Floristic Diversity of Protected Ecosystems of Kandi Region of Punjab, India.

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Abstract: Present study was conducted in protected ecosystems of Pathankot, Hoshiarpur and Garhshanker areas of Kandi region of Punjab. Total 206 species belonging to 159 genera and 59 families were identified from these sites. The contribution of dicotyledons, monocotyledons and pteridophytes was 77.7%, 20.4% and 1.9%, respectively. *Ipomoea* was the most dominant genera. Biological spectrum of the study site showed that therophytes (52%) were the most dominant life form followed by phanerophytes (27%). [New York Science Journal. 2010;3(4):96-103]. (ISSN 1554-0200).

Keywords: Biological spectrum; Floristic diversity; Kandi region of Punjab; Life form.

1. Introduction

The Kandi region spanning from Kashmir region, Punjab and Haryana, is transitional zone between the Siwaliks and plains (Shardha and Bagchi 2001). Forests of Kandi region of Punjab are the most disturbed and fragmented among these regions. Kandi area of Punjab is a sub-mountainous zone that stretches in a thin belt along the northeastern border of the state of Punjab, and comprises the Punjab Shiwaliks and strip of undulating land below the hills covering the districts of Gurdaspur, Hoshiarpur, Fatehgarh Sahib and Ropar, with a length of 161 Km and a width of 10 Km.

The forests of Punjab are largely confined to the Shiwalik region or the Kandi region. About 83 percent of the forest area in the Kandi belongs to the local communities and private individuals. Private forests include those owned by individuals, groups of individuals or the *Panchayat*. The Forest Department exercises control over these forest areas under the Land Preservation Act, 1900. Due to high rate of anthropogenic disturbances in the form of fuel-wood collection, cattle grazing and fires, the floristic diversity of these forests is always under threat. Therefore, these disturbed forests were undertaken by the Forest Department of Punjab for plantations of various fuel-wood and fodder species.

Various workers (Sabnis, 1940; Nair, 1978; Meenakshi and Sharma, 1985; Sharma, 1990; Sharma and Rajpal, 1995; Sharma et al., 2003; Tiwana et al., 2005) have studied the flora of Punjab. But, the study of plantation and privately protected sites has not been emphasized in these studies. These protected sites along with privately protected sites were studied with an objective of listing the plant species of these sites.

2. Material and Methods

2.1 Study Area

Kandi area is located in North-Eastern part of Gurdaspur, Hoshiarpur, Nawanshahar, Ropar and Patiala districts lying between 30° 21' 48" to 32° 30' 00" north latitudes and 75° 32' 12" to 75° 56' 00" east longitudes. The present study was conducted in the protected areas of Garhshanker, Pathankot and Hoshiarpur parts of Kandi region.

The study area has an undulating and degraded topography. The whole area is a sub-montane tract forming a part of upper, middle and lower Shiwaliks. Geologically, the region is representative of Indo-Gangetic alluvial formation. The rocks are disposed in two broad belts, an outer and an inner belt, formed of the upper and lower tertiary periods respectively.

The study region is generally mountainous and sub-mountainous, which largely modifies the temperature and other climatic factors. The climate of the area is semi arid, and most of the rainfall is received during monsoon from July to September and few in winters, during January and February. Rainfall data averaged for the last five years indicate that the study areas (Pathankot, Hoshiarpur and Garhshankar) receive about 61.89 to 90.12% rainfall during rainy season i.e. from June to September (Figure 1). The maximum temperature of 47.3 ^{0}C was recorded in the month of June and minimum 0.7 ^{0}C in January.

2.2 Methodology

The area was frequently visited through out the study year. The plant samples were collected from different locations. The details of the plant specimens were recorded with date in field notebook and specimen

of the plants were tagged with coding and pressed in plant press.

The specimens were brought to laboratory where they were dried and poisoned to protect the fungal growth. The specimens were mounted on standard sized herbarium sheets and then identified from the herbarium of B. S. I. Northern Circle Dehradun, D.D. Herbarium F. R. I. Dehradun. The Identified specimens were deposited in office of Chief Conservator of Forest, Research Circle, Hoshiarpur, Punjab.

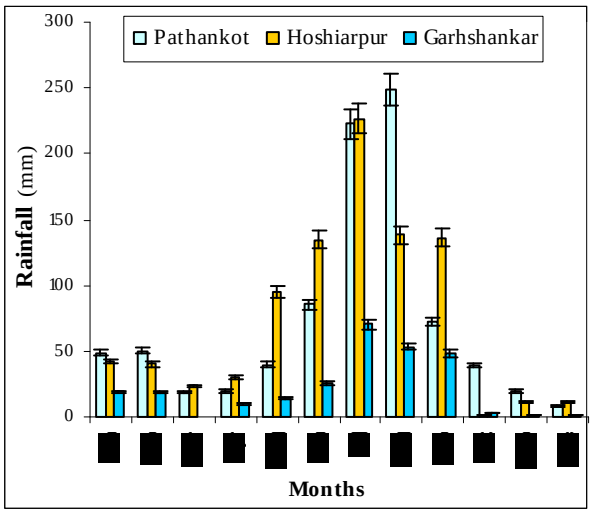

Figure 1. Rainfall data of various sites of Kandi region

The term life form, in general refers to the shape or appearance of an organism. Raunkiaer (1934) defined life-forms as '*the sum of the adaptation of a plant to climate'*. He classified the plant species into five life-forms viz. phanerophytes (P), chamaephytes (Ch), hemicryptophytes (H), cryptophytes (Cr) and therophytes (Th). In this study we used this classification and studied the biological spectrum of the study site.

Results and Discussion

The diversity is the functional and structural unit of the biological communities, and is the manifestation of habitat change resulting from the interaction of biotic and abiotic factors of the environment (Vasistha et al., 2005, unpublished)

Total 206 species belonging to 159 genera and 59 families were reported from the present study sit e(Table, 1). Contribution of angiosperms was 98.1% (dicotyledons, 77.7% and monocotyledons, 20.4%) and of pteridophytes was 1.9% (4 species). Among angiosperms, dicotyledons contributed 79.2% (160 species) and monocotyledons 20.8% (42 species). Four pteridophytes from 3 families and 3 genera were recorded.

Poaceae was the most dominant family with 23 genera and 28 species, followed by Papilionaceae (13 genera and 20 species) and Asteraceae (12 genera and 12 species) (Table, 2). The dominance of Poaceae in Kandi area may be due to the climatic and physiognomic conditions such as presence of low soil moisture (low rainfall) and nutrient status.

Table 1. Different ranks of taxa distributed in Kandi regions of Punjab.

	Species	Genera	Families
Angiosperms			
Dicotyledons	160	124	48
Monocotyledons	42	32	08
Non-angiosperms			
Pteridophytes	04	03	03
Total	**206**	**159**	**59**

Table 2. Most Dominant families of the study site

Family	Species	Genera
Poaceae	28	23
Paplionaceae	20	14
Asteraceae	13	12
Euphorbiaceae	9	6
Convolvulaceae	8	3
Mimosaceae	8	4
Amaranthaceae	7	6
Cesalpinaceae	7	2
Acanthaceae	6	5
Cyperaceae	6	2
Lamiaceae	5	5
Malvaceae	5	4
Solanaceae	4	2
Tiliaceae	4	3
Anacardiaceae	3	3
Apocynaceae	3	3
Boraginaceae	3	3
Meliaceae	3	3
Rubiaceae	3	2
Sapindaceae	3	3
Sterculiaceae	3	3
Urticaceae	3	3
Verbinaceae	3	3
Adiantaceae	2	1
Bixaceae	2	1
Cucurbitaceae	2	2
Dioscoreaceae	2	1
Liliaceae	2	2
Menispermaceae	2	2
Oliaceae	2	2
Polygalaceae	2	1
Polygonaceae	2	1
Portulacaceae	2	1
Rhymnaceae	2	1
Rutaceae	2	2
Scrophulariaceae	2	1
Other (23)	1	1

Sandy soil, with almost negligible nitrogen (Vasistha et al., 2005, unpublished), favoured the invasion of members of family Paplionaceae. These are generally pioneer plants having the ability to fix the

atmospheric nitrogen and thus they help in increasing the nitrogen fertility of the sites. Sharma (1990) and Sharma et al. (2003) also reports these families as the most dominant in Punjab. *Ipomoea* was the most dominant genera (7 species) among all the plants collected and *Acacia*, the most dominant tree genera (4 species).

The floristic diversity (Annexure, 1) further shows that the vegetation was mainly comprised of herbs or forbs (66 genera and 82 species), trees (35 genera and 41 species), grasses (23 genera and 28 species), shrubs (20 genera and 26 species) and climbers (12 genera and 17 species), Sedges (2 genera and 6 species), and Ferns, (3 genera and 4 species).

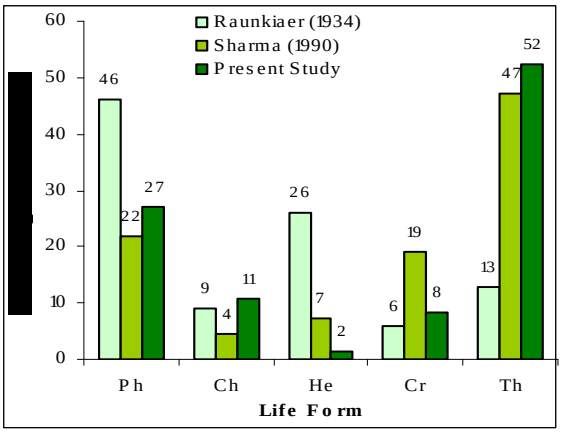

Figure 2. Normal biological spectrum of Raunkiaer (1934), and biological spectrum of Punjab (Sharma, 1990) and present study area.

The biological spectrum (Figure 2) of the present study site shows that therophytes (52%) were the most dominating life form. The other major life-forms were phenerophytes (27%) and chamaephytes (11%). Raunkiaer (1934) reported phanerophytes (46%) as the most dominating life form globally. The results of present study were in accordance with the study of Sharma (1990) for the entire Punjab, which reported therophytes (42%) as the most dominant life form in the arid climate of the state.

Raunkiaer (1934) stated that moisture and heat conditions of the environment are of prime importance in determining the pattern of plant distribution in different zones of the earth. He further added that the unfavourable period of the year again plays an important role, and acts as limiting factor, because it exhibits pronounced effect than the favourable period. The domination of therophytes indicates the water stress conditions and grassland nature of the site. Low rainfall (Figure 1) and dominance of poaceae supports these views.

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Annexure I: List of species of Kandi region of Punjab

Name of Species	Form	Family	Habit
Adhatoda vasica Linn.	D	Acanthaceae	Shrub
Andrographis echioides (Linn.) Nees	D	Acanthaceae	Herb
Barleria cristata Linn.	D	Acanthaceae	Herb
Dicliptera roxburghiana Nees	D	Acanthaceae	Herb
Justicia diffusa Hook f.	D	Acanthaceae	Herb
Justicia japonica Thunb.	D	Acanthaceae	Herb
Achyranthes aspera Linn.	D	Amaranthaceae	Herb
Achyranthes aspera Linn. var. *porphyristachya* Hook. f.	D	Amaranthaceae	Herb
Aerva sanguinolenta (Linn.) DC.	D	Amaranthaceae	Herb
Amaranthus spinosus Linn	D	Amaranthaceae	Herb
Celosia argentea Linn.	D	Amaranthaceae	Herb
Digera muricata (Linn.) Martius	D	Amaranthaceae	Herb
Pupalia lappacea (Linn.) Juss.	D	Amaranthaceae	Herb
Pistacia khinjuk Stocks	D	Anacardiaceae	Tree
Lannea coromandelica (Houtt.) Merr.	D	Anacardiaceae	Tree
Mangifera indica Linn.	D	Anacardiaceae	Tree
Carissa opaca Stapf.	D	Apocynaceae	Shrub
Holarrhena antidysenterica Wall.	D	Apocynaceae	Tree
Ichnocarpus frutescens Br.	D	Apocynaceae	Climber
Hedera helix Linn.	D	Araliaceae	Climber
Ageratum conyzoides Linn.	D	Asteraceae	Herb
Ageratum sp.	D	Asteraceae	Herb
Artemisia scoparia Waldst & Kit.	D	Asteraceae	Herb
Bidens bipinnata Linn.	D	Asteraceae	Herb
Inula cuspidate (DC.) Cl.	D	Asteraceae	Herb
Launaea asplenifolia (Willd.) Hook f.	D	Asteraceae	Herb
Parthenium hysterophorus Linn.	D	Asteraceae	Shrub
Saussurea albescens (DC.) Hook. f. and Thoms.	D	Asteraceae	Herb
Siegesbeckia orientalis Linn.	D	Asteraceae	Herb
Synedrella viahs Gaertn.	D	Asteraceae	Herb
Tridax procumbens Linn.	D	Asteraceae	Herb
Wedelia diflora DC.	D	Asteraceae	Herb
Xanthium strumarium Linn.	D	Asteraceae	Herb
Sterospermum chelonoides (Linn. f.) DC.	D	Bignoneaceae	Tree
Flacourtia indica (Burm.f) Merr.	D	Bixaceae	Shrub
Flacourtia sapida Roxb.	D	Bixaceae	Shrub
Cordia obliqua Willd.	D	Boraginaceae	Tree
Cynoglossum zeylanicum Thunb.	D	Boraginaceae	Herb
Ehretia laevis Roxb.	D	Boraginaceae	Tree
Bauhenia vahlii W. & A.	D	Cesalpinaceae	Climber
Bauhenia variegata Linn.	D	Cesalpinaceae	Tree
Cassia absus Linn.	D	Cesalpinaceae	Herb
Cassia fistula Linn.	D	Cesalpinaceae	Tree
Cassia occidentalis Linn.	D	Cesalpinaceae	Under shrub
Cassia pumila Lamk.	D	Cesalpinaceae	Herb

Contd…..

Cassia tora Linn.	D	Cesalpinaceae	Under shrub
Chenopodium album Linn.	D	Chenopodiaceae	Herb
Cloeme viscosa Linn.	D	Cloemeaceae	Herb
Cuscuta reflexa Roxb.	D	Convolvulaceae	Climber
Evolvulus alsinoides Linn.	D	Convolvulaceae	Herb
Ipomoea cairica (Linn.) Sweet.	D	Convolvulaceae	Climber
Ipomoea calycina (Roxb.) Benth. ex Cl.	D	Convolvulaceae	Climber
Ipomoea carnea Jacq.	D	Convolvulaceae	Climber
Ipomoea eriocarpa R. Br.	D	Convolvulaceae	Climber
Ipomoea hispida Roem. & Sch.	D	Convolvulaceae	Climber
Ipomoea pes-tigridis Linn.	D	Convolvulaceae	Climber
Momordica charantia Linn.	D	Cucurbitaceae	Climber
Trichosanthes cucumerina Linn.	D	Cucurbitaceae	Climber
Diospyros melanoxylon Roxb.	D	Ebenaceae	Tree
Bridelia retusa Spreng.	D	Euphorbiaceae	Tree
Emblica officinalis Gtn.	D	Euphorbiaceae	Tree
Emilia sonchifolia (Linn.) DC.	D	Euphorbiaceae	Herb
Euphorbia geniculata Ortega	D	Euphorbiaceae	Herb
Euphorbia hirta Linn.	D	Euphorbiaceae	Herb
Euphorbia stracheyi Boiss.	D	Euphorbiaceae	Herb
Mallotus philippinensis Muell. Arg.	D	Euphorbiaceae	Tree
Phyllanthus simplex Retz.	D	Euphorbiaceae	Herb
Phyllanthus urinaria Linn.	D	Euphorbiaceae	Herb
Fumaria indica (Hassk.) Pugsley	D	Fumariaceae	Herb
Anisomeles indica (Linn.) Kuntze	D	Lamiaceae	Under shrub
Colebrookia oppositifolia J. E. Smith	D	Lamiaceae	Shrub
Leucas cephalotes (Roth.) Sprengel	D	Lamiaceae	Herb
Ocimum gratissimum Linn.	D	Lamiaceae	Herb
Pogostemon benghalense (Burm. f.) O. Kuntze	D	Lamiaceae	Shrub
Litsaea glutinosa (Lour.) C.B. Robin.	D	Lauraceae	Tree
Woodfordia fruticosa Kurz.	D	Lytheraceae	Shrub
Hibiscus lobatus (Murray) Kuntz.	D	Malvaceae	Herb
Malvastrum coromandelianum (Linn.) Garcke	D	Malvaceae	Herb
Sida cordifolia Linn.	D	Malvaceae	Herb
Sida humilis Willd.	D	Malvaceae	Herb
Urena lobata Linn.	D	Malvaceae	Under Shrub
Azadiracta indica Linn.	D	Meliaceae	Tree
Melia azadirach Linn.	D	Meliaceae	Tree
Toona ciliata Roxb.	D	Meliaceae	Tree
Cissampelos pareira Linn.	D	Menispermaceae	Climber
Tinospora cordifolia (Wild.) H. f. & Th.	D	Menispermaceae	Climber
Acacia catechu Willd.	D	Mimosaceae	Tree
Acacia leucophloea (Roxb.) Willd.	D	Mimosaceae	Tree
Acacia modesta Willd.	D	Mimosaceae	Tree
Acacia nilotica (L.) Willd. ex Del.*	D	Mimosaceae	Tree

Contd…..

Albizzia lebbek Benth.	D	Mimosaceae	Tree
Albizzia procera Benth.	D	Mimosaceae	Tree
Leucaena leucocephala (Lam.) de Wit.	D	Mimosaceae	Tree
Mimosa himalayana Gamble	D	Mimosaceae	Shrub
Ficus glomerata Roxb.	D	Moraceae	Tree
Martynia annua Linn.	D	Myrtyniceae	Herb
Boerhavia diffusa Linn.	D	Nyctaginaceae	Herb
Jasminum multiflorum (Bur.f.) And.	D	Oleaceae	Shrub
Nyctanthes arbor-tristis Linn.	D	Oliaceae	Shrub
Oxalis corniculata Linn.	D	Oxalidaceae	Herb
Sesamum indicum Linn.	D	Padaliaceae	Herb
Abrus precatorius Linn	D	Papilionaceae	Climber
Alysicarpus vaginalis (L.) DC.	D	Paplionaceae	Herb
Atylosia platycarpa Benth.	D	Paplionaceae	Herb
Atylosia scarabaeoides (Linn.) Benth.	D	Paplionaceae	Herb
Butea monosperma (Lamk.) Taub.	D	Paplionaceae	Tree
Crotalaria ferruginea R. Grah.	D	Paplionaceae	Herb
Crotalaria medicaginea Lam.	D	Paplionaceae	Herb
Dalbergia sissoo Roxb.	D	Paplionaceae	Tree
Desmodium cordifolium (Harms) Schindler	D	Paplionaceae	Herb
Desmodium elegans DC.	D	Paplionaceae	Herb
Desmodium floribundum G. Don.	D	Paplionaceae	Under shrub
Desmodium laxiflorum DC.	D	Paplionaceae	Herb
Indigofera cordifolia Roth.	D	Paplionaceae	Herb
Indigofera hirsuta Linn.	D	Paplionaceae	Herb
Ougeinia oojeinensis (Roxb.) Hocht.	D	Paplionaceae	Tree
Phaseolus adenanthus W. Mey er.	D	Paplionaceae	Herb
Tephrosia purpurea Pers.	D	Paplionaceae	Under Shrub
Vicia sativa Linn.	D	Paplionaceae	Herb
Vigna vexillata (Linn) Richard	D	Paplionaceae	Herb
Zornia diphylla auct.	D	Paplionaceae	Herb
Polygala erioptera DC.	D	Polygalaceae	Herb
Polygala persicariifolia DC.	D	Polygalaceae	Herb
Polygonum plebeium R. Br.	D	Polygonaceae	Herb
Polygonum serrulatum Hook.	D	Polygonaceae	Herb
Portulaca oleracea Linn.	D	Portulacaceae	Herb
Portulaca quadrifida auct.	D	Portulacaceae	Herb
Ziziphus mauritiana Lamk.	D	Rhymnaceae	Tree
Ziziphus nummularia (Burm. f.) W. A.	D	Rhymnaceae	Shrub
Hedyotis stipulata R. Br. ex Hook f.	D	Rubiaceae	Herb
Hedyotis verticillata (Linn.) Lam.	D	Rubiaceae	Herb
Randia tetrasperma B. & H. f.	D	Rubiaceae	Shrub
Aegle marmelos Correa.	D	Rutaceae	Tree
Murraya koenigii (L.) Spreng	D	Rutaceae	Shrub
Casearia tomentosa Roxb.	D	Samydaceae	Tree

Contd…..

Cardiospermum halicacabum Linn.	D	Sapindaceae	Climber
Dodonaea viscosa (Linn.) Jacq.	D	Sapindaceae	Shrub
Schleicheria oleosa (Lour.) Oken.	D	Sapindaceae	Tree
Androsace saxifragifolia Bunge.	D	Saxifragaceae	Herb
Lindernia ciliata (Col.) Pennell.	D	Scrophulariaceae	Herb
Lindernia crustacea (Linn.) F. V. Muel.	D	Scrophulariaceae	Herb
Ailanthes excelsa Roxb.	D	Simaroubaceae	Tree
Physalis minima Linn.	D	Solanaceae	Herb
Solanum erianthum D. Don	D	Solanaceae	Shrub
Solanum nigrum Linn.	D	Solanaceae	Herb
Solanum xanthocarpum Burm. f.	D	Solanaceae	Under Shrub
Bombax ceiba Linn.	D	Sterculiaceae	Tree
Helicteres isora Linn.	D	Sterculiaceae	Tree
Melochia corchorifolia Linn.	D	Sterculiaceae	Herb
Corchorus acutangulus Lamk.	D	Tiliaceae	Herb
Grewia oppositifolia Roxb.	D	Tiliaceae	Tree
Grewia populifolia Vahl.	D	Tiliaceae	Shrub
Trumfetta rhomboidea Jacq.	D	Tiliaceae	Under Shrub
Canabis sativus Linn.	D	Urticaceae	Shrub
Holoptelea integrifolia Planch.	D	Urticaceae	Tree
Moras alba Linn.	D	Urticaceae	Tree
Premna latifolia Roxb.	D	Verbenaceae	Tree
Vitex negundo Linn.	D	Verbenaceae	Shrub
Lantana camara Linn.	D	Verbinaceae	Shrub
Tribulus terrestris Linn.	D	Zygophyllaceae	Herb
Phoenix sylvestris Roxb.	M	Arecaceae	Tree
Commelina benghalensis Linn.	M	Commelinaceae	Herb
Cyperus bulbosus Vahl.	M	Cyperaceae	Sedge
Cyperus compressus Linn.	M	Cyperaceae	Sedge
Cyperus cuspidatus Kunth.	M	Cyperaceae	Sedge
Cyperus niveus Retz.	M	Cyperaceae	Sedge
Cyperus rotundus Linn.	M	Cyperaceae	Sedge
Fimbristylis dichotoma (Linn.) Vahl.	M	Cyperaceae	Sedge
Dioscorea belophylla Voigt.	M	Dioscoreaceae	Herb
Dioscorea alata Linn.	M	Dioscoreaceae	Herb
Curculigo orchioides Gaertn.	M	Hypoxidaceae	Herb
Asparagus racemosus Baker	M	Liliaceae	Herb
Smilax aspera Linn.	M	Liliaceae	Climber
Habenaria plantaginea Lindl.	M	Orchidaceae	Herb
Alloteropsis cimicina (L.) Stapf	M	Poaceae	Grass
Apluda mutica Linn.	M	Poaceae	Grass
Arthraxon lancifolius (Trin.) Hochst.	M	Poaceae	Grass
Arundinaria falcata Nees	M	Poaceae	Grass
Arundinella nepalensis Trin.	M	Poaceae	Grass
Arundinella seotsa	M	Poaceae	Herb

Contd….

Arundo donax Linn.	M	Poaceae	Grass
Bothriochloa pertusa (Linn.) A. Cam.	M	Poaceae	Grass
Brachiaria ramosa (Linn.) Stapf.	M	Poaceae	Grass
Chrysopogon serrulatus Trin.	M	Poaceae	Grass
Cymbopogon jwarancusa Scholt.	M	Poaceae	Grass
Cynodon dactylon (Linn.) P. Beauv.	M	Poaceae	Grass
Dactyloctenum aegyptium (Linn.) P. Beauv.	M	Poaceae	Grass
Dactyloctenum sindicum Boiss.	M	Poaceae	Grass
Digitaria longiflora (Retz.) Koel.	M	Poaceae	Grass
Eleusine indica (Linn.) Gaertn.	M	Poaceae	Grass
Eragrostis nigra Nees ex Steudl.	M	Poaceae	Grass
Eragrostis tenella (Linn.) P. B. ex R. & S.	M	Poaceae	Grass
Erianthus filifolius Nees ex Steud	M	Poaceae	Grass
Heteropogon contortus (Linn.) P. Beauv.	M	Poaceae	Grass
Imperata cylindrical (Linn.) Raeus	M	Poaceae	Grass
Oplismenus compositus (Linn.) P. Beauv.	M	Poaceae	Grass
Saccharum spontaneum Linn.	M	Poaceae	Grass
Setaria glauca (Linn.) P. Beauv.	M	Poaceae	Grass
Setaria intermedia Roem. and Schult.	M	Poaceae	Grass
Setaria verticillata (Linn.) P. Beauv.	M	Poaceae	Grass
Sorghum halepense (Linn.) Pers.	M	Poaceae	Grass
Themeda anathera (Nees ex Steud.) Hack.	M	Poaceae	Grass
Adiantum edgeworthii Hook.	P	Adiantaceae	Herb
Adiantum incisum Forssk.	P	Adiantaceae	Herb
Dryopteris cochleata (D.Don) C.	P	Aspidiaceae	Herb
Cheilanthes sp.	P	Sinopteridaceae	Herb

D= Dicotyledons; M=Monocotyledons; P= Pteridophytes;

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