Phytosociological Status of Grasses in Forest Division of Jhalawar, Rajasthan

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ABSTRACT

Phytosociological analysis is one of the best methods for the assessment and documentation of the present status of grasses in the light of rapid extinction of native species. A total of 36 grass species belonging to Poaceae family with highest importance value index (IVI) of *Apluda mutica* (**49.27**) as dominant followed by *Aristida depressa* (**22.78**) and *Heteropogon contortus* (**21.70**) as co-dominant grass species has been reported. The Shannon diversity index (3.29) indicates quite diverse, healthy and complex ecosystem with richness and evenness of many different grass species. The forest area facing excessive grazing practice leads to expansion of non-fodder herbaceous species as well as invasion of obnoxious exotic species. Therefore, the study provides a comprehensive understanding with baseline information crucial for ecological dynamics and conservation planning of grasses in Forest Division of Jhalawar, Rajasthan.

Keywords: IVI, Relative, grasses, Phytosociological.

INTRODUCTION

Phytosociological analysis is the study of the characteristics, classification, inter-relationship and distribution of plant communities to describe population dynamics and an appropriate way to find out the dominant, frequent and most suitable plant species. Phytosociological studies are essential for protecting the natural plant communities as well as understanding the changes experienced in the past and continuing on in to the future.

Soundhi (1935) laid the foundation of scientific forest management later on Puri (1936) developed a temporary working plan for plantation in Jhalawar district first time. After independence exploration of plant diversity have been enumerated through working plan of Forest Division of Jhalawar by Gupta (1962), Agrawal (1981), Anand (1990), Meena (2015) and Panwar (2025)**.** Shringi (1981) gave a detailed account of grasses of Jhalawar district and contributed about *Flora of Jhalawar district* (1986). Sharma (1987) carried out studies about floristic, phytosociology and flora of Jhalawar district. However, most of the forest area are under immense anthropogenic disturbances and require careful management intervention to maintain overall biodiversity and sustainability. The present study of phytosociological status was carried out to understand distribution, characteristics, species richness and diversity of grasses of the study area. Most of the developed countries have these basic studies which have been used to develop forest working plan.

METHODOLOGY

Study Area

Forest Division of Jhalawar is located in south-eastern part of Rajasthan lies between Latitude 23º45’33’’N to 24º52’53” N and longitudes 75º 27’ 47’’E to 76 º 56’ 10’’E and comprises of 118672.52 hectare which makes 19.08% of the total land area of Jhalawar district. The study area is fragmented into 288 forest blocks that

administered by eight forests ranges namely Aklera, Asnawar, Bakani, Dag, Jhalawar, Khanpur, Manoharthana and Pirawa. The tropical climate has distinct pattern of season with the temperature ranges between 5^0C-47^0C. It receives an average annual rainfall of 850-900 mm mainly during southwest monsoon.

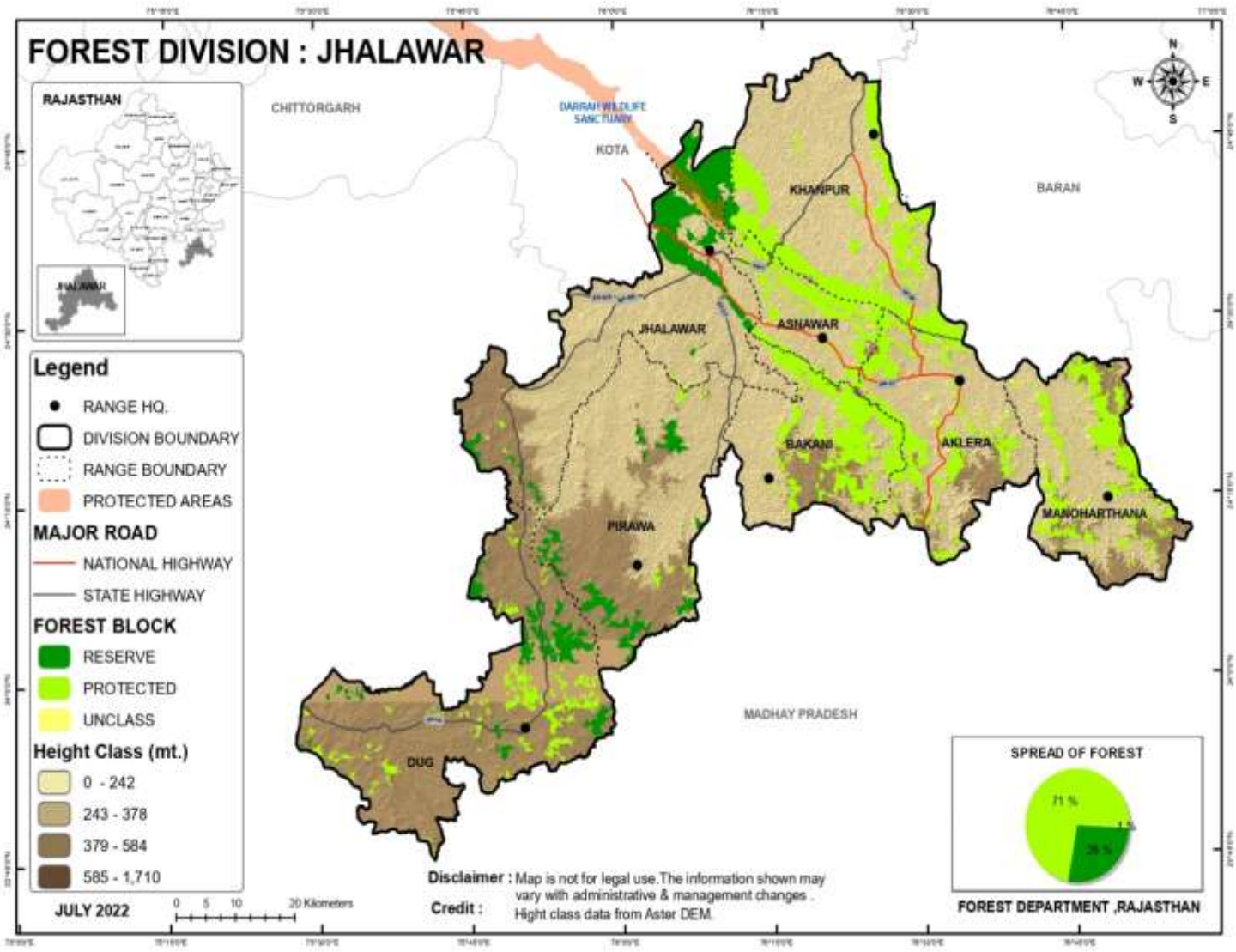


Figure 1: Map of Forest Division of Jhalawar showing eight forest ranges (Source: forest.rajasthan.gov.in)

Identification of Grasses

Representative specimens of selected species were collected and processed following standard herbarium preparation techniques. Species identification was based on morphological characters and confirmed using standard regional floras that further strengthen the reliability of the study by ensuring accurate species identification and providing permanent reference material.

Assessment of phytosociological characters

Phytosociological studies of grasses were carried out by random sampling method by using quadrats of 1m x1m during September 2025 to August 2026 by covering over all spectrum of grasses especially during monsoon and post monsoon season. The minimum size and number of sample plots were calculated by species area curve methods (Misra, 1968). A total 80 quadrats were placed using sample intensity at 0.008% by covering 10 larger forest blocks in each forest range of the study area. Basal area of grasses was measured at ground level and expressed as cm^2/ m^2. Data analysis was performed by using MS Excel.

IVI = R.F. + R. D. + R. Dom. Where; IVI = Importance Value Index, R.F. = Relative Frequency, R.D. = Relative Density and R. Dom. = Relative Dominance

The following indices offer a thorough understanding about the health and diversity of grasses if used together (Table 1).

Table: 1 Formulae for various diversity indices used in Forest Division of Jhalawar

S.N.	Diversity Index	Formula	Denotations	References
1	Shannon-Wiener's Diversity Index	$H = -\sum P_i (\ln P_i)$	ln = Natural log $P_i = \frac{Ni}{N}$	Shannon, 1948
2	Pielou Evenness Index	J=H/ln(S)	(S) =Total no. of species	Pielou, 1966
3	Simpson Concentration of Dominance	$CD = \sum_{i=1}^{s} [\frac{Ni}{N}]^2$	$\frac{Ni}{N}$ is same as Shannon	Simpson, 1949
4	Simpson diversity Index	D= 1-CD	CD= Simpson Conc. of Dom.	Simpson, 1949
5	Menhinick's Index of Species Richness	$d = S/\sqrt{N}$	S= No. of species N= total number of individuals	Menhinick, 1964
6	Margalef Index of Species Richness	$d = \frac{(S-1)}{\ln(N)}$	S= No. of species N= total number of individuals	Margalef, 1958

RESULTS

The herbaceous ground covers a total of 36 grass species belonging to the family Poaceae out of which 20 species was perennial and 16 species was annual. The study area indicates structurally diverse and functionally resilient in terms of life span. Rapid growth and propagation of these grasses not only by means of buried seeds germination under favourable climatic conditions but also spread through rhizomes and interconnected extensive root system could survive in soil for long period.

The study observed highest frequency and highest basal area by *Apluda mutica* while lowest by *Dactyloctenium scindicum*; the highest density of *Aristida depressa* (10.63 individuals/m²) while lowest density of *Saccharum spontaneum* (0.60 individuals/m²) and the highest abundance of *Cymbopogon martini* (22.72) while the lowest abundance of *Melanocenchris jacquemontii* (3.65).

The grasses showed contagious distribution pattern in term of higher A/F ratio. This condition arises due to localized vegetative reproduction, inefficient seed dispersal, heterogeneous micro-environmental conditions (varying soil nutrients, moisture and canopy openings), overgrazing and invasion of exotic species. Therefore, individuals occur in groups, clusters or patches leaving other areas vacant (Table 2).

Table 2: Quantitative character analysis of Grasses in Forest Division of Jhalawar, Rajasthan

S. N.	Name of Plant Species	Frequency (%)	Density (individuals/ m²)	Abundance	Total Basal Area (cm^2/m^2)	A/F Ratio
1	*Alloteropsis cimicina*	25.00	1.54	6.15	9.79	0.25
2	*Apluda mutica*	81.25	8.89	10.94	509.36	0.13
3	*Aristida depressa*	78.75	10.63	13.49	67.66	0.17
4	*Aristida funiculata*	45.00	2.51	5.58	16.00	0.12

5	*Bothriochloa pertusa*	23.75	1.31	5.53	8.36	0.23
6	*Brachiaria ramosa*	21.25	1.19	5.59	7.56	0.26
7	*Brachiaria reptans*	18.75	1.36	7.27	8.68	0.39
8	*Cenchrus barbatus*	2.18	1.75	1.35	0.54	3.64
9	*Cenchrus ciliaris*	1.92	1.88	1.28	0.51	3.66
10	*Cenchrus setigerus*	1.69	1.75	1.05	0.42	3.22
11	*Chloris barbata*	20.00	2.10	10.50	13.37	0.53
12	*Chloris dolichostachya*	18.75	1.20	6.40	7.64	0.34
13	*Chrysopogon fulvus*	20.00	1.36	6.81	8.68	0.34
14	*Chrysopogon gryllus*	18.75	1.31	7.00	8.36	0.37
15	*Chrysopogon zizanioides*	6.25	1.03	16.40	6.53	2.62
16	*Coix gigantia*	17.50	2.06	11.79	52.54	0.67
17	*Cymbopogon caesius*	21.25	3.31	15.59	21.09	0.73
18	*Cymbopogon martini*	22.50	5.11	22.72	32.56	1.01
19	*Cynodon dactylon*	76.25	4.05	5.31	25.79	0.07
20	*Dactyloctenium aegyptium*	37.50	3.24	8.63	20.62	0.23
21	*Dactyloctenium scindicum*	6.25	0.85	13.60	5.41	2.18
22	*Desmostachya bipinnata*	12.50	0.99	7.90	6.29	0.63
23	*Dichanthium annulatum*	36.25	4.61	12.72	29.37	0.35
24	*Dichanthium foveolatum*	15.00	1.31	8.75	8.36	0.58
25	*Digitaria ciliaris*	38.75	4.89	12.61	31.12	0.33
26	*Echinochloa colona*	32.50	3.60	11.08	22.92	0.34
27	*Eragrostis ciliaris*	12.50	1.15	9.20	7.32	0.74
28	*Heteropogon contortus*	41.25	6.73	16.30	171.30	0.40
29	*Melanocenchris jacquemontii*	32.50	1.19	3.65	7.56	0.11
30	*Oplismenus burmanni*	48.75	5.51	11.31	35.10	0.23
31	*Panicum antidotale*	18.75	1.46	7.80	83.82	0.42
32	*Saccharum munja*	11.25	0.66	5.89	37.97	0.52
33	*Saccharum spontaneum*	10.00	0.60	6.00	15.28	0.60
34	*Sehima nervosa*	41.25	4.93	11.94	125.45	0.29
35	*Sorghum halepense*	15.00	1.36	9.08	34.71	0.61
36	*Themeda quadrivalvis*	21.25	4.29	20.18	109.21	0.95
	Grand Total	1000	100	354.2	1579.18	

The phytosociological studies observed highest importance value index (IVI) of *Apluda mutica* (**46.70**) as dominant and most abundant on plain as well as hillock followed by co-dominant grass species such as *Aristida depressa* (**22.44**) more frequent on hillock and *Heteropogon contortus* (**21.70**) as more frequent on plain. Hence, top three species of grasses demonstrated through phytograph which is a quadriaxial diagram have been used to described R.F., R.D., R.Dom. and IVI (Figure 2).

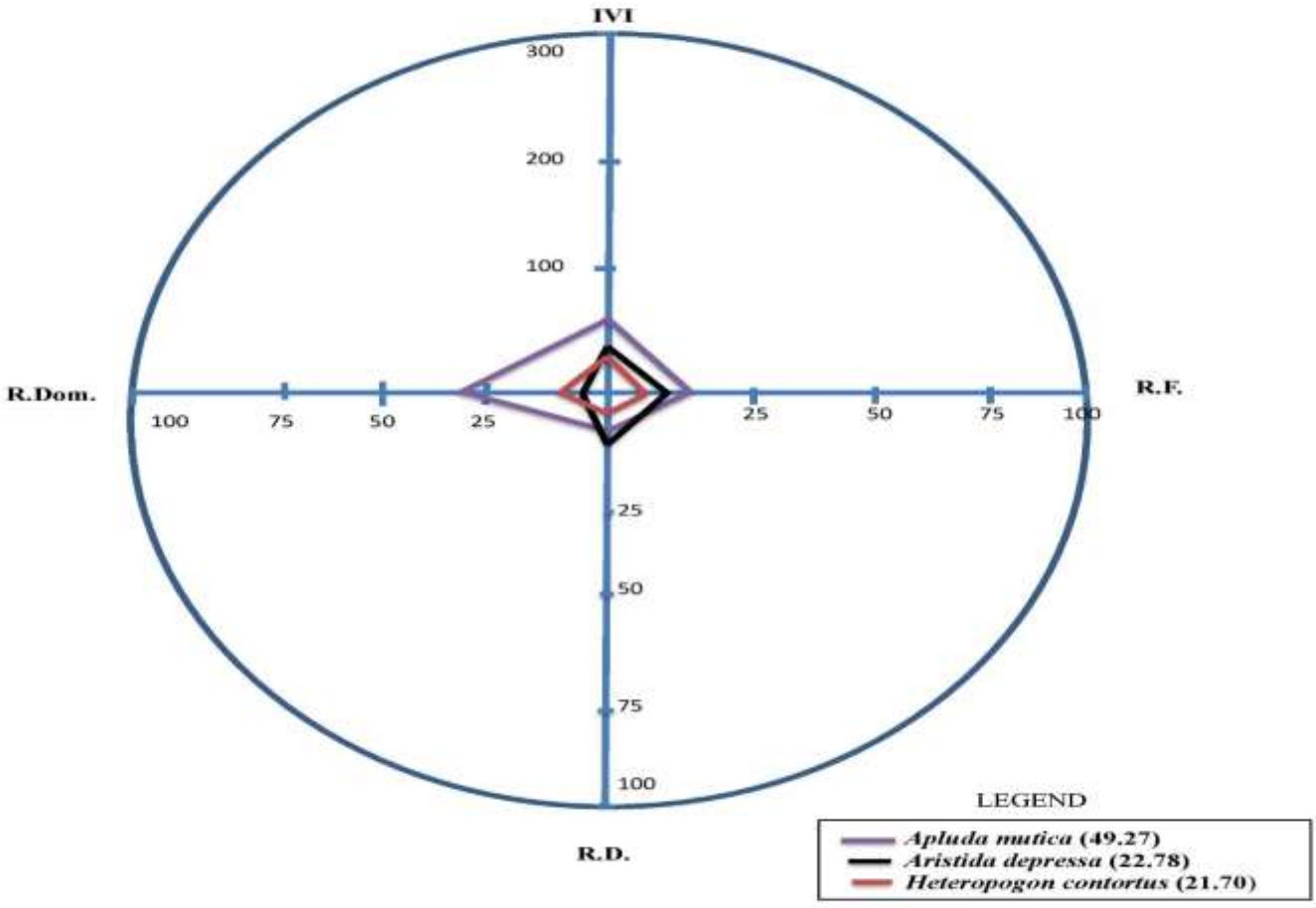


Figure 2: Phytograph of top three species of Grasses in term of IVI of Forest Division of Jhalawar, Rajasthan.

The study also observed significant presence of *Aristida funiculata, Cymbopogon martini, Dichanthium annulatum*, *Digitaria ciliaris, Sehima nervosa* and *Themeda quadrivalvis* in term of their relative attributes or IVI *(*Table 3). The decreasing order of IVI has been made to express the dominance, relative importance and ecological success of grasses species with a single value in Forest Division of Jhalawar, Rajasthan (Figure 3).

Table 3: Analysis of Relative Attributes and IVI of Grasses in Forest Division of Jhalawar, Rajasthan

S. N.	Name of Plant Species	Relative Abundance	Relative Frequency	Relative Density	Relative Dominance	IVI
1	*Alloteropsis cimicina*	1.74	2.50	1.54	0.62	4.66
2	*Apluda mutica*	3.09	8.13	8.89	32.25	**49.27**
3	*Aristida depressa*	3.81	7.88	10.63	4.28	**22.78**
4	*Aristida funiculata*	1.58	4.50	2.51	1.01	8.03
5	*Bothriochloa pertusa*	1.56	2.38	1.31	0.53	4.22
6	*Brachiaria ramosa*	1.58	2.13	1.19	0.48	3.79
7	*Brachiaria reptans*	2.05	1.88	1.36	0.55	3.79

8	*Cenchrus barbatus*	2.18	1.75	1.35	0.54	3.64
9	*Cenchrus ciliaris*	1.92	1.88	1.28	0.51	3.66
10	*Cenchrus setigerus*	1.69	1.75	1.05	0.42	3.22
11	*Chloris barbata*	2.96	2.00	2.10	0.85	4.95
12	*Chloris dolichostachya*	1.81	1.88	1.20	0.48	3.56
13	*Chrysopogon fulvus*	1.92	2.00	1.36	0.55	3.91
14	*Chrysopogon gryllus*	1.98	1.88	1.31	0.53	3.72
15	*Chrysopogon zizanioides*	4.63	0.63	1.03	0.41	2.06
16	*Coix gigantia*	3.33	1.75	2.06	3.33	7.14
17	*Cymbopogon caesius*	4.40	2.13	3.31	1.34	6.77
18	*Cymbopogon martini*	6.41	2.25	5.11	2.06	9.42
19	*Cynodon dactylon*	1.50	7.63	4.05	1.63	13.31
20	*Dactyloctenium aegyptium*	2.44	3.75	3.24	1.31	8.29
21	*Dactyloctenium scindicum*	3.84	0.63	0.85	0.34	1.82
22	*Desmostachya bipinnata*	2.23	1.25	0.99	0.40	2.64
23	*Dichanthium annulatum*	3.59	3.63	4.61	1.86	10.10
24	*Dichanthium foveolatum*	2.47	1.50	1.31	0.53	3.34
25	*Digitaria ciliaris*	3.56	3.88	4.89	1.97	10.73
26	*Echinochloa colona*	3.13	3.25	3.60	1.45	8.30
27	*Eragrostis ciliaris*	2.60	1.25	1.15	0.46	2.86
28	*Heteropogon contortus*	4.60	4.13	6.73	10.85	**21.70**
29	*Melanocenchris jacquemontii*	1.03	3.25	1.19	0.48	4.92
30	*Oplismenus burmanni*	3.19	4.88	5.51	2.22	12.61
31	*Panicum antidotale*	2.20	1.88	1.46	5.31	8.65
32	*Saccharum munja*	1.66	1.13	0.66	2.40	4.19
33	*Saccharum spontaneum*	1.69	1.00	0.60	0.97	2.57
34	*Sehima nervosa*	3.37	4.13	4.93	7.94	16.99
35	*Sorghum halepense*	2.56	1.50	1.36	2.20	5.06
36	*Themeda quadrivalvis*	5.70	2.13	4.29	6.92	13.33
	Grand Total	100.00	100.00	100.00	100.00	300.00

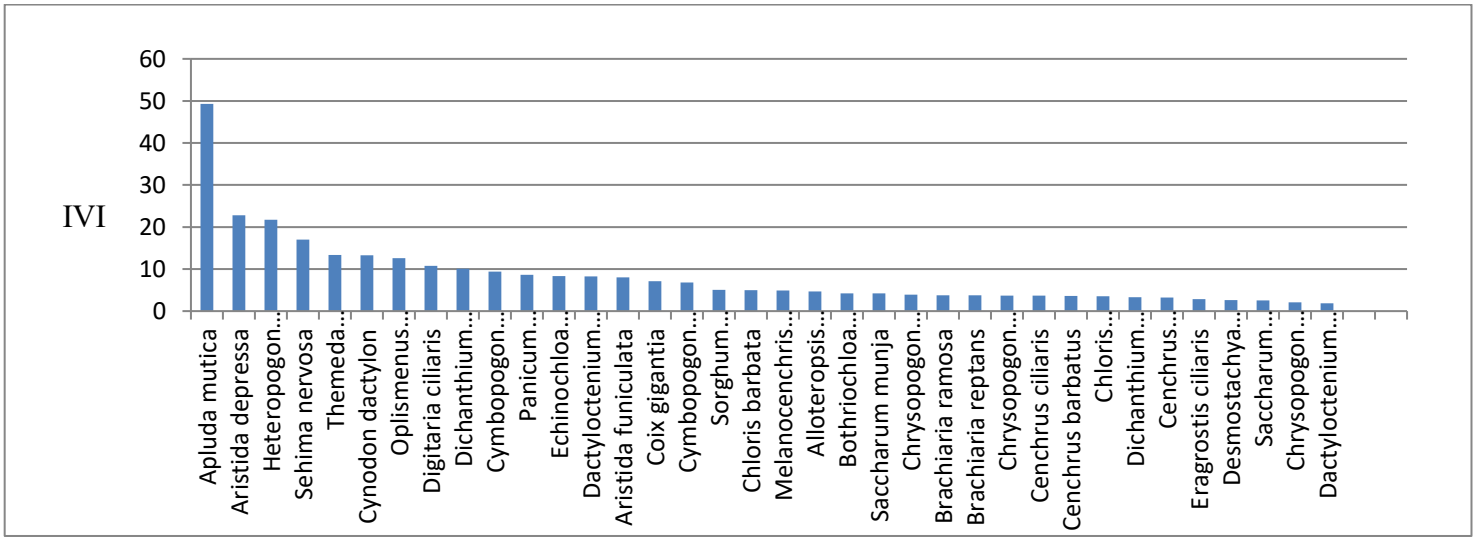


Figure 3: Decreasing order of IVI of Grasses species of Forest Division of Jhalawar, Rajasthan.

The Shannon diversity index showed higher biodiversity; The Pielou Index showed high evenness with extremely balanced community; Simpson index showed higher diversity value with evenly distributed species; Menhinick and Margalef index showed moderate to high species richness with highly diverse ecosystem. However, heterogeneous species composition is dominating in managed or plantation area (Table 4).

Table 4: Various diversity indices of Grasses calculated in Forest Division of Jhalawar

Shannon H (Diversity)	Simpson Conc. of Dominance	Simpson Diversity Index	Pielou SE (Evenness)	Menhinick (Richness)	Margalef (Richness)
3.29	0.05	99.05	0.92	0.40	3.89

DISCUSSION

Although the study area is fertile with catchment of various river facilities yet forest fragmentation (either by natural or anthropogenic) leads to extirpation of ecological wellbeing. Several studies in south-east Rajasthan found predominance of grasses due to high reproductive capacity, more adaptive and short lifespan that allow these grasses to rapidly colonize in the open spaces created by physical as well as biological disturbances (Kumar & Bairwa, 2026). Shringi (1981) also reported 65 species of grasses in Jhalawar district (South-East Rajasthan).

Significant presence of *Cynodon dactylon* and *Oplismenus burmanni* in the study area with higher frequency value strongly co-related with significant structural openings in the canopy due to anthropogenic disturbances, grazing and ecological edge effects and a dense forest canopy or understory that restricts direct sunlight that indicate as an obligate sciophytes respectively (Singh, 2018). Invasion of exotic species was noticed in barren and open area leads to significant decrease in IVI value of grass species. Therefore, disturbance gradients cause decrease in frequency, density, abundance and basal area that ultimately affects grass diversity in forest (Dar *et al.,* 2013).

CONCLUSION

The current status of plant communities is alarming and continuously declining of biodiversity up to disappearance due to anthropogenic disturbances. The notable feature of herbaceous layer is that they are overwhelmed or co-dominated by graminoid vegetation, grow pretty much everywhere not only helps in soil stabilization and formation of channels for water infiltration when alive but also addition of organic matter to soil and increasing its fertility after die. Although grasses may appear uniform or insignificant at first glance yet they also play a pivotal role in the global carbon cycle, soil stabilization, habitat formation, nutrient cycling and as a primary food source for wild and domestic herbivores. Therefore, depletion of grasses causes ecosystem imbalance and the extinction of many dependent species. This study not only helps in understanding the richness of grasses but also inspires further researchers for continued monitoring and detailed studies on biomass and nutritional attributes of grasses are recommended to support long-term conservation strategies and scientific management of grasses in Forest Division of Jhalawar, Rajasthan.

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Ethical considerations

The authors also declare that the research work did not violate any rules related to wildlife or any ethical violation.

Conflict of Interest

The authors don't have any conflict of interest directly or indirectly related to work.

Data availability

The data which is produced and examined in this research paper is available upon request from the corresponding author.

Limitations

The study carried out with small number of quadrats that lack seasonal replication, data related to soil pattern and disturbance.

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