

DISTRIBUTION OF SEDGES ON DIFFERENT ECOLOGICAL REGIONS OF KERALA

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ABSTRACT

The family Cyperaceae (Sedges) is the third largest among monocots, comprise about 5500 species and 109 genera (Muasya, 2009). They are cosmopolitan, grass like and are often form an important component of many ecosystems ranging from marshes to deserts. Sedges are primarily distributed in cold to temperate regions of world (Starr *et. al.* 2004, Mabberley, 2008), dominated in wetlands and tropical grasslands. Physical environment and climate patterns play an important role in the distribution of plant species. Plant species are neither evenly nor randomly distributed on the surface of earth, but physical environment and climate governs their distribution in definite geographical units. Water depth has been reported to be one of the most important factor that influence vegetation distribution and species assemblage (Lind & Vesser, 1962). Some species are habitat specific, narrowly distributed, whereas others are potential weeds that occur in a variety of environments. Analysis of distributional patterns of plant species is of utmost importance in observing the distributional range, origin, diversification and evolution of particular flora. Therefore, the relationship between environmental factors and the distribution patterns of sedges among various ecological regions of Kerala were studied. Sedges are found in all habitat of the study area including forest, grasslands, and coastal

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regions. Most of the species are found in the low land moist or wet areas like in and around lakes, reservoirs, river banks and beds, wetlands, rice fields etc. Least no of species were reported from the coastal regions of kerala. Most of them are cosmopolitan in nature, however some species are highly habitat specific. The study observed the distribution pattern of sedges in Kerala in relation to different habitats and altitude. Water depth and altitude variation are seems to be determining the species in a region.

Keywords : Sedges, Distribution, Kerala

INTRODUCTION

Physical environment and climate patterns play an important role in the distribution of plant species. Both biotic and abiotic factors, such as soil topography, geology, climate change, species evolution and migration will affects their spatial distribution. Geographical distribution patterns of plant vegetation provide an understanding of plant diversity, habitat specific species and of conservation concerns. Plant species are neither evenly nor randomly distributed on the surface of earth, but physical environment and climate governs their distribution in definite geographical units. Plants shows remarkable range of adaptability to various ecological conditions, some species were highly specific in their habitat, which finally leads to rarity and local endemism. Knowledge of how ecologically important morphological characters vary within the distributional range of plant species, as well as the underlying control mechanisms for such variation, is essential to understand how the plants may respond to environmental changes (Anna *et. al.* 2002).

The members of the family Cyperaceae are commonly known as 'sedges' and are cosmopolitan, grass like plants, often form an important component of many ecosystems ranging from marshes to deserts. They are primarily distributed in

cold to temperate regions of world (Starr *et. al.* 2004, Mabberley, 2008), dominated in wetlands and tropical grasslands. The most important environmental variables correlates with sedge assemblage structures were the water depth, altitude, and rainfall. Some species are habitat specific, narrowly distributed, whereas others are potential weeds that occur in a variety of climatic conditions. Analysis of distributional patterns of plant species is of utmost importance in observing the distributional range, origin, diversification and evolution of particular flora. Therefore, an attempt has been made to study the relationship between environmental factors and the distribution patterns of sedges among various ecological settings of Kerala.

MATERIALS AND METHODS

Field exploration

Exploration trips were conducted to different ecological settings and vegetation types in different seasons in the study area. Selected ecological regions of the study area include different forest types, grasslands, marshy areas and coastal regions. During field trips almost all the species were collected along with their associates. The data regarding the habit, habitat, flowering, fruiting etc. were recorded in the field itself along with photographs and collected plants specimens were carefully studied in fresh condition. The plant specimens collected for herbarium purpose were processed as per the procedures (Jain & Rao, 1977; Forman & Bridson, 1991). Voucher specimens were deposited in the herbarium Department of Botany, Christian College for future reference. The collected plant parts were analysed, critically studied by using microscope and identified with the help of monographs, floras and revisionary works. The specimens were provisionally identified using authentic literature and monographs and later cross-matched with specimens including types deposited at herbaria, virtual herbarium of K, E, L, P, BM, U, MO, LINN etc.

Study Area

The study has been carried out in Kerala, the smallest state located in the extreme south-western part of India. The state is bounded on the north and northeast by Karnataka, east by Western Ghats, south by Tamil Nadu, and west by Arabian Sea. The area has a complex topography with mountains, valleys, ridges and scarps. The rich biodiversity and varied habitats of the area harbours a sizable number of plants and large number of endemics having special relevance to conservation. Geographically, Kerala can be divided into three climatically distinct regions: the eastern highlands; rugged and cool mountainous terrain, the central mid-lands; rolling hills, and the western lowlands; coastal plains. The eastern region of Kerala consists of high mountains, gorges and deep-cut valleys immediately west of the Western Ghats, 41 of Kerala's west-flowing rivers and 3

fits east-flowing ones originate in this region. The highest peaks reach around 2,500 metres (8,200 feet). Anamudi in the Idukki district is the highest peak in south India. The Western Ghats mountain chain is recognised as one of the world's eight "hottest hotspots" of biological diversity and is listed among UNESCO World Heritage sites. The chain's forests are considered to be older than the Himalaya Mountains. Kerala's western coastal belt is relatively flat compared to the eastern region, and is criss-crossed by a network of interconnected brackish canals, lakes, estuaries, and rivers known as the Kerala Backwaters.

RESULTS

The study observed the distribution pattern of sedges in Kerala in relation to different habitats and altitude. Sedges are found in all habitat of the study area including forest, grasslands, and coastal regions. Most of them are cosmopolitan in distribution, however some species are highly habitat specific. Water depth

and altitude variation are seems to be determining the species richness in the region. Periodic survey conducted in various habitats and literature review revealed the presence of 140 species of sedges in the study region where specifically occurred in these habitats. Distribution pattern of species in different habitats of the study area are discussed below:

Grasslands

Grasslands are the regions where the grasses are dominated. A total of 37 species of sedges have been collected from different study regions. Based on the altitude, grasslands are of two types. Low level Grasslands lie up to 1000 m altitude and are very scattered and often intermixed with forests. Based on the habitat features, this type can again divided into two types based on moisture regime. i. Dry grasslands: These occur along dry rocky plateaus and isolated hills observed at Thalimparamba, Kasargode, Bendadukka, Chelanoor, Attappadi, Nilambur etc. ii. Wet grasslands: Portions of the swampy, marshy and coastal niche lying below the mean sea level of Kuttanadu and Aleppey. High altitude grasslands or "montane grasslands" lie normally above an altitude of 1500 m.

Table 1: **Grassland specific sedges (37 species)**

GRASSLANDS		
Low level Grasslands		High altitude grasslands (16 species)
Dry grasslands (9 species)	Wet grasslands (12 species)	
<i>Cyperus bulbosus</i> Vahl	<i>Carex baccans</i> Nees.	<i>Carex hebecarpa</i> C. Meyer subsp. <i>ligulata</i> (Nees) T.Koyama.
<i>C. castaneus</i> Willd	<i>C. breviculmis</i> R. Br.	<i>C. lateralis</i> Kuek.
<i>C. cuspidatus</i> Kunth	<i>Cyperus cyperinus</i> (Retz.) Valck. Sur. Gesl.	<i>C. lindleyana</i> Nees.
<i>C. tenuiculmis</i> Boeck.	<i>C. cyperoides</i> (L.) Kuntze	<i>C. longipes</i> D. Don.
<i>Pycnus stramineus</i> (Nees) C. B. Clarke	<i>Eleocharis attenuata</i> (Franch. & Sav.) Palla	<i>C. maculata</i> Boott.
<i>Fimbristylis latiglumifera</i> Govind.	<i>Fimbristylis pseudomicrocarya</i> Govind.	<i>C. nubigena</i> D. Don.
<i>F. salbundia</i> (Nees) Kunth	<i>F. pseudonarayanii</i> Ravi & Anil Kumar	<i>Fimbristylis dura</i> (Zoll. & Moritz.) Merr.
<i>Bulbostylis barbata</i> (Rottb.) Kunth ex Clarke	<i>F. rectifolia</i> Govind.	
<i>B. densa</i> (Wallich) Hand.-Mazz.	<i>F. rugosa</i> Govind.	<i>F. mathewii</i> Murug. V, Balas. & Nagarajan
	<i>Kyllinga squamulata</i> Thonn ex Vahl.	<i>F. ovata</i> (Burm. f.) Kern.
	<i>Rhynchospora rubra</i> (Lour.) Makino	<i>F. semidisticha</i> Govind.
	<i>Scleria biflora</i> Roxb.	<i>F. uliginosa</i> Hochst. ex Steud.,
		<i>F. velliangiriensis</i> Murug. V, Balas. & Nagarajan
		<i>Fimbristylis tuckerii</i> Viji, Pandur. & Deepu sp. nov.
		<i>Scleria mikawana</i> Makino.
		<i>S. parvula</i> Steudel.
		<i>S. subcapitatum</i> (Thw.) Ohwi

Forest Areas

A total of 30 species of sedges have been observed from 5 different kinds of forests. Which includes, Shola forests, otherwise known as montane wet temperate forest and confined to moist valleys, slopes, Agasthyamala, Eravikulam National park, Chinnar wild life sanctuary, Upper Silent Valley, Mnnavon shola etc. Sholas occurs as patches of forests alternating with large stretches of grasslands forming shola grasslands complex. Evergreen forests normally occur between 1000 – 1800 m above sea level and distributed at Silent Valley, Wayanad, Periyar national park, Idukki, Pathanamthitta etc. Semievergreen forest occurs on the slopes of hills and mountains and usually forms a bridge between wet evergreen and moist deciduous forests and found at Nilambur, Muthanga, Kalpatta. Deciduous forests were observed in Wayanadu regions and Scrub forest is open and composed of stunted vegetation.

Table 2 : Sedges of forest areas (30 species)

Sl. No	HABITAT TYPES	NAME OF SPECIES
1.	Shola forest (4 species)	<i>Carex bilateralis</i> Hayata., <i>C. walkeri</i> Arn. ex Boot, <i>C. wallichiana</i> Sprengel. and <i>C. wightiana</i> Nees.
2.	Evergreen forest (11 species)	<i>Carex christii</i> Boeck., <i>C. cruciata</i> Wahlenb., <i>C. filicina</i> Nees, <i>C. phacota</i> Sprengel., <i>C. pseudoaperta</i> Bocck. ex Kuek. , <i>C. speciosa</i> Kunth., <i>C. vicinalis</i> Boott, <i>C. myosurus</i> Nees., <i>Hypolytrum nemorum</i> (Vahl) Spreng., <i>Rhynchospora panduranganii</i> Viji, Shaju & Geetha Kum., <i>Scleria lithosperma</i> Sw.
3.	Semievergreen forest (7 species)	<i>Cyperus nutans</i> Vahl. ssp. <i>eleusinoides</i> (Kunth) Hains, <i>Cyperus squarrosus</i> L., <i>Diplacrum caricinum</i> R. Br., <i>Fimbristylis eragrostis</i> (Nees & Meyen ex Nees) Hance., <i>F. latinucifera</i> Govind., <i>Pycneus</i>

		<i>uniloides</i> (R.Br.) Urb., <i>Scleria terrestris</i> (Linn.) Fass. etc.
4.	Deciduous forest (5 species)	<i>Ascopholis gamblei</i> Fischer, <i>C. diffusus</i> Vahl, <i>Fimbristylis cinnamometorum</i> (Vahl) Kunth., <i>Kyllinga brevifolia</i> var. <i>stellulata</i> (Valeck.-Sur.) Ohwi., <i>Kyllinga odorata</i> Vahl.
5.	Scrub forest (4 species)	<i>C. compressus</i> Linn, <i>C. cuspidatus</i> Kunth, <i>C. tenuiculmis</i> Boeck., <i>C. rubicundus</i> Vahl,

Sedges of low wet areas, marshy areas and coastal regions: (67 species)

1. Low land moist or wet areas like in and around lakes, reservoirs, river banks, wetlands, rice fields etc. : (48 species)

Cyperus amabilis Vahl, *C. compactus* Retz., *C. difformis* Linn., *C. distans* Linn., *C. dubius* Rottb., *C. exaltatus* Retz., *C. haspan* Linn, *C. involucratus* Rottb., *C. iria* Linn., *C. nutans* Vahl, *C. pangorei* Rottb., *C. paniceus* (Rottb.) Boeck., *C. pilosus* Vahl, *C. rotundus* Linn., *C. sphacelatus* Rottb., *C. tenuispica* Steud., *Courtoisina cyperoides* (Roxb.) J. Sojak., *Eleocharis atropurpurea* (Retz.) Presl. & C. Presl., *E. congesta* D. Don, *E. retroflexa* (Poir.) Urb. subsp. *chaetaria* (Roem. & Schult.) Koyama, *E. tetraquetra* Nees, *Fimbristylis acuminata* Vahl., *F. aestivalis* (Retz.) Vahl, *F. aphylla* Steudel, *F. argentea* (Retz.) Vahl , *F. bisumbellata* (Forsskal) Bubani, *Fimbristylis dichotoma* (Linn.) Vahl ssp. *Podocarpa* (Nees & Meyen) T. Koyama, *F. dipsacea* (Rottb.) Clarke, *F. littoralis* Gaudich., *F. schoenoides* (Retz.) Vahl, *F. woodrowii* Clarke., *Fuirena ciliaris* (L.) Roxb., *F. umbellata* Rottb., *F. uncinata* (Wild.) Kunth, *Kyllinga melanosperma* Nees ssp. *bifolia* (Miq.) Karthik., *Lipocarpa chinensis* (Osbeck) Kern, *L. gracilis* (Rich. ex Pers.) Nees, *Pycnus flavidus* (Retz.) Koyama, *P. macrostachyos* (Lamk.) J. Raynal., *P. polystachyos* (Rottb.) Beauv., *P. pumilus* (Linn.) Nees ex C.B.Clarke, *P. sanguinolentus* (Vahl)

Nees ex C.B. Clarke, *Queenslandiella hyalina* (Vahl) Ballard, *Rhynchospora corymbosa* (Linn.)

Britton, *R. wightiana* (Nees) Steud, *Schoenoplectiella juncooides* (Roxb.) Lye, *Scleria foliosa* Hochst. ex A. Rich. and *S. flaccida* Clarke.

2. Marshy areas (37 species)

Bulbostylis barbata (Rottb.) Kunth ex Clarke., *Fimbristylis acuminata* Vahl., *C. difformis* Linn., *C. distans* Linn., *C. haspan* Linn., *C. iria* Linn., *C. pilosus* Vahl., *C. rotundus* Linn., *C. sphacelatus* Rottb., *C. tenuispica* Steud., *Courtoisina cyperoides* (Roxb.) J. Sojak., *Eleocharis atropurpurea* (Retz.) Presl. & C. Presl., *E. congesta* D. Don, *E. Dulcis*, *E. retroflexa* (Poir.) Urb. subsp. *chaetaria* (Roem. & Schult.) Koyama, *E. tetraquetra* Nees, *F. aestivalvis* (Retz.) Vahl, *F. argentea* (Retz.) Vahl, *Fimbristylis dichotoma* (Linn.) Vahl T. Koyama, *F. dipsacea* (Rottb.) Clarke, *F. littoralis* Gaudich., *F. schoenoides* (Retz.) Vahl., *F. stigmatotecta* Govind., *F. tristachya* R. Br., *F. woodrowii* Clarke., *Fuirena ciliaris* (L.) Roxb., *F. Ponmudiensis*, *F. umbellata* Rottb., *Kyllinga melanosperma* Nees., *Lipocarpa chinensis* (Osbeck) Kern., *Pycneus flavidus* (Retz.) Koyama., *P. polystachyos* (Rottb.) Beauv., *P. pumilus* (Linn.) Nees ex C. B. Clarke., *P. sanguinolentus* (Vahl) Nees ex C. B. Clarke., *Rhynchospora corymbosa* (Linn.) Britton., *R. wightiana* (Nees) Steud., *Schoenoplectiella juncooides* (Roxb.) Lye.

3. Coastal areas (9 species)

Cyperus arenarius Retz., *C. cephalotes* Vahl., *C. articulatus* Linn., *C. javanicus* Houtt., *C. stoloniferus* Linn., *Eleocharis spiralis* (Rottb.) Roemer & Schultes T. Koyama, *Fimbristylis cymosa* R. Br., *F. ferruginea* (L.) Vahl., *F. polytrichoides* (Retz.) Vahl.

4. Sedges of specific habitats (6 species)

Cyperus cephalotes Vahl often grow on some floating substances like decaying plant materials. There are certain species confined to particular habitats. *Fimbristylis falcata* (Vahl) Kunth., *F. kingii* C.B. Clarke and *Fimbristylis narayanii* C. Fischer are usually found on rocky slopes of higher altitudes. *Isolepis fluitans* (L.) R. Br., generally found as floating vegetation in the higher altitudes. *Cyperus papyrus* L., a large emergent, aquatic perennial occurs in dense populations in swamps.

DISCUSSION AND CONCLUSION

According to the study of relationship between habitat variation and the distribution patterns of sedges, reveals that the water depth, altitude, and rainfall were the most important environmental factors correlates with the sedge assemblage. Distribution patterns of sedges indicated preference of several species for certain habitats. Out of the 140 species collected from the study region 58 species were collected from low land wet areas and marshy areas, which reveals the domination of sedge species in the midland regions of the study area. The genus *Carex* and *Scleria* is mainly observed in high altitude regions of forest regions. The genus *Fimbristylis* is distributed in low land as well as high altitude areas.. However some species are common in different habitats.



Plate 1- Distribution of Sedges in different habitats of Kerala

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