Chapter 2

Major Genera in Cyperaceae Family in the World

Abstract

The diversity of sedges is marked in a wide range of habitat of tropical, subtropical and temperate regions of the world, with 5687 species reported. The dominant genera within the Cyperaceae family are *Carex* L. (2003 species), *Cyperus* L. (964 species), *Rhynchospora* Vahl. (399 species), *Fimbristylis* Vahl. (320 species), *Eleocharis* R.Br. (302 species), *Scleria* P.J.Bergius (258 species), *Bulbostylis* Kunth. (227species), *Schoenus* L. (149 species) and *Mapania* Aubl. (100 spp.). These nine genera together hold more than 80% of the total species diversity of the family. The general characteristic features and detailed distribution pattern of the dominant genera are described in the chapter.

Introduction

Bruhl (1995) classified Cyperaceae into 2 subfamilies; Cyperoideae and Caricoideae, while Goetghebeur (1998) recognised 4 subfamilies; Mapanioideae, Cyperoideae, Scleroideae and Caricoideae. Subsequently Simpson (2007) recognized only 2 subfamilies; Mapanioideae and Cyperoideae. Larridon (2022) recently proposed two subfamilies, 24 tribes, 10 subtribes, 95 genera and 5687 species, based on a stable phylogenetic framework based on morphological, molecular phylogenetic and phylogenomic studies (**Table 1)**.

The highest diversity of the family is marked in humid and semi-humid tropics along with temperate and cold temperate regions of the world, and the plant group flourish well in a wide range of habitat, especially in marshy areas. The nine dominant genera within the family that hold more than 80% of the total species diversity includes *Carex* L. (2003 species), *Cyperus* L. (964 species), *Rhynchospora* Vahl. (399 species), *Fimbristylis* Vahl. (320 species), *Eleocharis* R.Br. (302 species), *Scleria* P.J. Bergius (258 species), *Bulbostylis* Kunth. (227 species) and *Schoenus* L. (149 species) and *Mapania* (100 species). Most of the remaining genera of Cyperaceae are quite small and many are monotypic.

Table 1. Genera and number of species in Cyperaceae family (Ref. Larridon, 2022)

Genera	Number of species
Abildgaardia Vahl	9
Actinoschoenus Benth.	2
Actinoscirpus (Ohwi) R.W.Haines& Lye	1
Afroscirpoides García-Madr. & Muasya	1
Afrotrilepis (Gilly) J.Raynal	2
Ammothryon R.L.Barrett, K.L.Wilson&J.J.Bruhl	1
Amphiscirpus Oteng-Yeb.	1
Anthelepis R.L.Barrett, K.L.Wilson&J.J.Bruhl	4
Arthrostylis R.Br.	2
Becquerelia Brongn.	6
Bisboeckelera Kuntze	4
Blysmopsis Oteng-Yeb.	1
Blysmus Panz. ex Schult.	3
Bolboschoenus (Asch.) Palla	15
Bulbostylis Kunth	227
Calliscirpus C.N.Gilmour, J.R.Starr&Naczi	2
Calyptrocarya Nees	8
Capeobolus Browning	1
Capitularina J.Kern	1
Carex L.	2003
Carpha Banks & Sol. ex R.Br.	15
Caustis R.Br.	7
Cephalocarpus Nees	20
Chaetospora R.Br.	3
Chamaedendron Larridon	5
Chorizandra R.Br.	6
Chrysitrix L	4
Cladium P.Browne	3
Coleochloa Gilly	8
Costularia C.B.Clarke	15
Cryptangium Schrad. ex Nees	1
Cyathochaeta Nees	5
Cyathocoma Nees	3
Cyperus L.	964
Didymiandrum Gilly	1
Diplacrum R.Br.	10

Diplasia Pers.	1
Dracoscirpoides Muasya	3
Dulichium Pers.	1
Eleocharis R.Br.	302
Eriophorum L.	18
Erioscirpus Palla	2
Evandra R.Br.	2
Exocarya Benth.	1
Exochogyne C.B.Clarke	2
Ficinia Schrad.	87
Fimbristylis Vahl	320
Fuirena Rottb.	55
Gahnia J.R.Forst. &G.Forst.	41
Gymnoschoenus Nees	2
Hellmuthia Steud.	1
Hypolytrum Pers.	63
Isolepis R.Br.	69
Khaosokia D.A.Simpson	1
Koyamaea W.W.Thomas&Davidse	1
Krenakia S.M.Costa	10
Lagenocarpus Nees	15
Lepidosperma Labill.	80
Lepironia Pers.	1
Machaerina Vahl.	55
Mapania Aubl.	100
Mesomelaena Nees	5
Microdracoides Hua	1
Morelotia Gaudich.	6
Neesenbeckia Levyns	1
Nelmesia Van der Veken	1
Netrostylis R.L.Barrett, J.J.Bruhl&K.L.Wilson	11
Oreobolus R.Br.	17
Paramapania Uittien	7
Phylloscirpus C.B.Clarke	3
Pseudoschoenus (C.B.Clarke) Oteng-Yeb.	1
Ptilothrix K.L.Wilson	1
Reedia F.Muell.	1
Rhodoscirpus Lév.-Bourret, Donadío&J.R.Starr	1
Rhynchocladium T. Koyama	1

Rhynchospora Vahl	399
Schoenoplectiella Lye	63
Schoenoplectus (Rchb.) Palla	16
Schoenus L.	149
Scirpodendron Zipp. Ex Kurz	2
Scirpoides Ség.	4
Scirpus Tourn. ex L.	47
Scleria P.J.Bergius	258
Scleroschoenus K.L.Wilson, J.J.Bruhl & R.L.Barrett	6
Sumatroscirpus Oteng-Yeb.	4
Tetraria P.Beauv.	39
Trachystylis S.T.Blake	1
Trianoptiles Fenzl ex Endl.	3
Trichophorum Pers.	19
Trichoschoenus J.Raynal	1
Tricostularia Nees	11
Trilepis Nees	5
Xyroschoenus Larridon	1
Zameioscirpus Dhooge & Goetgh.	3
Zulustylis Muasya	2
Total species	5687

***Carex* L.**

Carex with a cosmopolitan distribution of 2003 species is the largest genus within the family described by Linneaeus in his 'Species Plantarum' with *Carexhirta* as the type species. The tribe Cariceae of subfamily Cyperoideae includes *Carex* L., *Kobresia* Willd., *Uncinia* Pers., *Schoenoxiphium* Nees and *Cymophyllus* Mack. The sister groups in tribe Scripeae are clearly distinguished from *Carex* by the transition from bisexual flowers with a bristle perianth to unisexual flowers without a perianth in *Carex*. Kuekenthal (1909) described four subgenera of the genus based on the structure of the inflorescence; *Carex*, *Psyllophora*, *Vignea* and *Vigneastra.*

Members of *Carex* are perennial herbs with branched, tufted or creeping woody rhizome clothed with remnants of old bladeless sheaths. Culms arise centrally or laterally, erect, mostly triquetrous or trigonous, solid or sometimes hollow (**Figure 1**). Leaves are mostly basal with distinct petiole and ligule at the junction of blade and sheath. Inflorescence paniculate, racemose or spicate, more rarely reduced to a single terminal spike. Involucral

bracts are foliaceous, setaceous or glumaceous. Florets are unisexual and devoid of perianth. The male flowers of *Carex* possess three stamens subtended by a glume directly inserted on the axis while the female flowers are enclosed in a sac-like organ, called the utricle or perigynium. The utricle indicates the presence of a lateral axis, often called the rachilla, and is usually short and inhibited at an early stage in the genus (Kunth, 1835; Kuekenthal, 1909). The adaxial side of a lateral branch of *Carex* possess three kinds of prophylls: the swollen (or inflorescence) prophyll, the cladoprophyll and the glumaceous prophyll. The swollen prophyll is at the base of paracladia in the core *Carex* clade (Reznicek 1990). It is same as that of empty perigynium, and referred as the perigynium-like prophyll (Snell 1936). The cladoprophyll is a tubular sheath near the base of peduncles of pseudospikes. The prophyll that appears at the basal position on the bud is membranous, glume like, shorter and colourless (Kukkonen, 1994).

Figure 1. *Carexbaccans*- Inflorescence, spikelet, utricle and nut

***Cyperus* L.**

The type genus *Cyperus* L. is the second largest genus included under the tribe Cypereae of subfamily Cyperoideae, with about 964 species reported globally, and it was described by Linneaeus in his 'Species Plantarum' with *Cyperus esculentus* as the type species (Bruhl, 1995).The genus occurs worldwide from tropical to temperate regions, with a concentration of species and presumed origin in tropical Africa (Goetghebeur, 1998; Spalink *et al.*, 2016). *Cyperus* shows remarkable ranges of adaptability to varied ecological conditions, mostly growing on damp, marshy and waterlogged places.

Cyperus is a taxonomically complex genus and the status of infra generic divisions are still under confusion among the taxonomists. The genus can be easily recognized by its nature

of inflorescence with conspicuous involucral bracts, absence of perianth and distichous spikelets with several fertile glumes (**Figure 2**). Most of the species are annual or perennial herbs. Annuals are with fibrous roots only, but perennials are with short or long stolons, sometimes emitting tubers (*Cyperus rotundus*). Leaves alternate, spirally arranged in a basal rosette, terminal simple to decompound inflorescence, as anthelodia, glomerules, spikes, subdigitate spikes, digitate clusters or fascicles.

Figure 2.*Cyperus pilosus*- Inflorescence, spikelet and nut

The first attempt to classify the genus was done by Nees (1834), and divided the genus into eight sections. In 1935-36 Kuekenthal made a comprehensive revision of the genus and divided into 6 subgenera, 61 sections and 8 sub sections. Classification of the genus is controversial due to the morphological diversity and the presence of several convergent evolutionary lines. The latest molecular works reveal that the core genus *Cyperus* includes several segregate genera. Taxonomic complexity of the genera resulted in the accumulation of 79 subdivisional names of which 20 are not validly published and two are illegitimate (Wim Huygh*et. al.,* 2010). Nees in 1834 proposed the first infra generic classification and divided the genus into eight sections. According to Kunth (1837) and Steudel (1834), *Mariscus* and *Kyllinga* are segregated genera. Recently Larridon *et al.* (2011, 2014, 2022) recognized a new classification of the genus *Cyperus* and elucidated the phylogenetic relationships and generic delimitation in C4 *Cyperus,* combining the genera like *Ascolepis*, *Kyllinga* and *Pycreus*.

***Rhynchospora* Vahl**

Rhynchospora Vahl, commonly known as 'beaked sedge or beak-rush', with 399 species worldwide, is predominantly distributed in warm temperate zones and the neotropics but its centre of distribution is the Americas. The diagnosis is primarily based on characters of the 2-sided achene including style base and bristles (**Figure 3**). The terminal portion of the achene is crowned by the persistent style base which is often termed to as the nut-beak.

Figure 3. *Rhynchospora corymbosa*-Inflorescence and nut

***Fimbristylis* Vahl.**

The genus *Fimbristylis* Vahl has about 320 species and distributed widely in pantropical and warm temperate regions of the world with the highest concentration of species in tropical Asia (Viji *et al*., 2016). The genus was described by Martin H. Vahl (1805) with *Fimbristylis dichotoma* as the type species. The members can be easily recognized with many flowered spikelets, bisexual florets without hypogynous bristles and deciduous style-base (**Figure 4**).

Figure 4. *Fimbristylis dichotoma*-Inflorescence, spikelet and nut

Fimbristylis, *Bulbostylis* and *Abildgaardia* are morphologically confusing genus and are under wide debate. Based on embryo type, Lye and Haines (1983) placed *Abildgaardia* and *Bulbostylis* within a single genus. Based on the fact that style base persists or not, Clarke (1893), Barros (1947) and Kern (1974) included *Abildgaardia* as a section under *Fimbristylis* and treated *Bulbostylis* as a separate genus. However, based on morphological similarities, Bentham (1883) and Koyama (1961) recognized *Abildgaardia*, *Bulbostylis* and *Fimbristylis* as a single genus namely *Fimbristylis*. Molecular phylogeny supports the division of *Abildgaardia*, *Bulbostylis* and *Fimbristylis*, but the relationship among these genera is still unclear (Ghamkar *et al.*, 2007).

***Eleocharis* R. Br.**

The genus *Eleocharis* R. Br., commonly known as 'spike sedge', is a cosmopolitan genus with marked concentration of taxa in subtropical America (Goetghebeur, 1998) and a presumed origin in North America (Spalink *et al.*, 2016). *Eleocharis* species are distributed in seasonally wet to permanently flooded habitats from tropical to temperate regions of both the hemispheres with 302 species. Classification of *Eleocharis* is difficult because relatively few macroscopic characters such as unbranched culms, rudimentary leaves with basal, tubular sheaths, reduced inflorescence to a simple terminal spikelet and absence of involucral bracts are provided as characteristic of the genus (**Figure 5**).

Figure 5. *Eleocharis* dulcis- Habit, spike and nut

***Scleria* Bergius**

The genus *Scleria* Bergius, with a presumed origin in South America, is distributed in tropical and warm-temperate regions of both the hemispheres with about 258 species

globally (Spalink *et al.*, 2016). There are some peculiar structures providing taxonomical delimitation to this genus such as hypogynium, hardened disc at the base of the achene and contra-ligule (**Figure 6**). The flap like structure is present on the rim of the leaf sheath on the opposite side from the blade and is membranous. The nature of hypogynium may be a prominent collar or an inconspicuous ridge around the point of attachment of the achene. Before the abscission of achene, the hypogynium is attached to a concave disc, the cupula, which remains with the inflorescence when the achene is shed.

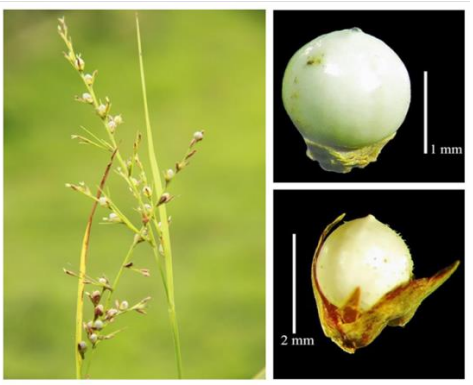

Figure 6. *Scleria levis*- Inflorescence and nut

***Bulbostylis* Kunth.**

The genus *Bulbostylis* Kunth. emerges as monophyletic within tribe Abildgaardieae and comprises 227 species, distributed mainly in the tropical and subtropical regions of the world (Larrindon *et al.*, 2021).

Figure 7. *Bulbostylis barbata* and *Bulbostylis densa*

The genus is mainly recognized by the achenes crowned by a persistent, button-like style-base, apical leaf-sheath trichomes, trifid or bifid styles, the trigonous or rarely biconvex nutlets, and the stylopodium that varies from persistent to deciduous on the nutlet apex (**Figure 7**). Species inhabit varied habitats from open to non-forested areas, growing on sandy substrates and are important components of natural open herbaceous vegetation (Goetghebeur, 1998).

Conclusions

Only a limited number of researchers have taken up the study of Cyperaceae group and as such the status of knowledge on the sedge flora of various regions of the world is not of the required level of perfection. Despite of the economic and ecological significance and wide occurrence, sedges receive little attention from flora workers because of the minute flowers enclosed in glumes and arranged in complicated inflorescence of spikelet, along with inadequate herbarium collections, and the need for basic taxonomic surveys is often emphasized for this plant group.

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