Indian Journal of Ecology (2025) 52(2): 306-311
DOI: https://doi.org/10.55362/IJE/2025/4493

Manuscript Number: 4493
NAAS Rating: 5.38

Phytosociological Assessment and Diversity of Herbaceous Vegetation in Gomarda Wildlife Sanctuary, Chhattisgarh, India

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***Abstract*:** Gomarda wildlife sanctuary is situated in the Sarangarh-Bilaigarh district of Chhattisgarh, India. The area is covered with tropical mixed deciduous vegetation. The present study was carried out in five sampling sites viz. Chantipali, Manjarmati, Bhatakona, Tendudhar and Gomarda to investigate the phytosociological parameters to determine the distribution and diversity of herb species in the sanctuary. The maximum IVI indicated the greater distribution of species like *Oplismenus burmanni* (Retz.) P. Beauv. in Chantipali and Manjarmati, *Heteropogon contortus*(L.) P.Beauv. *ex* Roem. &Schult. in Bhatakona and Gomarda, *Scleriatessellata* Willd. in Tendudhar and the minimum IVI showed the scarce distribution of herbal species like *Cajanus scarabaeoides*(L.) Thouars, *Hemidesmus indicus* (L.) R.Br. and *Stylosantheshamata* (L.) Taub. in Chantipali, *Hemionitis tenuifolia* (Burm.*f.*) Christenh. in Manjarmati and Bhatakona, *Cissampelos pareira* L. in Tendudhar and Gomarda. The maximum value of herbal diversity (Shannon-Wiener index) was (3.36) in Manjarmati and minimum (1.31) in Chantipali. The study revealed the presence of 66 herb species belonging to 52 genera and 25 families.

***Keywords*:** Chhattisgarh, Diversity, Gomarda Wildlife sanctuary, Herbs, Phytosociology

Herbs are playing an important role in forest ecosystem and herbaceous floor vegetation show high nutrient content and rapid turnover rates as influenced by climatic conditions and vegetation characteristics (Chen et al., 2021). Herbs have interrelationship with plants growing in their vicinity. Assessing understorey vegetation is crucial for understanding ecological processes and interactions in forest ecosystems (Jhariya et al., 2013, Jhariya and Singh 2021). Herbaceous vegetation makes up ninety percent of plant species and up to twenty percent of foliar litter, but making up less than one percent of the forest's biomass. The herb layer plays a crucial role in forest formation despite fierce competition (Borah et al., 2021). The occurrence of species and their natural relationship is an important aspect of the community structure. Studies in sub-tropical regions have highlighted an entirely distinct pattern for vegetation distribution distinguished by altitude fluctuation (Almeida et al., 2020). Altitude and topography affect soil texture, physical and chemical qualities, influencing plant composition (Kermavnar and Kutnar 2020). Diversity of any region is a crucial ecological characteristic which has a strong correlation with existing environmental and anthropogenic influences. It not only indicates productivity but also represents the health of the vegetation. The loss and degradation of habitats reduce community diversity. However, field surveys provides an adequate information on vegetation structure (Ullah et al., 2024). This study aims to document the phytosociological characteristics of herbaceous vegetation in Gomarda Wildlife Sanctuary through site-specific sampling.

MATERIAL AND METHODS

Study site: Gomarda wildlife sanctuary lies between 21°30'24"N. latitude and 83°06'4"E. longitude. It covers an area of about 277.82 km^2 of forests in both Baramkela and Sarangarh forest ranges (Fig. 1). The land is gently undulating, with numerous rocks and boulders, incapable of cultivation, and hence naturally protected. In the summer season, the temperature varies from 29.5°C to 49 °C, while in the winter season, it drops 8°C to 25°C. The perennial Lath river flowing through the centre of the sanctuary is the main source of water. The vegetation is tropical mixed deciduous forest with sal (*Shorea robusta*), teak (*Tectona grandis*), bamboo (*Dendrocala musstrictus*), *terminalia* spp. and other species (FSI 2024).

Field sampling: The study was conducted during July 2022 to February 2023 at five different sites viz. Chantipali, Manjarmati, Bhatakona, Tendudhar and Gomarda within the core, buffer and transition zones. All the five sites were selected on the basis of different topology viz. slope, fold aspect, soil texture and soil structure for the study (Table 1). The sampling was carried out in all three seasons; rainy, winter and summer (Margalef, 1958). Circular quadrats of 354.4 cm circumference were laid at each study site randomly until three times new species stop being found (Odum 1971, Muller-Domboisand Ellenberg 1974) (Fig. 2).

Identification of collected samples: Identification and nomenclature of collected herbaceous plants was done by following The Flora of British India Vol. I-VII (Hooker, 1875-97); Flora of Madhya Pradesh Vol. I (Verma et al., 1993); Vol. II (Mudgal et al., 1997); Vol. III (Singh et al. 2001); Supplement to The Flora of Madhya Pradesh (Khanna et al., 2001); Floral Diversity of Chhattisgarh (Mishra and Naik, 2021); Biodiversity of Chhattisgarh: A Check List (Pandey et al., 2023) and Plants of the World Online (https://powo.science.kew.org) respectively. Plants that could not be assigned a species rank were considered morphospecies, which are morphologically identical and treated as a single species in later analyses (Linares-Palomino and Ponce-Alvarez 2009).

Data analysis: frequency, density and abundance were estimated (Mishra 1968) and used to compute relative density (RD) relative frequency (RF) and relative abundance (RA). The importance value index (IVI) for the herb species was determined as the sum of the relative frequency, relative density and relative abundance (Cottam and Curtis 1956, Mishra et al., 2012).

Relative frequency (RF) = (Frequency of a species /Total frequency of all the species) x 100.

Relative density (RD) = (Density of a species/Total density of all the species) x 100.

Relative abundance (RA) = (Abundance of a species/Total abundance of all the species) x 100.

Importance value index (ivi) = RF + RD + RA.

Species diversity: This was calculated for each forest type.

Shannon Weaver's diversity index- H' (Shannon and Weiner 1963).

$H' = -\Sigma [(ni/N) \ln (ni/N)]$

Simpson's index of dominance - D (Simpson 1949).

$D = \Sigma (ni/N)$,

Where, *ni* = Total number of individuals of species *i*

N = Total number of individuals of all species in that vegetation type.

Simpson's diversity index = 1- D (Simpson 1949).

RESULTS AND DISCUSSION

A total of 66 herb species were recorded from all the five sites belonging to 52 genera and 25 families. Poaceae was represented highest number of species (19), followed by Cyperaceae 7 species, Malvaceae 5 species, Asteraceae and Rubiaceae both 3 species, Convolvulaceae, Acanthaceae, Phyllanthaceae and Polygalaceae 2 species each, and remaining 16 families were represented by one species each. The maximum number of herb species (39) were recorded at the site Tendudhar followed by Manjarmati (33), Gomarda (32), Bhatakona (28) and minimum at Chantipali (24). The Importance value index (IVI) was highest at Chantipali, for *Oplismenus burmanni* (Retz.) P.Beauv. as 31.10 followed by *Heteropogon contortus* (L.) P.Beauv. *ex* Roem & Schult; while *Cajanus scarabaeoides* (L.) Thouars, *Hemidesmus indicus* (L.) R.Br. and *Setaria flavida* (Retz.) Veldkamp had showed the least IVI. At Manjarmati, the IVI was recorded highest for *Oplismenus burmanni* (Retz.) P.Beauv. as 23.64 followed by *Grona triflora* (L.) H.Ohashi & K.Ohashi as 22.51; while least IVI was recorded for

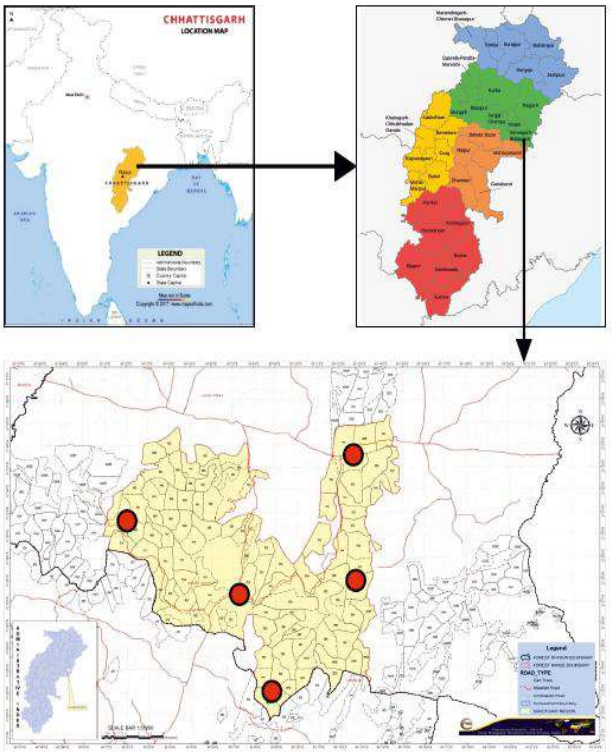

Fig. 1. Map showing location of Gomarda Wildlife Sanctuary and five sampling sites

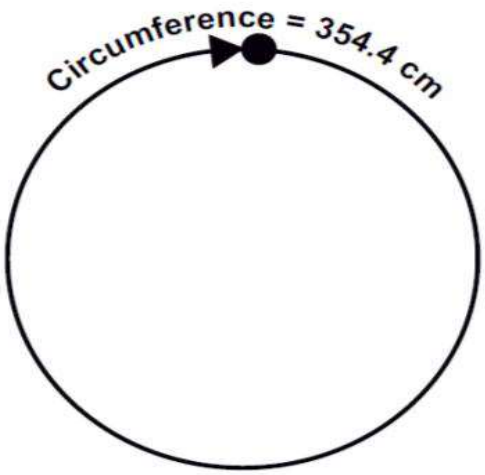

Fig. 2. Circular quadrate

Table 1. Phytosociological study of herbaceous layer in five different study sites of Gomarda Wildlife Sanctuary

Botanical name of the herbs	IVI				
	Chantipali	Manjarmati	Bhatakona	Tendudhar	Gomarda
Alloteropsis cimicina (L.) Stapf	4.44	13.95	15.41	6.96	6.76
Aristida adscensionis L.	14.74	7.70	12.63	11.22	8.09
Ayenia herbacea (Roxb.) ined.	-	-	6.42	-	3.76
Bonnaya ciliate (Colsm.) Spreng.	-	8.11	11.17	-	-
Bothriochloa pertusa (L.) A.Camus	10.64	-	-	-	-
Brachiaria ramosa (L.) Stapf	12.39	7.49	-	-	-
Cajanus scarabaeoides (L.) Thouars	2.95	-	-	3.83	6.84
Cenchrus americanus (L.) Morrone	14.23	12.13	-	-	-
Chrysopogon zizanioides (L.) Roberty	-	5.09	-	2.35	-
Cissampelos pareira L.	-	3.70	-	1.48	2.38
Cissus repanda (Wight &Arn.) Vahl	-	3.80	4.51	-	-
Crotalaria prostrata Rottler *ex* Willd.	-	-	5.45	-	3.74
Curculigo orchioides Gaertn.	-	4.74	-	5.56	-
Cyanthillium cinereum (L.) H.Rob.	-	7.10	-	-	-
Cynodon arcuatus J. Presl	18.01	13.55	18.69	14.27	
Cynodon radiatus Roth	-	-	-	-	21.70
Cyperus albescens (Steud.) Larridon & Govaerts	-	8.47	-	-	-
Cyperus alopecuroides Rottb.	-	10.56	8.49	-	-
Cyperus iria L.	-	9.00	-	11.07	12.80
Digitaria abludens (Roem. & Schult.) Veldkamp	15.99	8.11	19.32	-	14.91
Digitaria longiflora (Retz.) Pers.	11.29	-	-	-	4.53
Dioscorea bulbifera L.	-	4.73	2.98	-	5.74
Echinochloa colonum (L.) Link	15.34	12.15	-	8.05	-
Elephantopus scaber L.	9.03	8.56	-	10.29	8.15
Emilia sonchifolia (L.) DC.	10.54	-	-	-	-
Eragrostiella brachyphylla (Stapf) Bor	14.32	-	-	9.91	15.43
Eragrostiella nardoides (Trin.) Bor	-	-	-	4.54	7.60
Euphorbia hirta L.	-	5.35	9.44	-	-
Evolvulus alsinoides (L.) L.	7.51	-	-	5.25	6.53
Evolvulus nummularius (L.) L.	-	14.48	19.86	8.29	-
Fimbristylis alboviridis C.B.Clarke	-	-	8.69	-	10.70
Fimbristylis dichotoma (L.) Vahl	-	9.95	11.17	10.29	-
Grewia hirsuta Vahl	4.86	-	-	2.80	3.76
Grewia rothii DC.	-	-	2.98	1.48	-
Grona triflora (L.) H. Ohashi & K. Ohashi	15.15	22.51	15.63	11.73	19.06
Habenaria furcifera Lindl	-	-	-	5.92	-
Hemidesmus indicus (L.) R.Br.	2.95	-	5.45	3.84	-
Hemionitis tenuifolia (Burm.*f.*) Christenh.	-	2.48	3.66	-	-
Heteropogon contortus(L.) P.Beauv. *ex* Roem. & Schult.	24.52	17.69	31.58	16.13	23.29
Justicia glauca Rottler	-	3.39	5.56	4.54	-

Cont...

Table 1. Phytosociological study of herbaceous layer in five different study sites of Gomarda Wildlife Sanctuary

Botanical name of the herbs	IVI				
	Chantipali	Manjarmati	Bhatakona	Tendudhar	Gomarda
Mesosphaerum suaveolens (L.) Kuntze	-	-	9.99	-	11.80
Murdannia nudiflora (L.) Brenan	-	-	-	6.70	9.99
Oplismenus burmanni (Retz.) P.Beauv.	31.10	23.64	-	13.20	-
Phyllanthus niruri L.	-	6.83	13.95	-	-
Phyllanthus virgatus G.Forst.	-	-	7.66	7.12	-
Pigea enneasperma (L.) P.I.Forst.	9.77	-	7.31	-	12.17
Polygala arvensis Willd.	-	7.61	-	-	9.32
Polygala erioptera DC.	-	-	-	6.49	-
Rostellularia mollissima (Nees) Nees	-	-	-	-	3.76
Scleria terrestris (L.) Fassett	19.64	-	-	6.96	3.74
Scleria tessellata Willd.	-	-	-	24.24	-
Scleromitrion verticillatum (L.) R. J. Wang	-	7.10	-	5.22	-
Senna cobanensis (Britton) H. S. Irwin & Barneby	-	-	-	3.84	-
Senna tora (L.) Roxb.	5.78	-	-	-	4.53
Setaria flavida (Retz.) Veldkamp	21.90	10.87	14.85	9.73	5.40
Setaria pumila (Poir.) Roem. & Schult.	-	-	-	14.55	-
Sida acuta Burm.*f*.	-	5.44	11.95	-	-
Spermacoce hispida L.	-	6.83	11.20	5.88	13.78
Spermacoce pusilla Wall.	-	-	-	-	13.01
Sporobolus diandrus (Retz.) P.Beauv.	-	-	-	3.46	4.56
Striga densiflora (Benth.) Benth.	-	-	-	5.39	-
Stylosanthes hamata (L.) Taub.	2.95	-	4.00	9.05	-
Theriophonum minutum (Willd.) Baill.		-	-	5.22	4.53
Trichosanthes cucumerina L.	-	-	-	3.06	-
Triumfetta rhomboidea Jacq.	-	6.88	-	-	-
Urochloa ramosa (L.) T. Q. Nguyen	-	-	-	10.08	17.66

Hemionitis tenuifolia (Burm.*f*.) Christenh. as 2.48., The IVI at Bhatakona was highest for *Heteropogon contortus* (L.) P.Beauv. *ex* Roem. & Schult. as 31.58 followed by *Evolvulus nummularius* (L.) L. as 19.86; while *Hemionitis tenuifolia* (Burm.*f*.) Christenh. showed least IVI value as 3.66. At Tendudhar, the IVI was highest for *Scleria tessellata* Willd. as 24.24 followed by *Heteropogon contortus* (L.) P.Beauv. *ex* Roem. & Schult. while minimum was for *Cissampelos pareira* L. (1.48) at Gomarda. The highest IVI e was recorded for *Heteropogon contortus* (L.) P. Beauv. *Ex* Roem. & Schult)(23.29) followed by *Cynodon radiatus* Roth as while *Cissampelos pareira* L. showed the least IVI as 2.38 (Table 2).

The maximum diversity of herbaceous layer (Shannon Weaver's diversity index- H') was 3.36 for the site Manjarmati and minimum was 1.31 for Chantipali (Fig. 3). In different habitats of Pench Tiger Reserve, Madhya Pradesh and Similipal Tiger Reserve, Odisha, the H' ranged from 1.78 to 3.05 and 1.78 to 3.12 respectively ,reflecting slightly moderate diversity as compared to this study (Singh et al., 2014, Chourasia et al., 2016). The highest value of dominance (Simpson's index of dominance - D) was 0.055 for site Chantipali and lowest value 0.035 for Tendudhar (Fig. 3). Similar trend was observed in various communities and regions of Mudumalai Wildlife Sanctuary, Tamil Nadu and Periyar Tiger Reserve, Kerala (Sundarapandian and Swamy 2010, Murali et al., 2013) The maximum diversity of herbs (Simpson's index of diversity- 1- D) was 0.965 for site Tendudhar and minimum 0.945 for Chantipali (Fig. 3). These value indicated the structure of the herbaceous layer from greater to moderate distribution in the study area. The recorded information on

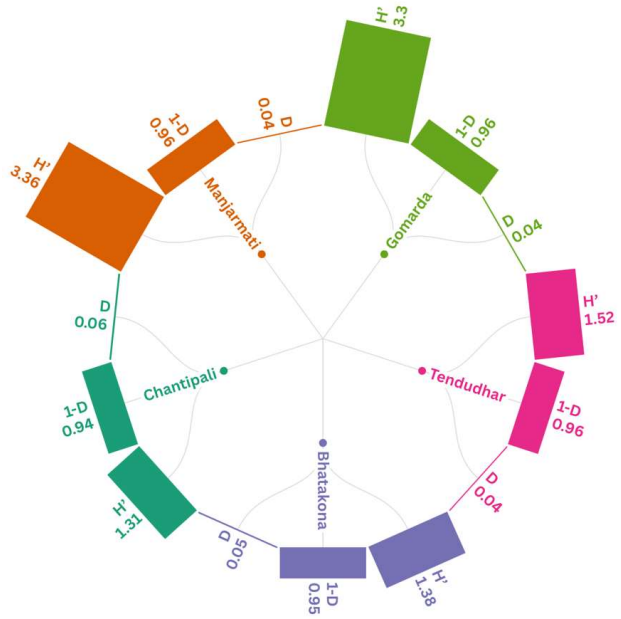

Fig. 3. Different diversity indices of herbaceous layer in five different study sites of Gomarda wildlife sanctuary

the diversity of the communities provides a better insight into the status of the forests in the Gomarda Wildlife Sanctuary.

CONCLUSION

Recurrent forest fires and illegal resource extraction threatens Gomarda wildlife sanctuary's natural cycle and biodiversity. Herbs play an important role in forest structure and diversity, demonstrating the sanctuary's ecological value. Strict fire control methods, enforcement against exploitation, and long-term livelihood prospects for people are vital. Conservation efforts should prioritize research collaborations, biodiversity assessments, and awareness campaigns. Long-term protection necessitates an Integrated Forest Management Plan that includes conservation funds and legislative support to preserve the sanctuary's ecological survival.

ACKNOWLEDGEMENT

The authors cordially acknowledge the PCCF (Wildlife) Chhattisgarh for supporting this research.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest regarding the publication of this article. The research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Received 06 January, 2025; Accepted 28 March, 2025

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