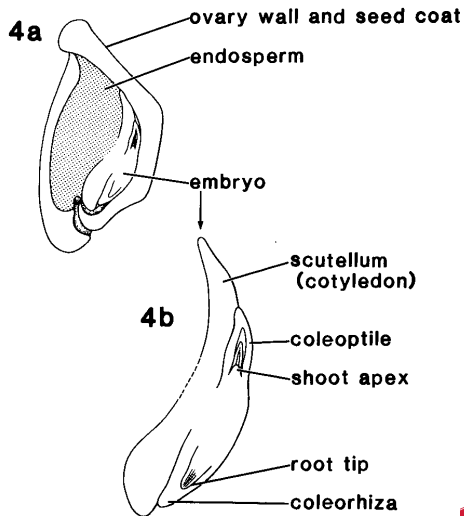
Kranz anatomy of leaves in C₄ grasses (above)



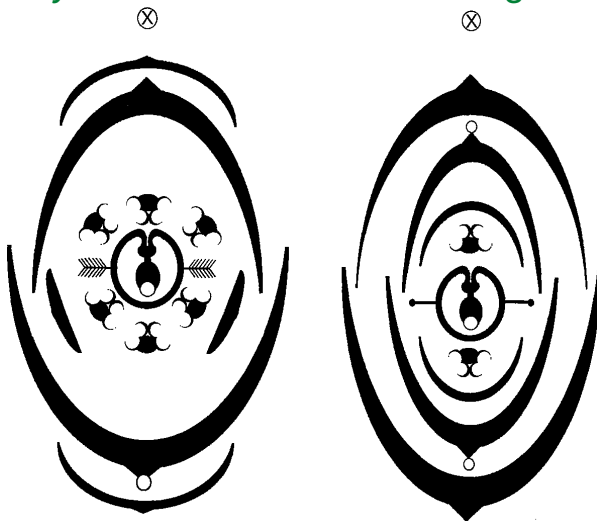
Typical Monocot Embryo (*Zephyranthes treatiae*, Amaryllidaceae)



Grass Embryo (*Zea diploperennis*)



Grasses: *Oryza* and *Anthoxanthum* diagrams



$$\uparrow P_{0-3} A_{0-3+2-3} \underline{G_{(2)}}$$



Grass inflorescences

- ▶ Compound spikes
- ▶ Panicles



Rare event: bamboo (*Schizostachyum* sp.) is flowering!



Festuca sp.

Rice (*Oryza sativa*), the most important world crop



Corn (*Zea mays*), the most productive world crop (up to 10 MT/ha)



Gramineae or Poaceae—Grass family

Diversity of Gramineae



Subfamily Anomochlooideae

- ▶ Broad leaves, no spikelets, no lodicules, 4–6 stamens. Tropical South America.
 - ▶ *Anomochloa*—anomochloa
 - ▶ *Streptochaeta*—streptochaeta



Anomochloa

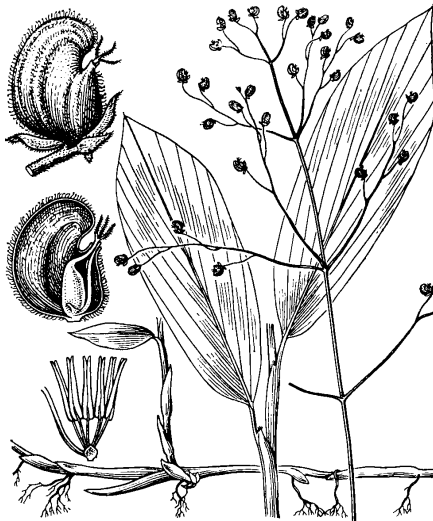


Subfamily Pharoideae

- ▶ Broad leaves with pinnate venation, spikelets one-flowered, unisexual, in panicles, 6 stamens, 3 stigmas.
 - ▶ *Pharus*—pharus, South America
 - ▶ *Leptaspis*—leptaspis, tropics of Old World



Leptaspis



Subfamily Puelioideae

- ▶ Broad leaves with parallelodromous venation, spikelets with multiple unisexual florets, 3 lodicules, 6 stamens, 3 stigmas
 - ▶ *Puelia*—puelia (Tropical Africa, poorly studied)



Puelia



Subfamily Bambusoideae

“BEP clade” starts here.

- ▶ Mostly woody plants, leaves broad or narrow, spikelets bisexual or unisexual, number of flower parts vary. $\approx 1,200$ species.
 - ▶ *Phyllostachys*—golden bamboo, often cultivated in southern U.S.
 - ▶ *Arundinaria*—hill cane, native to eastern U.S.
 - ▶ *Bambusa*—bamboo, reaches 35 m in height
 - ▶ *Melocanna*—has large berry-like caryopses



Arundinaria appalachiana



Melocanna



Subfamily Ehrhartoideae

- ▶ Herbaceous plants, ligules mostly not fringed, sometimes annuals, inflorescences are mostly panicles, 2 lodicules, 2 styles, stamens 3–6. \approx 120 species.
 - ▶ *Oryza*—rice
 - ▶ *Zizania*—wild rice
 - ▶ *Leersia*—cut grass



Leersia oryzoides



Subfamily Pooideae

Annuals or perennials, inflorescences are compound spikes, racemes or panicles, spikelets bisexual, lodicules 2, stamens 3, styles 2, embryo small (like in previous subfamilies). $\approx 3,300$ species.

Tribes:

Bromeae *Bromus*—brome grass

Meliceae *Melica*—melic, *Glyceria*—mannagrass

Poeae *Poa*—bluegrass, *Festuca*—fescue, *Avena*—oats, *Phleum*—timothy grass and many others

Stipeae *Stipa*—needle-and-thread, *Oryzopsis*—ricegrass

Triticeae *Triticum*—wheat, *Secale*—rye, *Hordeum*—barley, *Agropyron*—wheatgrass and many others



Bromus commutatus



Subfamily Aristidoideae

“PACCAD clade” starts here.

- ▶ Xerophytic grasses, mostly tropical and subtropical, ligules fringed, panicles, lemma with three awns, palea short, stamens 1–3, embryo small or large, C_4 (*Aristida*). \approx 350 species.
 - ▶ *Aristida*—threeawn



Aristida purpurea



Subfamily Arundinoideae

- ▶ Large perennials, sometimes almost woody, have panicles, palea not reduced, stamens 1–3, embryo mostly large, C₃-plants. \approx 35 species.
 - ▶ *Arundo*—giant reed
 - ▶ *Phragmites*—reed



Arundo



Subfamily Danthonioideae

- ▶ Large xerophytic grasses with narrow leaves, ligule hairy, lemma with single awn, C₃-plants. \approx 250 species.
 - ▶ *Danthonia*—oatgrass from outside of prairies
 - ▶ *Cortaderia*—pampas grass



Cortaderia



Subfamily Panicoideae

Primarily tropical grasses, ligule often consists of hairs or absent, spikelets frequently paired, embryo large, leaves with Kranz anatomy, mostly C₄-plants. $\approx 3,270$ species.

Tribes:

Paniceae *Panicum*—millet, *Setaria*—pigeongrass,
Cenchrus—sandbur

Andropogoneae *Saccharum*—sugarcane, *Sorghum*—sorghum,
Zea—corn, *Coix*—Job's tears, *Andropogon*
(*Schizachyrium*)—bluestem



Setaria



Cenchrus



Coix



Subfamily Chloridoideae

Grasses of dry climates, ligule fringed, leaves have specific bicellular microhairs, spikelets compressed, sometimes one-sided, embryo large, C₄-plants, Kranz anatomy. $\approx 1,400$ species

Tribes:

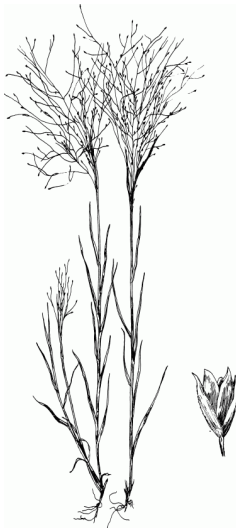
Eragrostideae *Eragrostis*—lovegrass

Zoysieae *Sporobolus*—dropseed, *Spartina*—cordgrass,
Calamovilfa—sandseed

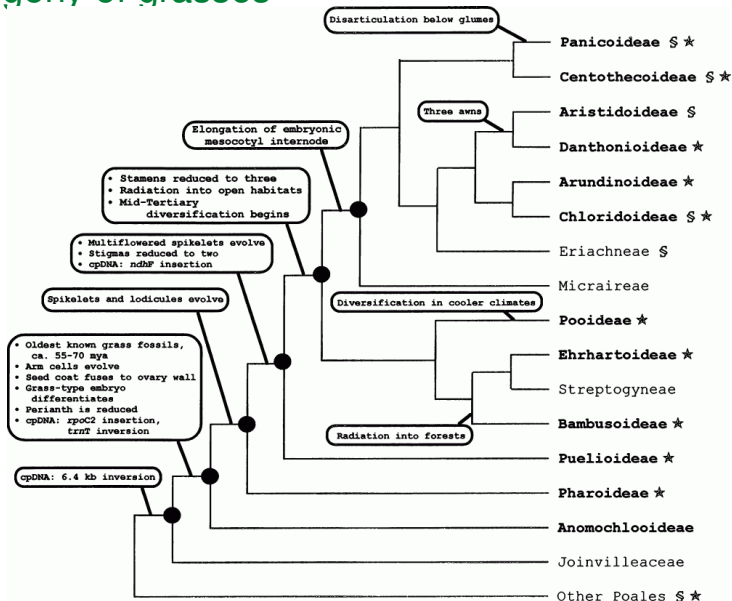
Cynodonteae *Muhlenbergia*—muhly, *Bouteloua*—grama



Muhlenbergia



Phylogeny of grasses



Graminioid families

- ▶ Gramineae
 - ▶ Cyperaceae
 - ▶ Juncaceae
 - ▶ Typhaceae
- And also Restionaceae, Xyridaceae, Mapaniaceae and others



Poales: grass-like plants and some others

Cyperaceae—sedge family



Main features of Cyperaceae

- ▶ 4,000 species, \approx 1,000 belongs to sedges, *Carex*
- ▶ Grasslike plants, distributed mostly in temperate and Arctic regions
- ▶ Prefer wet places

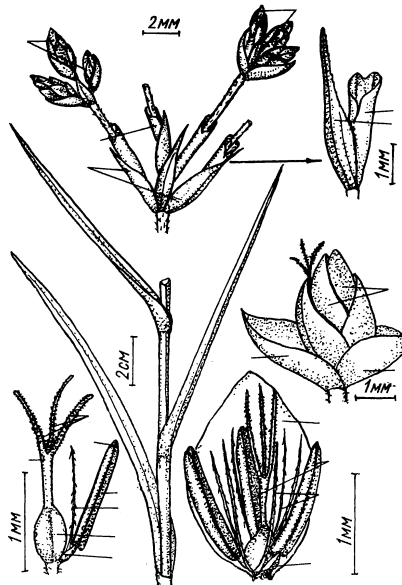


Morphology of Cyperaceae

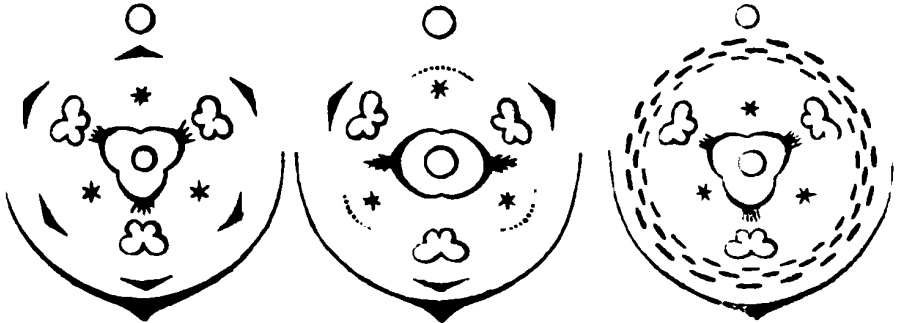
- ▶ Accumilate silica
- ▶ Leaves often in 3 ranks, stem is also a triangle on the cross-section
- ▶ Flowers small, wind-pollinated, unattractive, often unisexual, form spikes or spikelets and more complicated inflorescences
- ▶ Pollen grains in monads (from four microspores, only one survives)
- ▶ Perianth often reduced, stamens three, one pistil with one ovule but three carpels
- ▶ *Carex* flowers have specific bag-like perigynium
- ▶ Fruit is an achene



Scirpus sylvaticus floral parts



Cyperaceae flower diagram



$*P_{3+3} \vee 0 A_3 \underline{G_{(2-3)}}$

Diversity of Cyperaceae

Importance: Sometimes food, weaving materials, ornamentals

- ▶ *Eleocharis*—spikerush: base of style enlarged. *E. dulcis* is a Chinese water-chestnut. 13 species in ND.
- ▶ *Scirpus* s.l.—bulrush: scales are spirally arranged. Genus is frequently split into, e.g., *Scirpus* s.str., *Schoenoplectus*, and *Bolboschoenus* which is sometimes separated from *Schoenoplectus*. If not sure, go to *Scirpus* to ID. 11 species in ND.
- ▶ *Eriophorum*, cottongrass was used as fiber source. 4 species in ND.
- ▶ *Cyperus*—cyperus: spikelets with two rows of scales. *C. papyrus* was used for famous Egyptian papyrus, *C. esculentus* (chufa) has edible corms (occurred in Fargo region). 9 species in ND.
- ▶ ... and of course, *Carex*. 91 species in ND!



Eriophorum sp.



Cyperus papyrus



Carex flowers

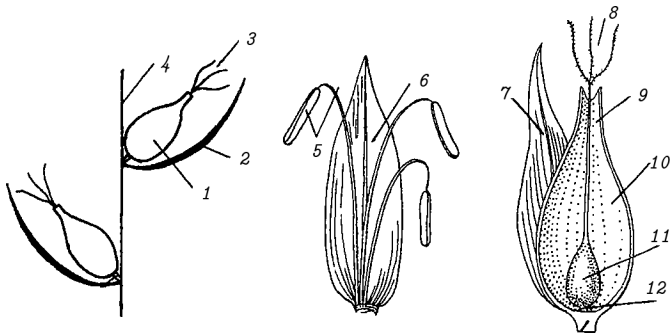
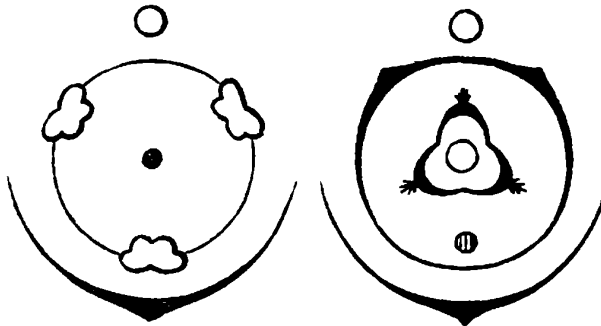


Diagram of *Carex* flower



$*P_0A_3$ or $\uparrow P_0G_{\underline{(2-3)}}$

Diversity of sedges (*Carex*)

Carex covers almost half of wet places in Arctic and northern temperate region. 3-ranked leaves, female flowers enclosed in perigynium.

Main groups:

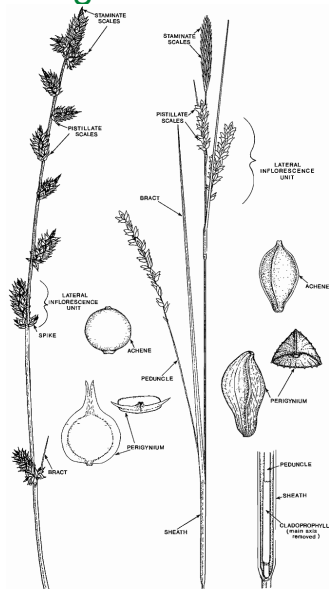
1 spike Subgenus *Psyllophora*, e.g. *Carex filifolia*

Bisexual spikes Subgenus *Vignea* (and also tropical subg. *Indocarex*),
e.g. *Carex brevior*

Unisexual spikes Subgenus *Carex*, e.g. *Carex retrorsa*



Subg. Vignea vs. subg. Carex



Carex filifolia



Carex brevior



Carex retrorsa



Poales: grass-like plants and some others

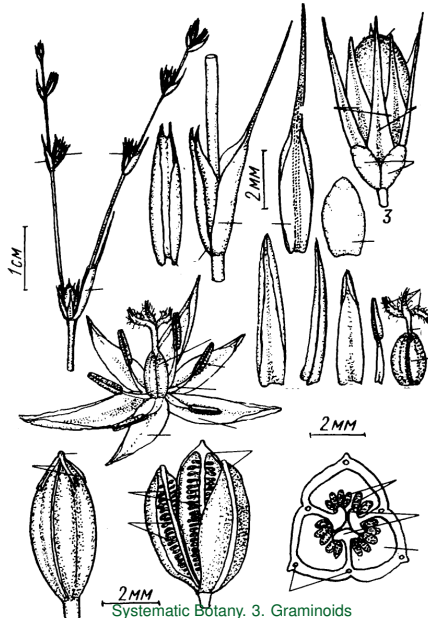
Juncaceae—rush family



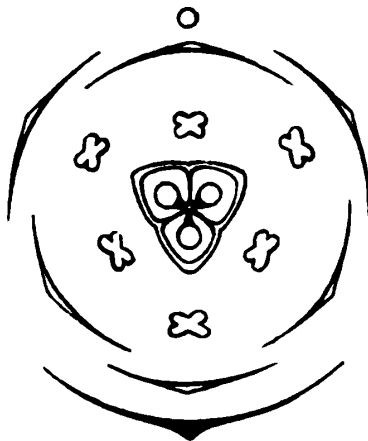
Juncaceae—rush family

- ▶ \approx 300 species
- ▶ Distributed in temperate and montane regions, growing in dump places
- ▶ Life forms: grass-like herbs
- ▶ Leaves flat to cylindric, with open sheath, sometimes reduced
- ▶ Flowers actinomorphic, 3-merous, perianth of 6 tepals, 6 stamens
- ▶ Pistil has 3 carpels
- ▶ Fruit is a capsule



Juncus bufonius flower parts

Juncaceae flower



*P₃₊₃A₃₊₃G₍₃₎

Representatives of Juncaceae

Importance: weaving materials

- ▶ *Juncus*—rush: cylindric leaves
- ▶ *Luzula*—wood-rush: “normal” grass-like flat leaves



Juncus effusus



Luzula parviflora



Poales: grass-like plants and some others

Typhaceae—cattail family

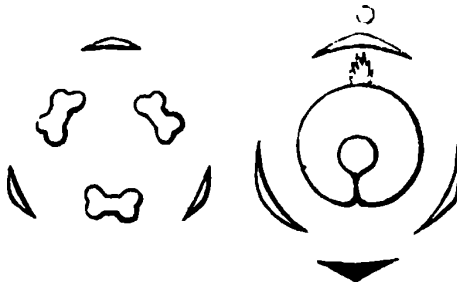


Typhaceae—cattail family

- ▶ \approx 40 species
- ▶ Distribution: widespread
- ▶ Life forms: grass-like coastal or water plants
- ▶ Leaves distichous, linear, mostly basal
- ▶ Dense inflorescences
- ▶ Flowers very reduced, male with one or 3 stamens
- ▶ Pistil unicarpellate, with one ovule
- ▶ Fruit an achene or drupe

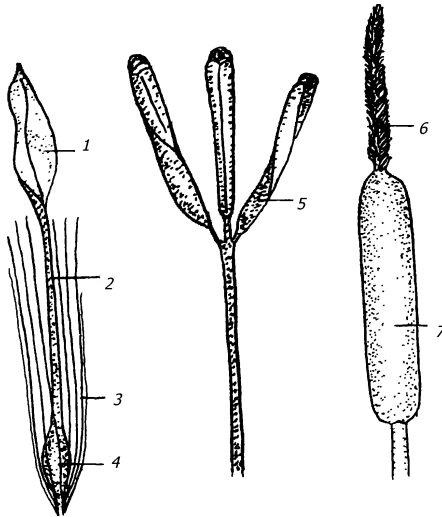


Typhaceae flowers



♂*P₃A₃; ♀*P₃G₁

Typha latifolia flower parts



Representatives of Typhaceae

Importance: mating and weaving material, edible pollen and rhizomes, sometimes ornamental.

- ▶ *Sparganium*—bur-reed (sometimes separated to its own family)
- ▶ *Typha*—cattail



Sparganium eurycarpum



Summary

CHARACTER	JUNCACEAE (RUSHES)	CYPERACEAE (SEDGES)	POACEAE (GRASSES)
GENERA/SPECIES	8/300	146/5,315	650–785/10,000
HABITAT	wet areas	wet areas or sterile soils	dry to moist areas
STEM CROSS SECTION	terete	triangular	terete or ellipsoid
INTERNODES	solid, with large pith	usually solid	usually hollow, or less commonly solid
NODES	not jointed	not jointed	jointed
LEAF RANKS	3	3	2
LEAF BLADE	flat to terete	flat	flat
LEAF SHEATH	open	closed	open and with ligule
INFLORESCENCE	basically cymose, and often congested	arranged in spikelets	arranged in spikelets
NUMBER OF BRACTS SUSTENDING EACH FLOWER	2 or more	1 (glume, scale)	usually 2 (palea and lemma)
PERIANTH	usually 6 chaffy tepals	absent, or reduced to a varying number of bristles or scales	reduced to 2 (or sometimes 3) lodicules
ANTHER ATTACHMENT	basifixed	basifixed	basifixed, but deeply sagittate and appearing versatile
POLLEN	in tetrads	single, but each grain ("pseudomonad") representing a degraded tetrad	single
FRUIT TYPE	loculicidal capsule	achene	caryopsis (grain)
EMBRYO	surrounded by endosperm	embedded in base of endosperm	outside of endosperm



For Further Reading



A. Shipunov.

Shipunov, A. Plants of North Dakota. Manual.

2017—onwards.

Mode of access: http://ashipunov.info/shipunov/school/biol_448/nd_manual/nd_manual.pdf



A. Shipunov.

Shipunov, A. Flora of North Dakota: Checklist. Version 2. Ed.: Kartesz, J., and Nishino, M.

2017—onwards.

Mode of access: <http://ashipunov.info/shipunov/fnddb2>



Minot State University Herbarium (MSU)



Flora of Great Plains.

1986.

University Press of Kansas, Lawrence, KS.



Other useful books and Web sites

- ▶ Pohl (several editions) “How to know grasses”
- ▶ Hitchcock (1935) “Manual of Grasses of the United States”
- ▶ Flora of North America, two “grass” volumes (not available from efloras.org)
- ▶ “Manual of Grasses for North America” (2007)
- ▶ Looman (1982) “Prairie Grasses Identified and Described by Vegetative Characters”

