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Assessment of the Floristic Composition of a Scrub Forest Ecosystem in Kalbetta State Forest, Karnataka, India

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Abstract:
Tropical forests being the most diverse plant communities are disappearing at alarming rates owing to deforestation by its conversion to other land uses, excess extraction of its products and forest fires. These disturbances also result in fragmentation due to which these ecosystems often do not get time to recover adequately. The analysis of tropical forest ecosystems in terms of their constituent units and the detailed inventories of vegetation, habitats and biodiversity is the need of forest managers, conservationists and ecologists.
Kalbetta state forest is a small chunk of scrub forest in the Mysuru district of Karnataka, India. It has always been under pressure of encroachment and meeting needs of local people for timber, fuel wood etc. The study of floristic biodiversity of this area from the ecological perspective is a step in providing the authentic information on the existing biodiversity which would help in the management and conservation of this forest. The present study of floristic biodiversity assessment revealed 398 species belonging to Angiosperms (380), Pteridophytes (1), Bryophytes (2), Lichens (13) and Fungi (2). Among the angiosperms, Dicots constituted 240 Species belonging to 167 genera and 63 families whereas Monocots are poorly represented constituting 39 species belonging to 35 genera and 8 families. Overall ratio between Genera to species was recorded at 1:1.41and the Generic co-coefficient for the area was found to be 71.10 %.

Keywords: *Generic co-coefficient, Monotypic taxa, Floristic composition, Scrub Forest, Stratified Random Sampling.*

1. Introduction

The forests are unique natural ecosystems which are treasure houses of biodiversity. The tropical forest ecosystems provide variety of ecosystem services and play a critical role in the climate of earth. The deforestation of tropical forests resulting in loss of biodiversity is a matter of great concern in the context of global warming and climate change. The losses of forests which are the reservoirs of biodiversity have great impact on the global carbon sequestration and extinction of species. The problem with the forest disturbances is that plants or ecosystem often do not get time to recover adequately because of the continuous human onslaught (Singh, 1998).

Biodiversity is an integral part of our daily life and is most essential for our existence on this planet, because of which it is at serious threat. The analysis of tropical forest ecosystems in terms of their constituent units and the detailed inventories of vegetation, habitats and biodiversity is the need of forest managers. An obvious approach to conserve plant biodiversity is to map distributional patterns and look for concentrations of diversity and endemism (Gentry, 1992). Further, management of forest requires understanding of its composition in relation to other forests, the effects of past impacts on the present status and the present relationship of the forest with surrounding land uses (Geldenhuys and Murray, 1993). Quantitative plant biodiversity inventories of Indian tropical forests are available from various forests of Western Ghats and Eastern Ghats (Gamble, 1935; Somasundaram, 1963; Saldhana, 1984; Sukumar *et al*., 1992; Ganesh *et al*., 1996; Pascal and Pelissier, 1996; Pandith, 2012), but the floristic composition of the scrub forest in the rain shadow areas is comparatively poorly enumerated.

In the Indian scenario, the tremendous anthropogenic pressure on the forests has resulted in the loss of biodiversity. Large chunks of forests have been reduced to small fragmented forests (Vinayakumar *et al.*, 2016). However small these pockets are, they continue to be the treasure house of biodiversity. It is absolutely essential not to neglect these pockets of biodiversity. The Forest management in India, for the last few decades has become more conservation oriented focusing on sustainability, deviating from the concept of commercial exploitation of timber and other resources. Taxonomical hierarchical studies provide an insight into the diversity available for the speciation process in the context of evolution of plants. It also throws light on the adaptation and association of species from the ecological perspective. Since it is usually impossible to study the entire population within a study area, taking smaller samples of the population of interest is most desirable. Hence, Plot sampling is a highly versatile approach, providing information on densities, associations, dispersion patterns and indirect evidence on a variety of population process (Emslie, 2016). Stratified sampling involves

a mixture of the random sampling and purposive sampling methods in which the whole population is divided into different strata (Gurumani, 2003). A random sample from each stratum is taken in a number proportional to the stratum's size when compared to the population. Stratified sampling is used where there are small areas within a larger study location which are clearly diverse. It helps to reduce any bias which might arise if samples were chosen completely random (OWWT, 2016).

Ganeshaiah *et al* (2002) described a total of 178 families composed of 1408 genera and 4758 species in Karnataka. They have taken into consideration the major climatic zones of the state. Many researchers use Generic Coefficient as the number of genera required to yield one hundred species at the same average number of species per genus as in the available area (Jacord, 1912; Sinha, 2013).

The monotypic taxa deserve special attention from the conservation point of view, because they represent species which could be lost forever and because their related genomes of these plants do not exist anywhere else in the world. Further, monotypic taxa analysiswill provide presence of single genus with single species only. In Indian flora, among 236 genera of flowering plants, 176 genera belong to dicots and 60 genera belongs to monocots are monotypic (Rana *et al*., 2009).

In this context, study of the floristic composition of this chunk of forest called Kalbetta state forest from the ecological perspective is first of its kind. The study deals with assessment of floristic composition, Generic Coefficient and identifying monotypic taxa in the locality to understand the hierarchical taxonomic distribution.

2. Study Area

The study area Kalbetta State Forest is located in Hunsur taluk of Mysuru district, Karnataka, India. The geo coordinates are 76°14' 13" E 12°19' 14" N and 76° 15'16"E 12°17' 29" N geographically with an elevation range of 835m to 908 m above MSL (Figure1). This area was declared as the State Forest by the Government of Mysore during the year 1900. As per notification it covered an area of 1412 acres (571 ha). The major vegetation comprises of scrub forest with less than 0.25 densities and scanty natural regeneration interspersed with lot of rocky patches. Rainfall in the region varies between 600 to 900 mm annually. After several land conversions by the Government, the area is now left with only 178.8 ha. In addition to this, adjoining forest lands of 31.2 ha was included in the study area totaling to 210 ha.for the purpose of this study.

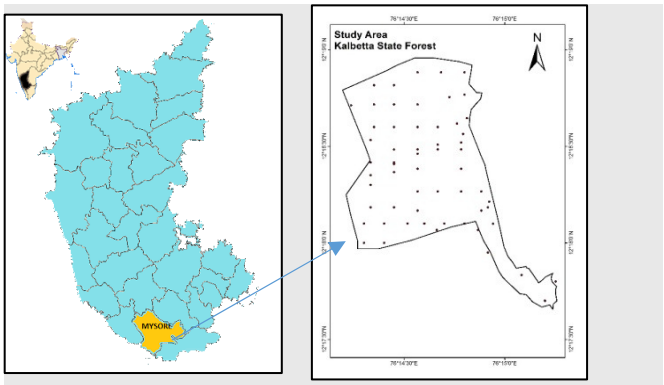

Figure 1: Location map of the Study area

3. Materials and Methods

The study area was classified into different blocks based on the structure and composition during the reconnaissance survey. The area classified were Low lying scrub, Hillock scrub, *Acacia*- Bamboo Mixed Plantation, *Acacia* plantation, *Cassia* mixed plantation, *Eucalyptus* plantation and Timber depot blocks.

The sampling method adopted was Stratified random sampling with a sampling intensity of 1%. Based on the species area curve method, a total number of 52 plots of 20x20m dimension were determined. The GIS technology (Fish net) was used for spatially locating the sample plots. The plots were laid on the ground by using GPS technology. All trees above 10cm Girth at Breast Height (GBH) were enumerated. Subsequently, shrubs and herbs were enumerated in 5x5m and 1x1m plots within the main sample plots respectively. In addition to the species recorded within the sample plots, major species observed in the study area during the field study have also been recorded.

Field visits were undertaken for 3 different seasons over a period of 2 years. Plant specimens were collected for herbarium preparation along with the photographs. Herbarium specimens were processed and labeled. The identification was done based on the morphological characters using field key and floras (Gamble, 1935; Somasundaram, 1963; Saldhana, 1984; Sankara Rao, 2009) and in consultation of Taxonomists at Department of Studies in Botany, University of Mysore.

Ratio between dicot and monocot was calculated to compare their proportional occurrence. Generic coefficient which is generally used to measure the generic diversification of the species contained in the area following Jacord (1912) method.

Generic Coefficient (G) % = (Total no. of genera / Total no. of species) x 100.

In addition to the above, most dominating families were identified to see the genera and species composition. The data collected was analyzed and results are presented.

4. Results and Discussion

4.1 The results indicated higher floristic composition in terms of number of species when compared to the data in the working plan document of Hunsur Forest Division, Karnataka Forest Department (Das, 2012). The results of the study (Table 1, Figure 2 and 3) shows that there are 398 species which belong to 72 families of flowering plants [Dicots: 65 (78.31%), Monocots: 7 (8.43%)] and 11 families of non-flowering plants [Pteridophyte: 01 (01.20%); Bryophyte: 02 (2.41%); Lichen: 06 (7.23%); Fungi: 02 (2.41%)]. Dicots contributed 330 (82.91%) species belonging to 231 (81.63%) genera of 65 families which is substantially higher than monocots. Monocots contributed only 50 (12.56%) species belonging to 40 (14.13%) genera of 7 families. Pteridophytes are represented by one (0.25%) species belonging to one (0.35%) genera of one family. The bryophytes are represented by two (0.50%) species belonging to two (0.71) genera of two families. Lichens are represented by 13 (3.27 %) species belonging to 7 (2.47%) genera of 6 families. The fungi are represented by two (0.50%) species belonging to two (0.71 %) genera of two families.

Class	Families		Genera		Species	
	No. of families	%	No. of Genera	%	No. of Species	%
Dicot	65	78.31	231	81.63	330	82.91
Monocot	7	8.43	40	14.13	50	12.56
Pteridophyte	1	1.20	1	0.35	1	0.25
Bryophytes	2	2.41	2	0.71	2	0.50
Lichens	6	7.23	7	2.47	13	3.27
Fungi	2	2.41	2	0.71	2	0.50
Total	**83**	**100**	**283**	**100**	**398**	**100**

Table 1: Number and percentage of Families, Genera and Species of each class

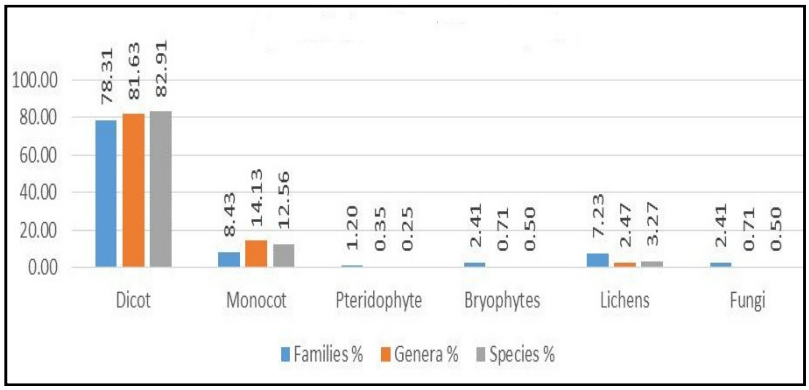

Figure 2: Representation of the floristic composition in terms of % of Families, Genera and Species

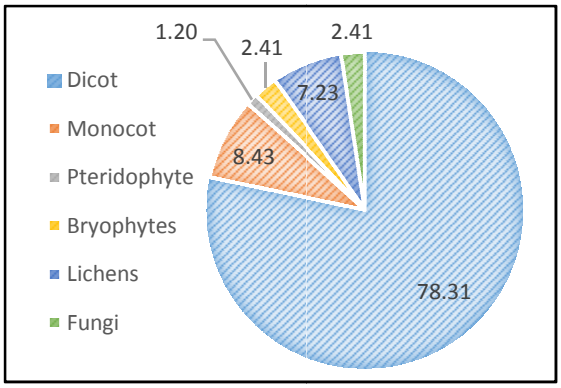

Figure 3: Representation of the floristic composition in terms of % of Families

4.2. Ratio between Monocot to dicot

Proportion of Monocotyledons to Dicotyledons was recorded 1:9.29 for families, 1:5.78 for genera and 1:6.6 for species.

4.3. Ratio between Genera to species

The ratio of total number of genera to species was recorded at 1:1.43 for dicot, 1:1.25 for monocot, 1:1 for Pteridophytes, 1:1 for Bryophytes, 1:1.86 for Lichens and 1:1.41 for Fungi (Table 2). Overall ratio between Genera to species was recorded at 1:1.41 when compared to Karnataka state of 1:3.38. The present study area comprises of only scrub vegetation type whereas the data given for Karnataka state represents various vegetation types.

	Species	Genera	Genera to species Ratio
Dicot	330	231	1:1.43
Monocot	50	40	1:1.25
Pteridophyte	1	1	1:1
Bryophytes	2	2	1:1
Lichens	13	7	1:1.86
Fungi	2	2	1:1
Over all	398	283	1:1.41

Table 2: Ratio between Genera to species

4.4. The Generic co-coefficient

It is the number of genera required to yield one hundred species at the same average number of species per genus as in the available sample. In this study, it was found to be 71.10 %. It is used to measure the generic diversification of the species contained in the association. The present result indicates that there is good count on diversification between genera and species.

4.5 Ten dominant families in terms of total number of genera were recorded. Leguminosae with 37 genera, Poaceae with 24 genera, Compositae with 20 genera, Malvaceae and Apocynaceae each with 15 genera, Rubiaceae with 12 genera, Acanthaceae and Lamiaceae each with 10 genera, Euphorbiaceae with seven genera and Rutaceae with six genera (Table 3). This clearly indicated the three dominant families Leguminosae, Poaceae, Compositae, Malvaceae and Rubiaceae have higher adaptive capacity than others. The former families of Papilionaceae, Ceasalpinae and Mimosae have been clubbed under one family Leguminosae and hence the number of genera representing this family are higher in count. Similarly, Sterculiaceae and Tiliaceae are clubbed under Malvaceae resulting in comparatively higher count (Anon, n.d*)*. Incidentally, the Poacece under monocots and Compositae under the dicots are the most advanced families from the evolutionary point of view which also indicates the adaptive capacity of these families.

Family	No. of Genera	%	No of Species	% Species
Leguminosae	37	13.07	62	15.58
Poaceae	24	8.48	29	7.29
Compositae	20	7.07	22	5.53
Malvaceae	15	5.30	22	5.53
Apocynaceae	15	5.30	17	4.27
Rubiaceae	12	4.24	21	5.28
Acanthaceae	10	3.53	16	4.02
Lamiaceae	10	3.53	13	3.27
Euphorbiaceae	7	2.47	14	3.52
Rutaceae	6	2.12	6	1.51

Table 3: Number and percentage of genera and species of the dominant families

4.6 Ten dominant genera found in the locality are *Acacia* with nine species, *Euphorbia* with six species, *Crotalaria*, *Ipomoea, Oldenlandia,* Parmotrema, *Phyllanthus*, *Polygala, Sida* and *Terminalia* each with five individual species (Table 4).

Genera	Count of species
Acacia	9
Euphorbia	6
Crotalaria	5
Ipomoea	5
Oldenlandia	5
Parmotrema	5
Phyllanthus	5
Polygala	5
Sida	5
Terminalia	5

Table 4: Number of the species in the dominant genera

4.7. Monotypic taxa

The present study recorded nine monotypic genera in the study area (Table 5). Major monotypic species are recorded from Rutaceae followed by Leguminosae. *Aegle marmelos* and *Limonia acidissima* are endemic species whereas *Chloroxylon swietenia* is both endemic and vulnerable.

Sl No	Species	Family	Habit
1	*Aegle marmelos* (L.) Correa.	Rutaceae	Tree
2	*Chloroxylon swietenia* DC.	Rutaceae	Shrub
3	*Hemidesmus indicus* (L.) R. Br. ex Schult.	Apocynaceae	Woody Climber
4	*Limonia acidissima* Groff.	Rutaceae	Tree
5	*Naringi crenulata* (Roxb.) Nicolson.	Rutaceae	Small Tree
6	*Pongamia pinnata* (L.) Pierre.	Leguminosae	Tree
7	*Tamarindus indica* L.	Leguminosae	Tree
8	*Trichuriella monsoniae* (L. f.) Bennet.	Amaranthaceae	Herb
9	*Urena sinuata* L.	Malvaceae	Under Shrub

Table 5: List of Monotypic genera with its habit

5. Conclusion

The present study of assessment of overall status of floristic composition of Kalbetta forests provides wider scope for regular, reliable and systematically recording of data for the purpose of its management. The results revealed aspectrum of flora which included Dicots, Monocots, Pteridophytes, Bryophytes, Fungi and Lichens. The generic coefficient having 71.10%, shows maximum diversity among the genera and species. The study found nine monotypic genera out of which three are endemic to India and one vulnerable species gives scope for greater conservation. The results of this study would enable forest managers to identify the status, trends in biodiversity and also to build floristic databases which would assist in planning and management of this forest. In the long run, this study would also help in identifying indicators in surveillance, slowing down biodiversity loss, facilitating sustainable use, and enhancing ecosystem functioning of Kalbetta state forest.

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