



TREE RESOURCES OF KATERNIAGHAT WILDLIFE SANCTUARY, UTTAR PRADESH, INDIA WITH ESPECIAL EMPHASIS ON CONSERVATION STATUS, PHENOLOGY AND ECONOMIC VALUES

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Abstract

Uttar Pradesh, one of the most populated states of India along international border of Nepal, contributes only about 3% of total forest & tree cover of the country as the major parts of the area is covered by agriculture lands and human populations. The forests are quite fragmented and facing severe anthropogenic pressure in many parts. To protect the existing biodiversity, several forest covers have been declared as National Parks and Wildlife Sanctuaries. In the present study, Katerniaghat Wildlife Sanctuary (KWS) has been selected to assess tree diversity, their phenology and economic values as the trees are the major constituent of any forest and more fascinating among all plant groups. The sanctuary consists of tropical moist deciduous type of vegetation and situated along the Indo-Nepal boarder in Bahraich district of Uttar Pradesh, India. After, thorough assessment of the area, a list of 141 tree species belonging to 101 genera and 38 families have been prepared. The family Fabaceae exhibits highest generic and species diversity with 14 genera and 23 species. The genus *Ficus* of Moraceae has been found the largest with 11 species. Maximum trees with about 51 species have been found to flower in post winter season (February to March) in the forest. About 62 trees are used as medicinal for various purposes, 50 as ornamental & avenue trees, 37 as timber wood, 36 as edible, 16 as fire wood and 12 as fodder. Since the sanctuary area has been surrounded by several villages and facing anthropogenic pressure, the public awareness program related with biodiversity conservation and sustainable uses is highly needed to protect the forest covers.

Keywords: Diversity, Tree, Phenology, Economic uses, Katerniaghat Wildlife Sanctuary, Uttar Pradesh, India.

Introduction

The biodiversity existing on our planet earth is a precious gift of the nature. Sustainable management of biodiversity is very important because of its known and unknown implication and also due to its rapid rate of depletion in the present era (ICLEI, 2009; Cooney, 2004). The assessment of the biodiversity is the first step towards formulating its management plans by documenting them. Such type of documentation of the plants with their phenology and economic benefits provides the basic knowledge of the plant wealth of the area which will be used in climate change assessment, sustainable uses and conservation programmes.

In India, Uttar Pradesh is one of the largest states which cover a geographical area of about 2,40,9288 km² (Anonymous, 2005). Most of the land of the state is used for agricultural activities and accumulation of human population whereas only 16,583 km² area is covered by the forests (Anonymous, 2005). Most of the forests of the state have been conserved by declaring them wildlife sanctuaries and national parks to protect its biodiversity. The forest of Katerniaghat declared as wildlife sanctuary in 1976 is situated in Bahraich district of Uttar Pradesh in India along the Indo-Nepal international border between 27° 41' - 27° 56' N and 81° 48' - 81° 56' E at 116 to 165 m elevations (Figure 1).

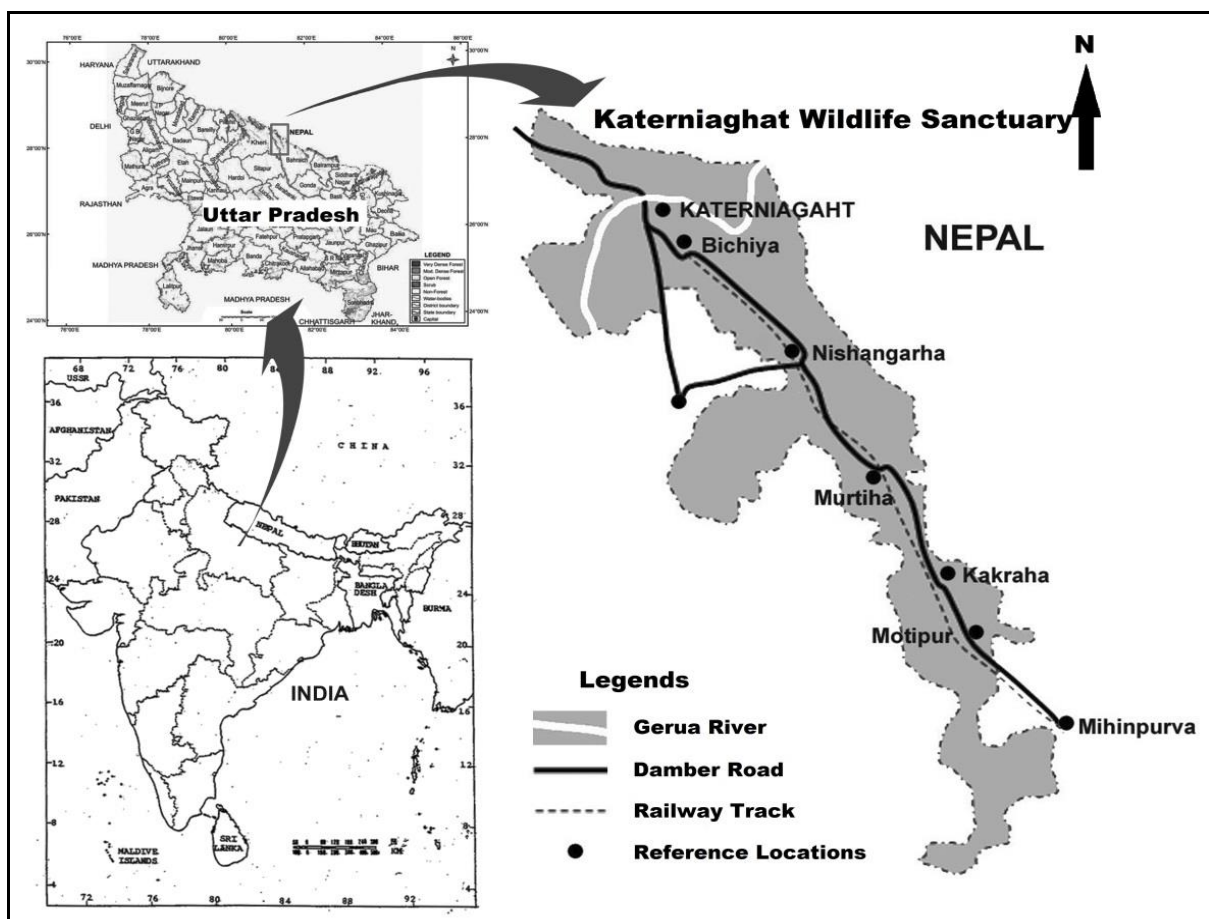


Figure 1. Location Map of Katerniaghat Wildlife Sanctuary, Uttar Pradesh, India

The sanctuary covers an area of 551.64 km² which has been divided into six forest ranges (i.e. Katerniaghat, Nishangarah, Dharmapur, Murthia, Kakraha and Motipur). The forest of the sanctuary comes under the tropical moist deciduous forest of the Himalayan Terai-Bhabar

region (Champion & Seth, 1968; Rodgers & Panwar, 1988). The entire area of the forest has been classified into four forest types (i) Sal forest, (ii) Teak plantation, (iii) Miscellaneous forest and (iv) Savannah grassland (Behera *et al.*, 2012). The rivers Kaudiyala and Saryu and its tributaries flowing adjacent to the sanctuary provide alluvial soil to the area.

Although, the scattered information on the plant diversity of the sanctuary area is available in different publications (Duthie, 1903; Panigrahi *et al.*, 1969; Saini, 2005a, b; Maliya & Datt, 2010; Kumar *et al.*, 2011; Maliya, 2011; Mishra *et al.*, 2013), however, a separate account exclusively on all tree species of the area including their phenology and economic values has not been dealt so far. Since trees are major constituent of the forest and play important role in ecological and climate change studies, in addition to their high economic values, the present study assess the tree diversity of entire area after critical evaluation of existing literature, examination of herbarium specimens housed at BSA, BSIP, CDRI, LWG and extensive field surveys. The phenological data and economic importance of all tree species occurring within the study area have also been provided for all species.

The main aim of the present study is to bring out a checklist of trees of the study area with their phenology, conservation status and economic importance. The checklist will provide a base line data for flora writing and diversity assessment of the area. The phenological information provided here may be used to compare the effect of climate change on the sexual behavior of the species in the future. The data provided on the conservation status will also help in the management of some of the rare and highly economically important tree species on priority basis by the forest department.

Materials and Methods

Climate

The monsoon climate is presented throughout the area. The area witnesses three distinct seasonal variations: winter (November to February), summer (April to June) and warm-rainy (July to September). The mean minimum and maximum temperature varies from 8 °C to 22 °C in January and to 27 °C to 40 °C in May - June. The annual rainfall varies from 36 to 142 mm in winter, 34 to 662 mm in summer and 1294 to 1689 mm in warm-rainy seasons (Bajpai *et al.*, 2012a).

Vegetation

The forest of the sanctuary comes under the tropical moist deciduous type of vegetation (Champion & Seth, 1968; Rodgers & Panwar, 1988). The entire area is chiefly dominated by sal forest, miscellaneous forest and teak plantation (Bajpai *et al.*, 2012b). The savannah grasslands are also present in some pockets in the forest area (Behera *et al.*, 2012). The upper stratum of the forest is represented by *Shorea robusta* Gaertn. f., *Tectona grandis* L. f., *Terminalia elliptica* Willd., *Madhuca longifolia* (L.) Macbr. var. *latifolia* (Roxb.) Chev., *Ficus benghalensis* L., *Ficus racemosa* L., *Bombax ceiba* L., *Sterculia villosa* Roxb. ex Sm. A. Rees, *Lannea coromandelica* (Houtt.) Merr., *Haldina cordifolia* (Roxb.) Ridsdale etc., while the middle stratum is represented by *Hymenodictyon orixense* (Roxb.) Mabblerley, *Syzygium cumini* (L.) Skeels, *Mitragyna parvifolia* (Roxb.) Korth., *Ehretia laevis* Roxb., *Lagerstroemia parviflora* Roxb., *Diospyros exsculpta* Buch.-Ham., *Schleichera oleosa* (Lour.) Merr., *Aegle marmelos* (L.) Correa, *Dalbergia sissoo* Roxb. ex DC. Mabblerley, *Mallotus nudiflorus* (L.) Kulju & Welzen etc. and the lower stratum is chiefly consists of

Mallotus philippensis (Lamk.) Muell.-Arg., *Ficus hispida* L. f., *Bridelia retusa* (L.) A. Juss., *Streblus asper* Lour., *Murraya koenigii* (L.) Spreng. etc.

Data collection and diversity assessment

During last three years from 2010 - 2012 the entire study area has been thoroughly explored in different seasons to collect and document the tree diversity. The plants were randomly collected from all kinds of habitats and vegetation and prepare the herbarium specimens following standard herbarium techniques (Lawrence, 1951; Jain & Rao, 1977). These specimens have been deposited at LWG for future record. All species have been correctly identified with the help of flora, revision and published work and compared with the earlier authentic collections housed at BSA, BSIP, CDRI and LWG. The correct nomenclature has been provided after consulting large number of recent regional and national floras, literature and different websites like GRIN, IPNI, ILDIS, The Plant list, Wikipedia etc. The phenology of the species has been recorded based on our field visits under taken in different seasons. An abundance scale has also been used to know the conservation status of the species in the area following Palmer *et al.* (1996). The information related with the economic values of the trees has been collected by interviewing the local tribal persons as well as from published work from the area. All species recorded here have been provided alphabetically in table 1 along with their conservation status, family, phenology and economic values.

Table 1. Alphabetical list of tree species with their conservation status, family, phenology and economic values

S.No.	Plants Name	Conservation Status	Family	Phenology	Economic Values
1	<i>Acacia auriculiformis</i> A. Cunn. ex Benth.	Cultivated	FABACEAE (Mimosoideae)	Sep. - Mar.	Ornamental & avenue tree
2	<i>Acacia catechu</i> (L. f.) Willd.	Abundant	FABACEAE (Mimosoideae)	Jul. - Feb.	Fodder, firewood
3	<i>Acacia nilotica</i> (L.) Willd. ex Delile	Planted	FABACEAE (Mimosoideae)	Aug. - Apr.	Hedge tree, fodder, medicinal
4	<i>Aegle marmelos</i> (L.) Correa	Abundant	RUTACEAE	Mar. - Jul.	Fruits edible
5	<i>Ailanthus excelsa</i> Roxb.	Abundant	SIMAROUBACEAE	Feb. - Jun.	Low grade timber
6	<i>Alangium salvifolium</i> (L. f.) Wang.	Frequent	CORNACEAE	Feb. - Aug.	Medicinal
7	<i>Albizia chinensis</i> (Osbeck) Merr.	Frequent	FABACEAE (Mimosoideae)	Mar. - Jan.	Ornamental & avenue tree, fodder
8	<i>Albizia lebbek</i> (L.) Benth.	Planted	FABACEAE (Mimosoideae)	Apr. - Mar.	Ornamental & avenue tree, medicinal
9	<i>Albizia odoratissima</i> (L. f.) Benth.	Planted	FABACEAE (Mimosoideae)	Apr. - Feb.	Ornamental & avenue tree
10	<i>Albizia procera</i> (Roxb.) Benth.	Planted	FABACEAE (Mimosoideae)	May - Feb.	Ornamental & avenue tree, medicinal
11	<i>Alstonia scholaris</i> (L.) R. Br.	Planted	APOCYNACEAE	Nov. - Jun.	Ornamental & avenue tree, medicinal
12	<i>Annona squamosa</i> L.	Cultivated	ANNONACEAE	Apr. - Jan.	Fruits edible
13	<i>Anogeissus acuminata</i> (Roxb. ex DC.)	Planted	COMBRETACEAE	Mar. - Dec.	Household timber

	Wall. ex Guill. & Perr.				wood
14	Antidesma acidum Retz.	Rare	PHYLLANTHACEAE	May - Nov.	Timber wood, medicinal
15	Antidesma ghaesembilla Gaertn.	Abundant	PHYLLANTHACEAE	Jun. - Dec.	Fruits edible
16	Artocarpus heterophyllus Lamk.	Cultivated	MORACEAE	Feb. - Sep.	Fruits edible as vegetable
17	Artocarpus lakoocha Roxb.	Cultivated	MORACEAE	Jan. - Nov.	Fruits edible
18	Averrhoa carambola L.	Cultivated	OXALIDACEAE	Jun. - Oct.	Fruits edible
19	Azadirachta indica A. Juss.	Cultivated	MELIACEAE	Mar. - Jul.	Timber wood, medicinal
20	Barringtonia acutangula (L.) Gaertn.	Abundant	LECYTHIDACEAE	Apr. - Nov.	Ornamental tree, medicinal
21	Bauhinia acuminata L.	Cultivated	FABACEAE (Caesalpinioideae)	Jul. - Jan.	Ornamental tree
22	Bauhinia malabarica Roxb.	Cultivated	FABACEAE (Caesalpinioideae)	Aug. - Mar.	Ornamental tree, medicinal
23	Bauhinia purpurea L.	Abundant	FABACEAE (Caesalpinioideae)	Sep. - Apr.	Ornamental tree, medicinal
24	Bauhinia racemosa Lamk.	Frequent	FABACEAE (Caesalpinioideae)	Mar. - Dec.	Religious, ornamental tree
25	Bombax ceiba L.	Abundant	MALVACEAE	Jan. - May	Silviculture, match industry
26	Breynia vitis-idaea (Burm. f.) C.E.C. Fisch.	Abundant	PHYLLANTHACEAE	Apr. - Nov.	Medicinal
27	Bridelia retusa (L.) A. Juss.	Abundant	PHYLLANTHACEAE	May - Dec.	Medicinal
28	Broussonetia papyrifera (L.) L'H'er ex Vent.	Cultivated	MORACEAE	Mar. - Oct.	Timber wood
29	Buchanania cochinchinensis (Lour.) Almeida	Occasional	ANACARDIACEAE	Feb. - May	Seed edible
30	Butea monosperma (Lamk.) Taub.	Planted	FABACEAE (Papilionoideae)	Mar. - Jun.	Dye, tannin, timber wood, medicinal
31	Callistemon citrinus (Curtis) Skeels	Planted	MYRTACEAE	Mar. - Jun.	Ornamental & avenue tree
32	Calotropis gigantea (L.) R. Br.	Abundant	APOCYNACEAE	Dec. - Aug.	Religious, medicinal, fiber
33	Careya arborea Roxb.	Abundant	LECYTHIDACEAE	Mar. - Jul.	Local timber wood, medicinal
34	Cascabela thevetia (L.) Lippold	Planted	APOCYNACEAE	Most part of the year	Ornamental tree, medicinal
35	Cassia fistula L.	Planted	FABACEAE (Caesalpinioideae)	Mar. - Dec.	Ornamental tree
36	Casuarina equisetifolia L.	Cultivated	CASUARINACEAE	Mar. - Jul.	Ornamental tree
37	Catunaregam spinosa (Thunb.) Trivengadam	Abundant	RUBIACEAE	Mar. - Dec.	Firewood, medicinal
38	Celtis tetrandra Roxb.	Abundant	CANNABACEAE	Feb. - Nov.	Firewood, medicinal
39	Citrus aurantiifolia (Christm.) Swingle	Cultivated	RUTACEAE	Apr. - Jan.	Fruits edible, medicinal
40	Citrus medica L.	Cultivated	RUTACEAE	Apr. - Jan.	Fruits edible, medicinal
41	Cordia dichotoma G. Forst.	Frequent	BORAGINACEAE	Mar. - Jul.	Fruits edible
42	Cordia grandis Roxb.	Cultivated	BORAGINACEAE	Mar. - Sep.	Fruits edible
43	Dalbergia latifolia Roxb.	Abundant	FABACEAE (Papilionoideae)	Apr. - Nov.	Timber wood

44	Dalbergia sissoo Roxb. ex DC.	Abundant	FABACEAE (Papilionoideae)	Mar. - Aug.	Timber wood
45	Delonix regia (Bojer ex Hook.) Raf.	Cultivated	FABACEAE (Caesalpinioideae)	Apr. - Mar.	Ornamental tree
46	Desmodium oojeinense (Roxb.) H. Ohashi	Abundant	FABACEAE (Papilionoideae)	Mar. - May	Medicinal
47	Dillenia indica L.	Abundant	DILLENACEAE	May - Feb.	Firewood, local timber wood
48	Dillenia pentagyna Roxb.	Abundant	DILLENACEAE	Mar. - May	Local timber wood, medicinal
49	Diospyros exculpta Buch.-Ham.	Abundant	EBENACEAE	Apr. - Oct.	Timber wood, medicinal
50	Ehretia acuminata R. Br.	Abundant	BORAGINACEAE	Sep. - Apr.	Ornamental & avenue tree
51	Ehretia laevis Roxb.	Abundant	BORAGINACEAE	Jan. - Aug.	Ornamental & avenue tree
52	Erythrina arborescens Roxb.	Cultivated	FABACEAE (Papilionoideae)	Jul. - Feb.	Ornamental tree, local timber
53	Eucalyptus tereticornis Sm.	Planted	MYRTACEAE	Feb. - Oct.	Quality timber wood
54	Ficus benghalensis L.	Abundant	MORACEAE	Jun. - Mar.	Religious, medicinal
55	Ficus elastica Roxb.	Cultivated	MORACEAE	Not seen	Ornamental tree
56	Ficus hispida L. f.	Abundant	MORACEAE	Aug. - Dec.	Fodder
57	Ficus microcarpa L. f.	Rare	MORACEAE	Aug. - Feb.	Ornamental tree
58	Ficus palmata Forssk. subsp. virgata (Roxb.) Browicz	Abundant	MORACEAE	Jun. - Oct.	Figs edible
59	Ficus racemosa L.	Abundant	MORACEAE	Apr. - Jul.	Figs edible
60	Ficus religiosa L.	Abundant	MORACEAE	Apr. - Sep.	Religious, medicinal
61	Ficus retusa var. nitida (Thunb.) Miq.	Rare	MORACEAE	Most part of the year	Ornamental tree
62	Ficus rumphii Blume	Abundant	MORACEAE	Apr. - Jul.	Fodder
63	Ficus semicordata Buch.-Ham. ex J. E. Sm.	Abundant	MORACEAE	May - Oct.	Figs edible
64	Ficus squamosa Roxb.	Occasional	MORACEAE	Apr. - Jan.	Fodder
65	Firmiana colorata (Roxb.) R. Br.	Rare	MALVACEAE	Feb. - Jun.	Ornamental tree
66	Flacourtia indica (Burm. f.) Merr.	Abundant	SALICACEAE	Feb. - May	Firewood, fruit edible, medicinal
67	Garuga pinnata Roxb.	Abundant	BURSERACEAE	Mar. - Oct.	Fruits edible, medicinal
68	Grewia asiatica L.	Abundant	MALVACEAE	Apr. - Jul.	Fruits edible, medicinal
69	Grewia multiflora Juss.	Frequent	MALVACEAE	Aug. - Jan.	Fruits edible
70	Grewia optiva Dumm. ex Burret.	Frequent	MALVACEAE	Aug. - Sep.	Timber wood, fruits edible
71	Grewia tillifolia Vahl	Rare in wild	MALVACEAE	Apr. - Sep.	Fruits edible, medicinal
72	Guazuma ulmifolia Lamk.	Cultivated	MALVACEAE	Feb. - Jul.	Religious, medicinal
73	Guidonia tomentosa (Roxb.) Kurz	Abundant	SALICACEAE	Feb. - Aug.	Firewood, fodder
74	Haldina cordifolia (Roxb.) Ridsdale	Abundant	RUBIACEAE	Jun. - Mar.	Timber wood
75	Helicteres isora L.	Abundant	MALVACEAE	Jul. - Dec.	Medicinal
76	Heynea trijuga Roxb. ex Sims	Abundant	MELIACEAE	Feb. - Oct.	Ornamental tree

77	Hibiscus rosa-sinensis L.	Cultivated	MALVACEAE	Most part of the year	Ornamental tree
78	Holarrhena pubescens (Buch.-Ham.) Wall. ex G. Don	Abundant	APOCYNACEAE	May - Feb.	Firewood, medicinal
79	Holoptelea integrifolia (Roxb.) Planch.	Frequent	ULMACEAE	Feb. - Jul.	Low grade timber wood
80	Hymenodictyon orixense (Roxb.) Mabberley	Abundant	RUBIACEAE	May - Jan.	Firewood, medicinal
81	Jacaranda mimosifolia D. Don	Cultivated	BIGNONIACEAE	Mar. - Oct.	Ornamental tree
82	Jatropha curcas L.	Planted	EUPHORBIACEAE	Apr. - Nov.	Hedge tree, seeds for bio-diesel
83	Kavalama urens (Roxb.) Raf.	Frequent	MALVACEAE	Jan. - Apr.	Gum production
84	Kydia calycina Roxb.	Frequent	MALVACEAE	Jul. - May	Medicinal, Fiber
85	Lagerstroemia parviflora Roxb.	Abundant	LYTHRACEAE	Apr. - Jan.	Ornamental tree
86	Lagerstroemia speciosa (L. ex Murray) Pers.	Frequent	LYTHRACEAE	May - Nov.	Ornamental tree
87	Lanea coromandelica (Houtt.) Merr.	Planted	ANACARDIACEAE	Mar. - Jun.	Local timber wood, medicinal
88	Lepisanthes rubiginosa (Roxb.) Leenh.	Rare	SAPINDACEAE	Apr. - Jul.	Timber & firewood, medicinal
89	Leucaena leucocephala (Lamk.) de Wit.	Planted	FABACEAE (Mimosoideae)	Jun. - Nov.	Fodder
90	Litsea glutinosa (Lour.) Rob.	Occasional	LAURACEAE	Apr. - Jan.	Seeds for essential oils, medicinal
91	Litsea monopetala (Roxb.) Pers.	Frequent	LAURACEAE	Mar. - Nov.	Timber wood, fodder, medicinal
92	Madhuca longifolia (L.) Macbr. var. latifolia (Roxb.) Chev.	Frequent	SAPOTACEAE	Mar. - Jul.	Petals edible, seed for vegetable oil
93	Mallotus philippensis (Lamk.) Muell.-Arg.	Abundant	EUPHORBIACEAE	Sep. - May	Tannin or dyes, medicinal, fodder
94	Mallotus nudiflorus (L.) Kulju & Welzen	Frequent	EUPHORBIACEAE	Feb. - Oct.	Timber wood, fodder, medicinal
95	Mangifera indica L.	Cultivated	ANACARDIACEAE	Feb. - Jul.	Fruits edible, timber wood
96	Manilkara hexandra (Roxb.) Dub.	Planted	SAPOTACEAE	Oct. - Feb.	Fruits edible, timber wood
97	Melia azedarach L.	Cultivated	MELIACEAE	Mar. - Jun.	Timber wood, medicinal
98	Milium tomentosa (Roxb.) Sinclair	Abundant	ANNONACEAE	Apr. - Jul.	Fruits edible, medicinal
99	Milium velutina (Dunal.) Hook. f. & Thoms.	Abundant	ANNONACEAE	Mar. - Aug.	Fruits edible, local timber wood
100	Mitragyna parvifolia (Roxb.) Korth.	Abundant	RUBIACEAE	May - Dec.	Timber wood, medicinal
101	Moringa concanensis Nimmo ex Dalz. & Gibb.	Cultivated	MORINGACEAE	Nov. - Feb.	Medicinal, firewood, low grade timber wood
102	Moringa oleifera Lamk.	Cultivated	MORINGACEAE	Feb. - Jul.	Fruits edible, medicinal, firewood
103	Morus alba L.	Cultivated	MORACEAE	Feb. - Jun.	Fruits edible
104	Murraya koenigii (L.) Spreng.	Abundant	RUTACEAE	Feb. - Oct.	Medicinal, leaf as spices
105	Neolamarckia cadamba (Roxb.) Bosser	Planted	RUBIACEAE	May - Oct.	Ornamental & avenue tree

106	Nyctanthes arbor-tristis L.	Cultivated	OLEACEAE	Sep. - Mar.	Ornamental tree, medicinal
107	Olex zeylanica L.	Rare	OLACACEAE	May - Jun.	Firewood
108	Oroxylum indicum (L.) Vent.	Occasional	BIGNONIACEAE	May - Dec.	Medicinal, firewood
109	Parkinsonia aculeata L.	Cultivated	FABACEAE (Caesalpinioideae)	Oct. - May	Hedge tree
110	Phyllanthus emblica L.	Cultivated	PHYLLANTHACEAE	Feb. - Dec.	Fruits edible, medicinal
111	Polyalthia longifolia (Sonn.) Thw.	Cultivated	ANNONACEAE	Apr. - Sep.	Ornamental tree, medicinal
112	Polyalthia suberosa (Roxb.) Thwaites	Cultivated	ANNONACEAE	Apr. - Sep.	Ornamental tree, medicinal
113	Pongamia pinnata (L.) Pierr.	Frequent	FABACEAE (Papilionoideae)	Apr. - Jul.	Avenue tree, seeds for bio-diesel
114	Psidium guajava L.	Cultivated	MYRTACEAE	Sep. - Aug.	Fruits edible
115	Putranjiva roxburghii Wall.	Planted	PUTRANJIVACEAE	Mar. - Jan.	Ornamental & avenue tree
116	Salix tetrasperma Roxb.	Abundant	SALICACEAE	Jan. - Jul.	Timber & firewood
117	Schleichera oleosa (Lour.) Merr.	Abundant	SAPINDACEAE	Mar. - Nov.	Avenue tree, firewood
118	Semecarpus anacardium L. f.	Frequent	ANACARDIACEAE	Apr. - Oct.	Timber wood, medicinal
119	Senna siamea (Lamk.) Irwin & Barneby	Planted	FABACEAE (Caesalpinioideae)	Jul. - Feb.	Fruits edible, medicinal, fodder
120	Shorea robusta Gaertn. f.	Abundant	DIPTEROCARPACEAE	Mar. - Jun.	Quality Timber wood
121	Sterculia foetida L.	Abundant	MALVACEAE	Feb. - Aug.	Ornamental tree, medicinal
122	Sterculia villosa Roxb. ex Sm. A. Rees	Abundant	MALVACEAE	Feb. - Oct.	Ornamental tree, medicinal
123	Stereospermum chelonoides (L. f.) DC.	Rare	BIGNONIACEAE	Apr. - Dec.	Timber wood, medicinal
124	Streblus asper Lour.	Abundant	MORACEAE	Jan. - Jul.	Firewood, medicinal
125	Syzygium cumini (L.) Skeels	Frequent	MYRTACEAE	Apr. - Aug.	Fruits edible, timber wood, avenue tree
126	Syzygium nervosum A. Cunn. ex DC.	Occasional	MYRTACEAE	Apr. - Aug.	Fruits edible, timber wood
127	Syzygium salicifolium (Wight) J. Graham	Abundant	MYRTACEAE	Mar. - Aug.	Fruits edible, timber wood
128	Tamarindus indica L.	Occasional	FABACEAE (Caesalpinioideae)	Jul. - Mar.	Fruits edible, avenue tree, medicinal
129	Tamarix gallica L. var. indica (Willd.) Ehrenb.	Occasional	TAMARICACEAE	Most part of the year	Ornamental tree
130	Tamilnadia uliginosa (Retz.) Tirveng. & Sastre.	Occasional	RUBIACEAE	May - Dec.	Ornamental tree
131	Tecoma stans (L.) Juss. ex Kunth	Cultivated	BIGNONIACEAE	Jul. - Jun.	Ornamental tree
132	Tectona grandis L. f.	Planted	LAMIACEAE	Jul. - Dec.	Quality timber wood
133	Terminalia arjuna (Roxb. ex DC.) Wight & Arn.	Planted	COMBRETACEAE	Apr. - Mar.	Avenue tree, medicinal
134	Terminalia bellirica (Gaertn.) Roxb.	Frequent	COMBRETACEAE	Mar. - Sep.	Avenue tree, medicinal

135	Terminalia elliptica Willd.	Abundant	COMBRETACEAE	May - Mar.	Timber wood, medicinal
136	Toona ciliata M. Roem.	Frequent	MELIACEAE	Mar. - Jul.	Timber wood
137	Wendlandia heynei (Roem. & Schult.) Santapau & Merchant	Frequent	RUBIACEAE	Mar. - Aug.	Ornamental tree
138	Wrightia arborea (Dennst.) Mabberley	Frequent	APOCYNACEAE	Apr. - Dec.	Ornamental tree, medicinal
139	Xylosma longifolia Clos	Frequent	SALICACEAE	Oct. - Apr.	Hedge tree
140	Ziziphus mauritiana Lamk.	Abundant	RHAMNACEAE	Sep. - Mar.	Fruits edible
141	Ziziphus xylopyrus (Retz.) Willd.	Rare	RHAMNACEAE	Apr. - Jul.	Fruits edible

Results and Discussion

The analysis of data reveals that the entire area consists of 141 tree species under 101 genera and 38 families. The family Fabaceae has been found to exhibit the highest generic and species diversity with 14 genera and 23 species (Figure 2). Species per genus ratio has been observed maximum in Moraceae (3.2) due to the presence of higher number of species (*i.e.* 16) than genera (*i.e.* 5). Nineteen families (*i.e.* Burseraceae, Cannabaceae, Casurinaceae, Cornaceae, Dilleniaceae, Dipterocarpaceae, Ebenaceae, Lamiaceae, Lauraceae, Lythraceae, Moringaceae, Olacaceae, Oleaceae, Oxalidaceae, Putranjivaceae, Rhamnaceae, Simaroubaceae, Tamariacaceae and Ulmaceae) are represented by single genus out of which 14 families (*i.e.* Burseraceae, Cannabaceae, Casurinaceae, Cornaceae, Dipterocarpaceae, Ebenaceae, Lamiaceae, Olacaceae, Oleaceae, Oxalidaceae, Putranjivaceae, Simaroubaceae, Tamariacaceae and Ulmaceae) consist of only solitary species. The genus *Ficus* of Moraceae has been observed the largest genus with 11 tree species.

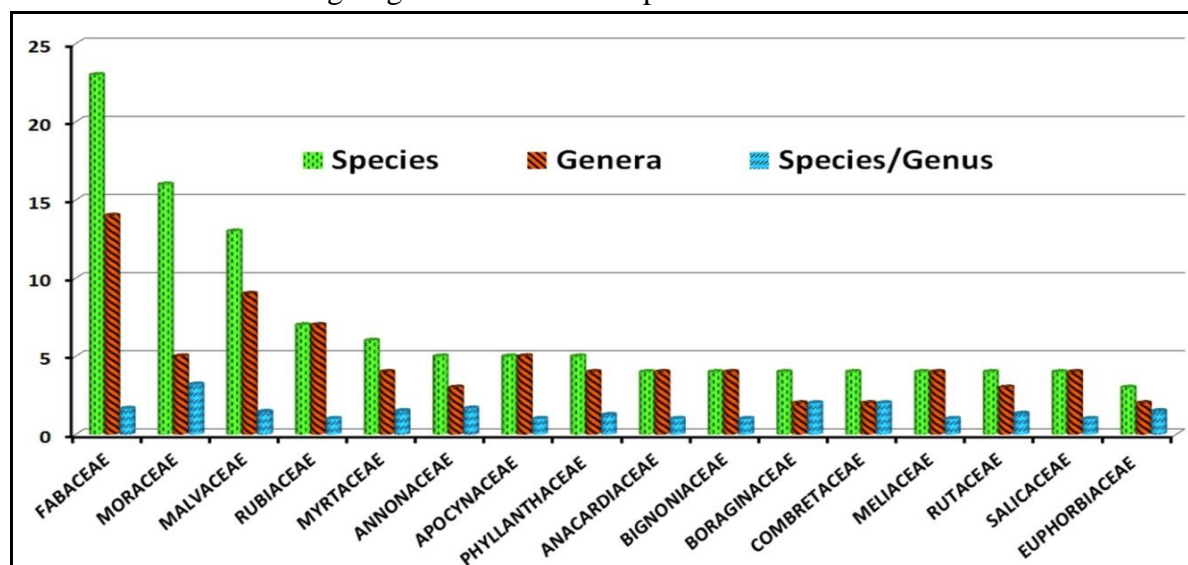


Figure 2. Diversity amongst the larger families (Number of Species, Genera and Species per Genus Ratio)

On the abundance scale (Palmer *et al.*, 1996) about 52 tree species have been found distributed abundantly and 21 as frequently in the sanctuary area. Due to the ornamental and other purposes about 31 trees have been grown in the fringes of the forest. In addition, about 20 trees have also been planted to fill up the open lands or as an avenue trees in the sanctuary. The eight species have been found occasionally and nine species rarely only with few individuals in the sanctuary area (Figure 3).

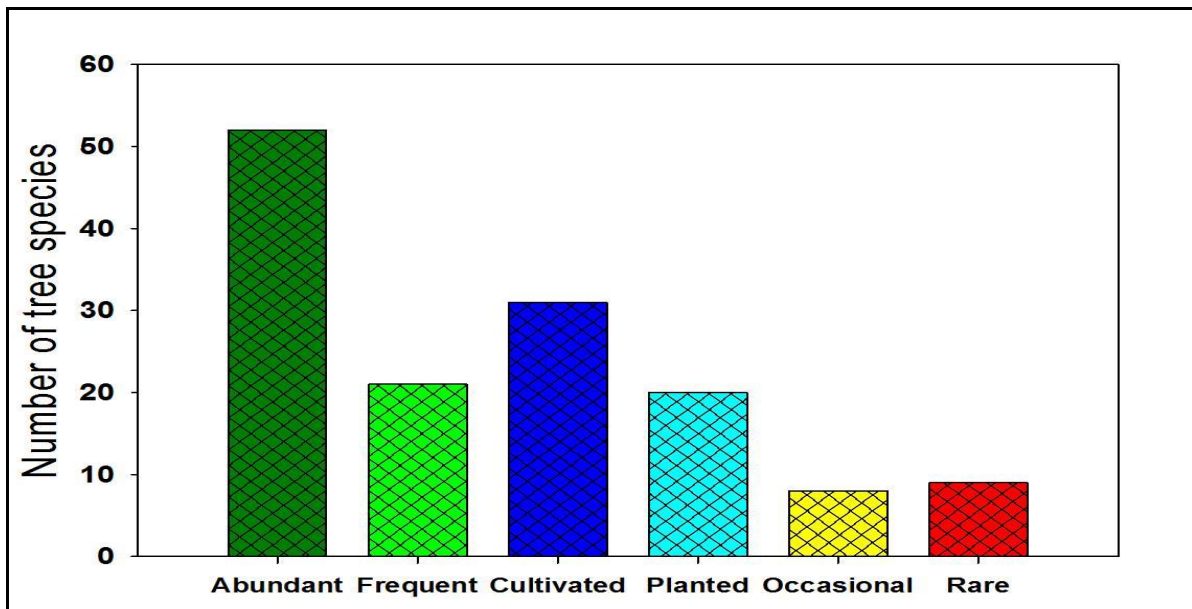


Figure 3. Number of Abundant, frequent, cultivated, planted, occasional and rare trees

The phenological observation reveals that the maximum tree species (about 51 spp.) flower in post winter season during February to March with the rise of ambient temperature and matured fruits are noticed on majority of the trees during rainy season (*i.e.* Jun.-Sep.) (Figure 4). The maximum germinations of seeds in the forest bed take place in post monsoon season. On an average about 11.3 ± 3.8 tree species have been observed in fruiting condition throughout the year which is considered good for the survival of faunal diversity available in the sanctuary.

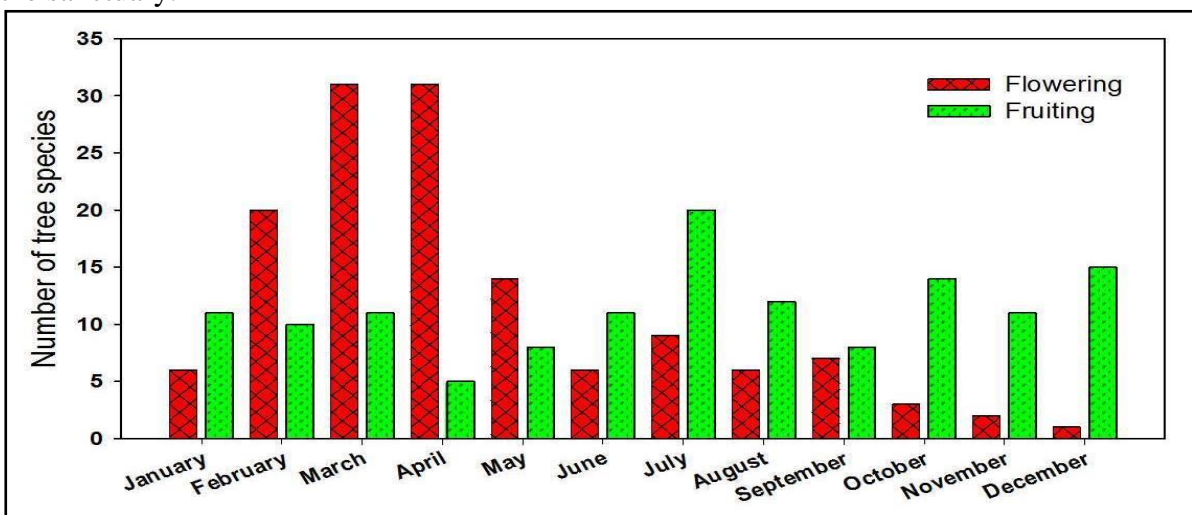


Figure 4. Number of flowering trees in different months of the year

About 44% (*i.e.* 62 spp.) of the total tree species of the sanctuary have been found useful for various medicinal purposes, 35.5% (*i.e.* 50 spp.) for ornamental, 26.2% (*i.e.* 37 spp.) for timber wood, 25.5% (*i.e.* 36 spp.) as edible, 11.4% (*i.e.* 16 spp.) for firewood and 8.5% (*i.e.*

12 spp.) for fodder (Figure 5).

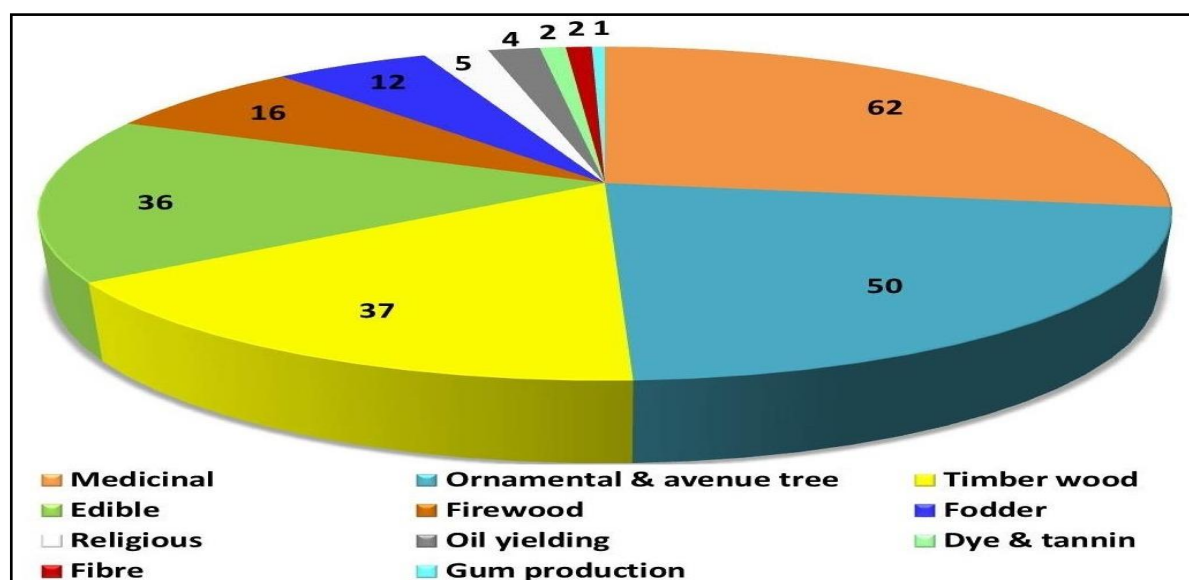


Figure 5. Number of species used for different aspects

Conclusion

Almost all tree species recorded here from the sanctuary area, directly or indirectly are in the use of human beings to meet their daily needs. Therefore, there is a heavy anthropogenic pressure on the forest by local people. This may leads to the gradual decrease of the species from the natural habitats. Hence, the awareness programme regarding the importance of the plant species for the survival of human beings on the planet Earth and their sustainable uses and conservation of biodiversity among local people is the need of hour. The area also contains many plant families represented by solitary genus and solitary species and some rare species which require special attention and conservation measures to protect their gene pool in the sanctuary area.

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