Original Research Article

PHYTODIVERSITY OF HERBACEOUS FLORA IN THE GRASSLANDS OF JANNARAM DIVISION, KAWAL TIGER RESERVE, TELANGANA, INDIA.

ABSTRACT

Aims : To study the diversity and composition of herbaceous species in the grasslands of Jannaram division, Kawal Tiger Reserve, Telangana, India..

Place and Duration of Study: Grasslands of Jannaram division, Kawal Tiger Reserve, Telangana, July 2022 toAugust 2023.

Methodology: The study was carried out by laying out 223 sample plots in the Jannaram division by dividing Jannaram division into 3 ranges. The plot size was 1 x 1 m. Varied diversity indices such as Simpson, Shannon–Weiner, species evenness, and IVI were calculated according to standard formulae. vegetation analysis and IVI value of each species were calculated and analysed.

Results : A total of 65 species, comprising 53 genera and 21 families, were reported. The dominant family in the study area was Poaceae, followed by Fabaceae, Malvaceae, Acanthaceae, Asteraceae and Euphorbiaceae. The Shannon–Weiner index was 3.46 and the Simpson index was 0.05, indicating high diversity with less dominance of herb layer in the study area. Top five species holding highest IVI value are *Iseilema laxum (29.935)*, *Cynodon barberi (12.191)*, *Eragrostis amabilis (12.147)*, *Dichanthium annulatum (11.696)*, and *Apluda mutica* (10.211).

Conclusions –This research produced fundamental information regarding the types of herbaceous plants and grasses present at the Jannaram, Kawal Tiger Reserve. This would serve as a guide to the systematists, ethnobotanists, amongst several others researchers who are interested in identifying.

Key words : *Importance Value Index, Jannaram division, Kawal Tiger Reserve, Phytosociology, Shannon–Weiner index and Simpson* index.

1. INTRODUCTION

Phytosociology is a subfield of vegetation science that studies plant communities within defined spatial units, most commonly vegetation stands. Its primary goals are to define and describe different species of vegetation by thoroughly analysing their entire floral makeup. This field studies numerous plant life forms and evaluates analytical qualities such as frequency, density, abundance, evenness, Importance Value Index (IVI), and diversity indexes. These evaluations aid in evaluating various factors and determining the most productive ones [1]. Grasslands are vegetation covers with an abundance of non-woody plants, which includes certain savannas, forests, and grasslands [2].Grasslands, which occupy 30% of the planet's surface, are among the world's largest ecosystems.

They can be found in every region of the world, with Sub-Saharan Africa and Asia having the highest total area covered by grasslands, with 14.5 and 8.9 million km^2, respectively. They are most common in semi-arid regions (28% of the world's grasslands), wet regions (23%), cold regions (20%), and desert regions (19%)[3].Out of the 136 terrestrial ecoregions recognized for their ecological significance, 35 are characterized as grasslands, showcasing the richness and diversity of this ecosystem. Around 4,500 relatively large protected areas, constituting at least 50% of such designated areas, are identified as grasslands. These protected grasslands encompass roughly 4 million square kilometers, equivalent to about 3% of the total land area. However, this comprises only 7.6% of the entire grassland area.

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When it comes to carbon storage, grasslands play a significant role, holding approximately 34% of the global carbon stock found in terrestrial ecosystems. In comparison, forests store 39% of this carbon, while agro-ecosystems account for 17%. Unlike tropical forests where the vegetation is the primary source of carbon storage, a major portion of carbon in grasslands is stored within the soil[2]. The biodiversity of grasslands includes a wide range of items that are valuable to humans[4].

Major grassland characteristics include species richness and composition. Plant life-forms, vegetation structure and dynamics, and primary productivity are all investigated and interact closely with herbivore grazing and play an important role in determining the biodiversity and ecosystem function of grasslands[5,6]. Although herbaceous vegetation accounts for less than 1% of forest biomass, it encompasses over 90% of plant species and produces up to 20% of foliar litter[7].The herbaceous layer has the highest species richness of any forest stratum, yet threat level estimates for arboreal species are frequently reported [8,9,10]. Understanding phytosociological parameters such as diversity indices, species diversity, species richness, species evenness, and distribution patterns is crucial for effective and sustainable management of grassland ecosystems. These analytical results offer a thorough insight into species composition, intricate relationships between various communities and ecosystems, resource sustainability, and how environmental factors influence ecosystem changes. To ensure the long-term preservation of biodiversity within these ecosystems, it's imperative to develop and implement appropriate management practices informed by this understanding.

In this context, the objective of this study is to gain a comprehensive understanding and analyze the structure of vegetation, along with assessing species diversity and composition within the grassland ecosystems. as well as which is crucial for the efficient management of forests.

1. MATERIALS AND METHODS

2.1 Study area

The present study was carried out in the Jannaram Division, Kawal Tiger Reserve, Telangana during 2022-23 (July-August). Geographically, the Jannaram Division was located on 19.11889490 N and 78.99897340 E in Mancherial District of Telangana State, is spread over an area of 893 km^2. It has a dry deciduous forest type with a few tiny grasslands [11].

The Birsaipet plateau, situated in the northwestern corner of this division, stands at an elevation of 396 meters above sea level. This plateau features a rolling terrain and its waters flow in two directions, ultimately converging into the Peddavagu, which traverses the plateau from the North-East to the South-West. The temperature in this region fluctuates between 15ºC and 45ºC. The division experiences an average annual rainfall of 750 mm, received mainly from the southwest monsoon. Kawal Wildlife Sanctuary boasts approximately 30 seasonal streams within its boundaries. This area plays a crucial role as a catchment area for numerous streams that eventually flow into the Kaddam reservoir and the Godavari River. Additionally, both inside and outside the Reserve Forest, there are numerous small, medium, and large tanks distributed across the division. [12].

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The study area was inventoried by laying of 223 sample plots on the basis of stratified random sampling method, dividing the Division into 3 ranges with a standard sampling intensity method. The phytosociological analysis of each sample grid of division was conducted by using randomly chosen 1 x 1 m plots.

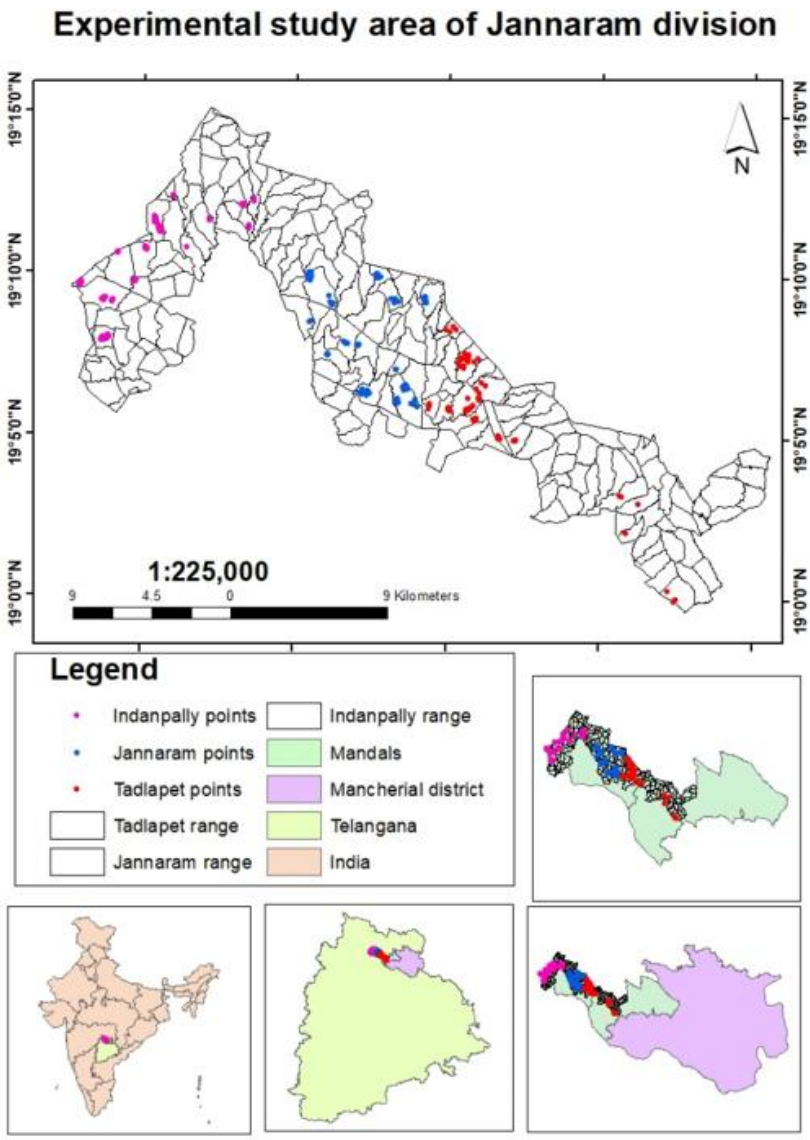

Fig1: Map of the study area, Jannaram division, Kawal Tiger Reserve, Telangana.

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2.2 Statistical Analysis

Several quantitative indices have been designed to provide information on different aspects of biodiversity viz. The Simpson Index [13]. Shannon–Weiner Index [13, 14]. IVI and Margalef Index [15]. The indices provide the biodiversity values and help to compare it between plant communities or ecosystems. The equations are as follows:

2.2.1 Simpson's Diversity Index

$(D) = 1 - \Sigma (n/N)^2$

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where n = the total number of organisms of a particular species

N = the total number of organisms of all species

2.2.2 Shannon Diversity index

$(H) = \Sigma\ pi\ ln\ pi$ (or) $H' = -\Sigma\ (ni/N) \times \log (ni/N)$

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where p_i=The proportion of the entire community made up of species *i*

The diversity of species increases in a given community with increasing H value and vice versa.

2.2.3 Species Evenness Index

$(E_H) = H / \ln(S)$

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where H=Shannon Diversity Index, S=The total number of unique species

This value ranges from 0 to 1.

2.2.4 Margalef Index

$(D) = (S-1)/\ln N$

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where S=No. of species in a sample and N=the total individuals

2.2.5 Important Value Index (IVI)

The analysis of the vegetation data was done using characters such as Abundance (A), Frequency (F), Density (D), Relative Density (RD), Relative Frequency (RF), Relative Abundance (RA), and Importance Value Index (IVI) in accordance with the standard formulae.

$$\text{Frequency } (\%) = \frac{\text{No.of quadrats in which species occurred}}{\text{Total no.of Sampling Unit Studied}} \text{X } 100$$

$$\text{Relative Frequency } = \frac{\text{Frequency of the species}}{\text{Total frequency of all species}} \times 100$$

$$\text{Density } = \frac{\text{No. of individuals of the species}}{\text{Total area studied}}$$

$$\text{Relative density } = \frac{\text{Density of the species}}{\text{Total density of all the species}} \times 100$$

$$\text{Abundance } = \frac{\text{Total no. of individuals of the species in all quadrats}}{\text{No. of quadrats in which species occurred}}$$

$$\text{Relative abundance} = \frac{\text{Abundance of individual species}}{\text{Total abundance of all species}} \text{x100}$$

IVI is calculated by adding relative density, relative abundance, and relative frequency values for each species[16, 17].

Important Value Index (IVI) = Relative Abundance + Relative Density + Relative Frequency

2. RESULTS

3.1 Vegetation structure

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Table1. Showing the IVI of the study area

S. No	Name of the Species	RF	RD	RA	IVI
1	*Aeschynomene indica* L	0.462	0.270	1.101	1.833
2	*Ageratum conyzoides* (L.) L	2.770	1.284	0.874	4.928
3	*Allmania nodiflora* (L.) R. Br. ex Wight	0.277	0.103	0.699	1.079
4	*Alloteropsis cimicina* (L.) Stapf	0.185	0.347	3.540	4.072
5	*Alternanthera sessilis* (L.) R. Br. ex DC.	2.678	3.005	2.116	7.799
6	*Alysicarpus hamosus* Edgew.	0.739	0.424	1.082	2.244
7	*Andrographis paniculata* (Burm.f.) Nees	0.092	0.090	1.836	2.018
8	*Apluda mutica L*	2.862	4.430	2.918	10.211
9	*Aristida setacea* Retz	1.662	1.323	1.501	4.485
10	*Biophytum sensitivum* (L.) DC	0.831	0.334	0.758	1.922
11	*Blepharis integrifolia* (L. fil.) E. Mey. & Drege	0.646	0.270	0.787	1.703
12	*Blumea axillaris* (Lam.) DC.	0.092	0.026	0.524	0.642
13	*Blumea lacera* (Burm.f.) DC	1.847	0.655	0.669	3.170
14	*Bothriochloa bladhii* (Retz.) S.T.Blake	0.185	0.270	2.753	3.208
15	*Brachiaria distachya* (L.) Stapf	0.646	0.758	2.210	3.614
16	*Brachiaria ramosa* (L.) Stapf	1.200	1.515	2.380	5.096
17	*Chloris barbata* Sw	2.216	2.684	2.284	7.184
18	*Chloris virgata* Sw	2.216	2.838	2.415	7.469
19	*Chrysopogon fulvus* (Spreng.) Chiov	1.754	1.901	2.043	5.698
20	*Cleome viscosa* L	1.754	0.822	0.883	3.460
21	*Commelina benghalensis* L	1.847	1.169	1.193	4.208
22	*Corchorus aestuans* L	0.092	0.013	0.262	0.367
23	*Cynodon barberi* Rang. & Tadul.	2.493	5.522	4.176	12.191
24	*Cyperus compressus* L	0.923	0.912	1.862	3.697
25	*Cyperus rotundus* L.	0.554	0.475	1.617	2.646
26	*Dactyloctenium aegyptium* (L.) Willd	3.509	3.172	1.705	8.385
27	*Desmodium gangeticum* (L.) DC	0.092	0.026	0.524	0.642
28	*Dichanthium annulatum* (Forssk.) Stapf	3.047	5.034	3.115	11.196

29	*Digitaria abludens* (Roem. & Schult.) Veldkamp	1.108	0.976	1.661	3.745
30	*Digitaria bicornis* (Lam.) Roem. & Schult.	3.416	3.442	1.899	8.757
31	*Dinebra retroflexa* (Vahl) Panz	2.031	1.747	1.621	5.399
32	*Drimia indica* (Roxb.) Jessop	0.092	0.026	0.524	0.642
33	*Eleusine indica* (L.) Gaertn	1.847	1.490	1.521	4.857
34	*Eragrostis amabilis* (L.) Wight & Arn	4.247	5.471	2.428	12.147
35	*Euphorbia hirta* L	2.862	1.862	1.227	5.951
36	*Euphorbia indica* Lam	1.108	0.771	1.311	3.190
37	*Hemidesmus indicus* (L.) R. Br.	2.493	0.899	0.680	4.072
38	*Heteropogon contortus* (L.) P.Beauv. ex Roem. & Schult	3.601	3.609	1.889	9.099
39	*Hybanthus enneaspermus* (L.) F.Muell	0.092	0.090	1.836	2.018
40	*Hygrophila auriculata* (Schumach.) Heine	2.124	0.655	0.581	3.360
41	*Iphigenia indica* (L.) A.Gray ex Kunth	0.092	0.013	0.262	0.367
42	*Iseilema laxum* Hack	8.864	17.375	3.696	29.935
43	*Justicia prostrata* (Roxb. ex C.B.Clarke) Gamble	0.369	0.295	1.508	2.173
44	*Justicia glauca* Rottler	3.693	3.365	1.718	8.776
45	*Leucas aspera* (Willd.) Link	2.585	0.912	0.665	4.162
46	*Melanocenchris jacquemontii* Jaub. & Spach	0.277	0.257	1.748	2.282
47	*Mollugo pentaphylla* L	0.185	0.154	1.573	1.912
48	*Murdannia spirata* (L.) G.Brückn	0.739	0.527	1.344	2.609
49	*Oldenlandia umbellata* L.	0.369	0.308	1.573	2.251
50	*Oplismenus burmanni* (Retz.) P.Beauv	1.662	2.568	2.914	7.144
51	*Pentanema indicum* (L.)	2.955	1.079	0.688	4.722
52	*Phyllanthus niruri* L	1.016	0.758	1.407	3.180
53	*Phyllanthus virgatus* G. Forst.	1.939	2.003	1.948	5.890
54	*Senna tora* (L.) Roxb	1.200	0.604	0.948	2.752
55	*Senna uniflora* (Mill.) H.S.Irwin & Barneby	0.462	0.141	0.577	1.180
56	*Setaria pumila* (Poir.) Roem. & Schult	1.570	1.657	1.990	5.216
57	*Setaria verticillata* (L.) P.Beauv.	0.739	0.848	2.163	3.750
58	*Sida acuta* Burm.f	0.739	0.270	0.688	1.697
59	*Sida cordata* (Burm.f.) Borss.Waalk	1.662	0.681	0.772	3.115
60	*Sida cordifolia* L	0.462	0.154	0.629	1.245
61	*Solanum surattense* Burm. F	1.108	0.308	0.524	1.941
62	*Spermacoce ocymoides* Burm.f	0.092	0.026	0.524	0.642
63	*Themeda quadrivalvis* (L.) Kuntze	1.754	2.992	3.216	7.962
64	*Tridax procumbens* (L.) L	2.678	1.978	1.393	6.048
65	*Zornia diphylla* (L.) Pers	0.092	0.026	0.524	0.642
		100.000	**100.000**	**100.000**	**300.000**

The IVI values of the top five herbaceous plants in the Jannaram division are as follows in decreasing order are *Iseilema laxum* (29.935) >*Cynodon barberi* (12.191) >*Eragrostis amabilis* (12.147) >*Dichanthium annulatum* (11.696) >*Apluda mutica* (10.211) (Table 1).

3.2 Diversity indices

Table 2. Species diversity indices of the Jannaram division, Kawal Tiger Reserve, Telangana.

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Diversity indices	Value
Simpson index (D)	0.05
Shannon-Weiner's index (H')	3.46
Species Evenness index	0.50
Margalef's diversity index (R)	7.14

The Simpson index in this area was 0.05 following low dominance of the species in the study area. The Shannon-Wiener's diversity index in the area was 3.46 indicating high diversity herb layer in the Jannaram division. The various other indices have been shown in the table 2.

4. DISCUSSION

4.1 Herb species abundance

The species composition of Jannaram division, Kawal Tiger Reserve, Telangana found in 223 quadrats (Observed as 65 species belonging to 53 genera representing 21 families) was higher than Other research studies by different authors work , i.e., 53 herb species in Hulikal Ghat region, central Western Ghats, Karnataka [18], 30 herb species belonging to 19 families in Archeological Museum Campus – Kochi[19], 30 herb species belonging to 19 families in the sacred groves of Perumudiyoor, Kerala[20]. However, the herb species diversity was comparatively better and five major herb species were dominated and occupied majority of the Jannaram division. However, considering the results of these similar studies, it can be concluded that the Jannaram division, Kawal Tiger Reserve possesses relatively well-diversified natural forests with higher number of herb species.

4.2 Diversity indices

The values of Shannon–Wiener's diversity index (3.46) and Species evenness index (0.50) of the reserve indicate effective and resulting in consideration of conservation and sustainable management of the area. The value of Margalef's diversity index (7.14) indicates proficient presence of tree species in the area. The value of Simpson's index (0.05) also indicates the less dominance of herb species. These results were higher than similar study by other authors, i.e., Shannon Wiener Diversity Index (H) is observed as 2.28 and Evenness index is 0.45 in Nilgiris Biosphere Reserve, Western Ghats, Southern India [21],Shannon Weiner diversity Index (H') is 1.80695667 in the sacred groves of Perumudiyoor, Kerala[20].

4.3 Phytosociological characters of the herb species

The IVI value indicates a complete picture of phytosociological character of a species in the community [22]. The highest IVI was found for *Iseilema laxum (29.935), Cynodon barberi (12.191), Eragrostis amabilis (12.147), Dichanthium annulatum (11.696), and Apluda mutica (10.211).* The IVI value of *Iseilema laxum* indicates that the majority of the study area is dominated by *Iseilema laxum*.

5. CONCLUSIONS

This research produced fundamental information regarding the types of herbaceous plants and grasses present at the Jannaram, Kawal Tiger Reserve. This would serve as a guide to the systematists, ethnobotanists, amongst several others researchers who are interested in identifying.

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