Journal of Medicinal Plants Studies
www.PlantsJournal.com

ISSN (E): 2320-3862
ISSN (P): 2394-0530
https://www.plantsjournal.com
JMPS 2023; 11(5): 125-128

Received: 03-08-2023
Accepted: 04-09-2023

Ram Gopal Singh
Research Scholar, Department of Botany, S.G.S. Government P.G. College, Sidhi, Madhya Pradesh, India

Awadh Raj Singh
Professor, Department of Botany, S.G.S. Government P.G. College, Sidhi, Madhya Pradesh, India

Corresponding Author:
Ram Gopal Singh
Research Scholar, Department of Botany, S.G.S. Government P.G. College, Sidhi, Madhya Pradesh, India

Ecological exploration of Bagdara forest of Singrauli District (M.P.)

Ram Gopal Singh and Awadh Raj Singh

Abstract
The present study was conducted in the Bagdara forest of Singrauli district to explore its ecological inventories. Random stratified sampling was adopted to collect the basic information like frequency, density and abundance for the calculation of importance value index (IVI). On the basis of principal component analysis (PCA) plot, three forest communities were identified and named as, Syzygium Lowland Forest (SLF), Shorea Miscellaneous Forest (SMF) and Mallotus Miscellaneous Forest (MMF). MMF community allowed the maximum 39 while SLF minimum 18 tree species growing in it. Conversely, SMF community showed higher heterogeneous tree diversity validated by lower Dominance index (0.085) and higher Simpson index (0.909). The values of these two indices were found very low in comparison with their range for tropical forests of India. On the other hand the diversity indices (Shannon & Fisher alpha) was calculated as maximum (2.794 & 11.958 respectively) for MMF community, which indicates the existence of better tree diversity in this forest community. The higher values of Evenness & Equitability indices (0.645 & 0.859 respectively) for SMF community showed the more evenly distribution of tree species in this community.

Keywords: Tree, phytosociology, Bagdara forest, Singrauli district

Introduction
The phyto diversity of an area can be easily evaluated by two ways, floristic assessment and ecological exploration. In most of the cases, the floristic approach only deals with the qualitative assessment of the plant wealth of an area to know how many kinds of plants existing there. Conversely, the ecological exploration measure / quantify the phyto diversity via frequency, density, abundance, importance value index (IVI), different diversity indices etc. This quantitative information from a habitat is very useful for studying the temporal succession of plants in that particular location (Bajpai *et al.*, 2015a) [1]. To determine this, numbers of studies from the different parts of the world (Campbell *et al.*, 1986; Mooney and O'Connell, 1990; Campbell *et al.*, 1992; Perkins *et al.*, 1999; Sambare *et al.*, 2011; Nowak *et al.*, 2017) [2, 3, 4, 5, 6, 7] as well as from India (Singh and Singh, 1991; Sagar *et al.*, 2003; Choubey and Shukla, 2006; Awasthi *et al.* 2007; Tripathi and Singh, 2009; Bajpai *et al.*, 2012a; Sarkar and Devi, 2014; Sarkar *et al.*, 2017 and Pandey, 2018) [8, 9, 10, 11, 12, 13, 14, 15, 16] have been conducted.
As far as India is concerned, most of the ecological studies come from the peninsular India. Only some scattered information (also not from all the forest areas) is available from rest of the area.

Materials and Methods
Study site
Bagdara wild life sanctuary was established in the year 1978. Bagdara sanctuary is located in the Singrauli district of Madhya Pradesh. It lies on latitude N 24°30'-N24°42' and longitude E82°20'-E82°42'
There is a Bagdara revenue village inside the sanctuary and also Bagdara Kalan revenue village in the southern periphery of the sanctuary previously, this area had lot of tigers. So the name 'Bagdara' has been derived from Bag = Tiger, Dhara = Earth *viz.*, the homeland of the tiger. It was a famous shooting block of Rewa State.
Total geographical area of the sanctuary is 478 sq. km. The protected forest area is 231.047 sq.km. And rest 248.953 sq. km. is the revenue area there is no reserve forest area in the sanctuary.

Data Collection and Analysis

Random stratified sampling (Greig-Smith 1983; Krebs, 1989) [17, 18] was adopted to collect the ecological data. Quadrates of 20 × 20 m were plotted to collect the basic information required for the calculation of frequency, density and abundance (Curtis and McIntosh, 1950) [19]. Data were collected only for the tree species (CBH ≥20 cm) (Bajpai *et al.*, 2015a) [1]. Relative values of frequency, density and abundance were used to calculate the Importance Value Index (IVI) for tree species in every quadrate. This IVI data was further used to re-congregate the quadrates to know the possible forest communities of the forests with the help of principal component analysis (PCA) using multivar option in PAST version 2.12 (Jongman *et al.*, 1995; Bajpai *et al.*, 2012a) [20, 13]. Different alpha diversity indices (Simpson, 1949; Cottam and Curtis, 1956; Ter Braak and Prentice, 1988) [21, 23] were also computed for the better understanding of forests of the study area.

Results and Discussion

The scattered graph of principal component analysis (PCA) clearly indicated that the forest of the study area can be congregated into three forests communities (Figure 1). On the basis of their representing tree species as well as habitat, these communities were named as, Syzygium Lowland Forest (SLF), Shorea Miscellaneous Forest (SMF) and Mallotus Miscellaneous Forest (MMF). In SLF the dominating tree is the *Syzygium cumini* (L.) Skeels with IVI of 154.92, followed by *Barringtonia acutangula* (L.) Gaertn. (32.02), *Mallotus philippensis* (Lam.) Müll. Arg. (28.34) and *Streblus asper* Lour. (25.12), thus named as same (Table 1). *Shorea robusta* Gaertn. (66.85), *Syzygium cumini* (L.) Skeels (38.26) and *Mallotus philippensis* (Lam.) Müll. Arg. (37.88) are the dominating trees of SMF; while the MMF community is dominated by *Mallotus philippensis* (Lam.) Müll. Arg. (37.88), *Syzygium cumini* (L.) Skeels (38.26), *Terminalia elliptica* Willd. (37.06) and *Bridelia retusa* (L.) A. Juss. (31.18).

The result of PCA claimed the existence of three forest communities in the study site *i.e.* Syzygium Lowland Forest (SLF), Shorea Miscellaneous Forest (SMF) and Mallotus Miscellaneous Forest (MMF). Similar kind of forests communities were also reported by other workers from the Terai eco-region (Tripathi and Singh, 2009; Bajpai *et al.*, 2012a; Bajpai *et al.*, 2015a) [12, 13, 1]. The first three dominant species (*Syzygium cumini* (L.) Skeels, *Barringtonia acutangula* (L.) Gaertn. And *Mallotus philippensis* (Lam.) Müll. Arg.) Of SLF community were moisture loving and the characteristic species of lowlands. The quadrates coming in this forest community were usually located near the Bagdara River, which also supports its above said nature of habitat. The SMF community was the residue of old natural Shorea (Sal) forest of the Terai eco-region. Although, the composition of this forest community has been changed with the time because of anthropogenic activities (Bajpai *et al.*, 2012b) [24]; but *Shorea robusta* Gaertn. is still a dominating tree in this community of the study site as well as in the several other forest patches of the Terai eco-region (Bajpai *et al.*, 2012a) [13]. One thing is very interesting to report from SMF, is the presence of *Syzygium cumini* (L.) Skeels as the second most dominating tree species in this community. It is remarkable, because the presence of this expansionist species may become a thread for the seedlings of *Shorea robusta* Gaertn. The MMF community is the patch of forest where the loss of natural *Shorea robusta* Gaertn. (Sal) was maximum due to deforestation of these trees for their valuable timber wood and now this opportunity (presence of more open space) is grasped by *Mallotus philippensis* (Lam.) Müll. Arg. and *Syzygium cumini* (L.) Skeels by increasing their population in this area.

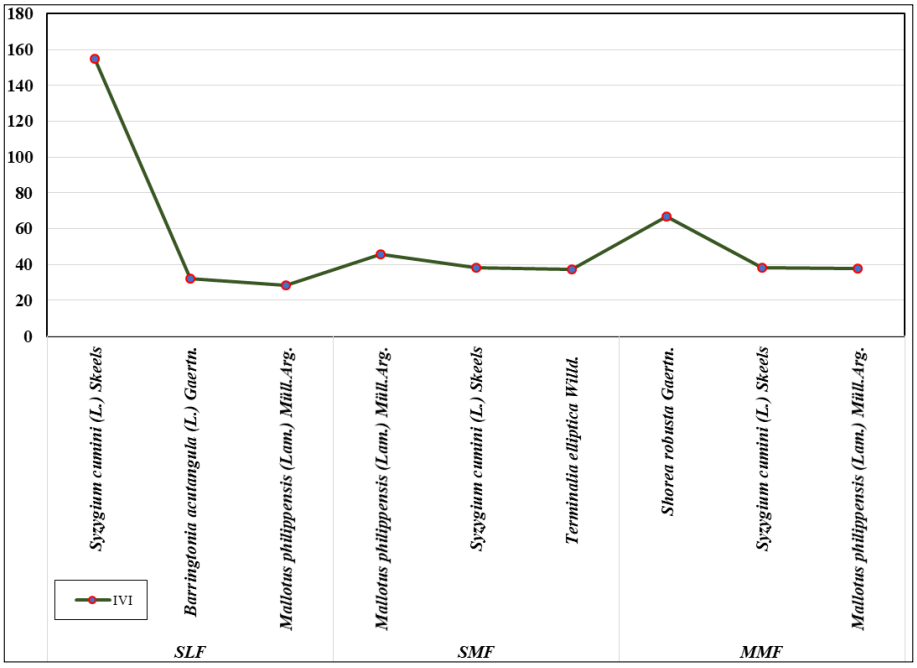

Fig 1: Graph analysis of top three IVI of tree species in three forest communities in Bagdara forest

When we see the overall inventory of the encountered forest communities, it results that the MMF community bears maximum 39 tree species, while the SLF community only 18 species (Table 2). The maximum number of site specific species was maintained by MMF (18) followed by SMF (2) and SLF (1). Twelve tree species were found common in all the three communities; 14 species were shared by SMF & SLF, 16 by SLF & MMF and maximum 20 by MMF & SMF. When we talk about different indices (Table 2), Dominance index was computed maximum for SLF (0.302), whereas

minimum for SMF (0.085); Simpson index was maximum for SMF (0.909), while minimum for SLF (0.701); Shannon & Fisher alpha indices maximum for MMF (2.794 & 11.958 respectively), however minimum for SLF (1.779 & 4.204 respectively); Evenness & Equitability indices were calculated maximum for SMF (0.645 & 0.859 respectively), but minimum for SLF (0.329 & 0.616 respectively).

Although, the maximum number of trees (39) and site-specific species (18) in MMF but the SMF community shows the higher heterogeneous tree diversity because of lower Dominance index (0.085) and higher Simpson index (0.909). The values of these two indices are very low in comparison with the range for tropical forest of India (0.21-0.97 for Dominance and 0.83-4.15 for Simpson index) (Tripathi and Singh, 2009; Bajpai *et al.*, 2012a; Sarkar and Devi, 2014; Bajpai *et al.*, 2015a) [12, 13, 14, 1]. These lesser values of Dominance and Simpson indices are very worrisome for the sustainability of the forest as it indicates the poor heterogeneous tree flora of the site. The presence of maximum Shannon & Fisher alpha indices for MMF (2.794 & 11.958 respectively) indicates the presence of better species diversity in comparison with the other two forest communities of the study site. The value of Shannon diversity index is within the range (0.83- 4.10) reported for Indian tropics (Visalakshi, 1995 and Bajpai *et al.*, 2015a) [25, 1]. The maximum values of Evenness & Equitability indices (0.645 & 0.859 respectively) for SMF reveal that the species are more evenly distributed in this community.

Table 1: Importance value index (IVI) of tree species in three forest communities in Bagdara forest (SLF-Syzygium Lowland Forest, SMF-Shorea Miscellaneous Forest and MMF- Mallotus Miscellaneous Forest)

S. No.	Tree species	SLF	SMF	MMF
1.	*Acacia nilotica* (L.) Delile	0.81	0.00	0.00
2.	*Aegle marmelos* (L.) Corrêa	8.64	11.35	15.97
3.	*Artocarpus lacucha* Buch.-Ham.	0.00	0.00	0.68
4.	*Azadirachta indica* A. Juss.	0.00	0.83	2.36
5.	*Barringtonia acutangula* (L.) Gaertn.	32.02	10.35	6.59
6.	*Bauhinia variegata* L.	0.00	0.00	0.69
7.	*Bridelia retusa* (L.) A. Juss.	0.00	31.18	5.41
8.	*Cordia dichotoma* G. Forst.	0.00	0.00	1.52
9.	*Eucalyptus regnans* F. Muell.	0.00	4.75	1.57
10.	*Ficus benghalensis* L.	6.30	10.66	14.78
11.	*Ficus hispida* L. f.	0.00	0.00	0.61
12.	*Ficus palmata* subsp. *virgata* Browicz	0.88	0.00	1.43
13.	*Ficus racemosa* L.	2.67	1.87	5.80
14.	*Ficus religiosa* L.	4.01	15.46	0.00
15.	*Flacourtia indica* (Burm. f.) Merr.	0.00	0.00	2.46
16.	*Haldina cordifolia* (Roxb.) Ridsdale	0.00	0.00	1.17
17.	*Holarrhena pubescens* Wall. ex G. Don	0.00	0.00	0.72
18.	*Hymenodictyon orixense* (Roxb.) Mabb.	0.00	0.00	1.71
19.	*Lagerstroemia speciosa* (L.) Pers.	0.00	2.19	2.60
20.	*Lannea coromandelica* (Houtt.) Merr.	1.93	9.10	4.45
21.	*Litsea monopetala* (Roxb.) Pers.	16.79	6.13	11.36
22.	*Madhuca indica* J. F. Gmel.	0.00	3.02	12.75
23.	*Mallotus nudiflorus* (L.) Kulju & Welzen	5.24	4.29	3.17
24.	*Mallotus philippensis* (Lam.) Müll. Arg.	28.34	45.52	37.88
25.	*Mangifera indica* L.	0.00	1.32	0.65
26.	*Melia azedarach* L.	0.00	0.00	1.33
27.	*Miliusa tomentosa* (Roxb.) J. Sinclair	0.00	0.00	2.76
28.	*Mitragyna parvifolia* (Roxb.) Korth	1.75	0.00	0.000
29.	*Phyllanthus emblica* L.	0.00	0.00	2.73
30.	*Pongamia pinnata* (L.) Pierre	0.95	0.00	2.79
31.	*Pterocarpus marsupium* Roxb.	0.00	0.00	2.95
32.	*Randia dumetorum* (Retz.) Lam.	0.00	0.00	0.80
33.	*Saraca asoca* (Roxb.) Willd.	0.00	0.00	0.75
34.	*Semecarpus anacardium* L. f.	0.00	0.00	0.80
35.	*Shorea robusta* Gaertn.	3.62	24.16	66.85
36.	*Streblus asper* Lour	25.12	21.78	13.49
37.	*Syzygium cumini* (L.) Skeels	154.92	38.16	38.26
38.	*Tectona grandis* L. f.	1.60	14.06	17.85
39.	*Terminalia arjuna* (Roxb. ex DC.) Wight & Arn.	0.00	0.00	2.99
40.	*Terminalia bellirica* (Gaertn.) Roxb.	0.00	4.83	0.00
41.	*Terminalia chebula* Retz.	0.00	0.00	1.44
42.	*Terminalia elliptica* Willd.	0.00	37.06	2.25
43.	*Ziziphus mauritiana* Lamk.	4.12	1.74	2.98

Table 2: Inventory details of forest communities of Bagdara forest (SLF- Syzygium Lowland Forest, SMF-Shorea Miscellaneous Forest and MMF- Mallotus Miscellane

S. No.	Name of plant species	SLF	SMF	MMF
1.	Number of species	18	22	39
2.	Site Specific species	2	1	18
3.	Dominance D	0.302	0.085	0.101
4.	Simpson 1-D	0.609	0.909	0.899
5.	Shannon H	1.779	2.654	2.794
6.	Fisher alpha	4.204	5.469	11.958
7.	Evenness e^H/S	0.329	0.645	0.420
8.	Equitability J	0.616	0.859	0.763

Conclusion

The study quantitatively explores the ecology of Bagdara forest situated Singrauli district (M.P.) and concluded the occurrence of three forest communities (*i.e.* Syzygium Lowland Forest, Shorea Miscellaneous Forest and Mallotus Miscellaneous Forest) in it. The IVI data of these forest communities clearly indicate that the *Syzygium cumini* (L.) Skeels is acting as expansionist species and expanding its area of occupancy; whereas, *Shorea robusta* Gaertn. Is struggling to safeguard its current population size. The Dominance and Simpson indices are very low in comparison with the available range for the tropical forest of India. It is a serious issue regarding the health as well as sustainability of the forest, accordingly here we are suggesting immediate short-term conservation programmes followed by long term programmes for the betterment of the forest dynamics.

Acknowledgements

Authors are thankful to forest Deptt. Of Singrauli district and local resident who permitted to carried out this work.

References

1. Bajpai O, Kushwaha AK, Srivastava AK, Pandey J, Chaudhary LB. Phytosociological status of a monotypic genus Indopiptadenia: A near threatened tree from the Terai-Bhabar region of central Himalaya. Research Journal of Forestry. 2015a;9:35-47.
2. Campbell DG, Daly DC, Prance GT, Maciel UN. Quantitative ecological inventory of Terra firma and the Varzea tropical forest on the Rio Xingu, Brazilian Amazon. Brittanica. 1986;38:369-393.
3. Mooney E. O'Connell. The Phytosociology and Ecology of the Aquatic and Wetland Plant Communities of the Lower Corrib Basin, County Galway. Proceedings of the Royal Irish Academy. Section B: Biological, Geological, and Chemical Science. 1990;90B:57-97.
4. Campbell DG, Stone JL, Rosas AJ. A comparison of the phytosociology and dynamics of three floodplain (Várzea) forests of known ages, Rio Juruá, western Brazilian Amazon. Botanical Journal of the Linnean Society. 1992;108.3:213-237.
5. Perkins L, Bredenkamp GJ, Grange JE. The phytosociology of the incised river valleys and dry upland savanna of southern KwaZulu-Natal. South African Journal of Botany. 1999;65.5-6:321-330.
6. Sambare O, Bognounou F, Wittig R, Thiombiano A. Woody species composition, diversity and structure of riparian forests of four watercourses types in Burkina Faso. Journal of Forestry Research. 2011;22:145-158.
7. Nowak A, Nobis M, Nowak S, Gębala M, Nobis A. Phytosociology and ecology of deciduous forests in Tajikistan (Middle Asia). Phytocoenologia. 2017;47:67-94.
8. Singh L, Singh JS. Species structure, dry matter dynamics and carbon flux of a dry tropical forest in India. Annals of Botany. 1991;68:263-273.
9. Sagar R, Raghubanshi AS, Singh JS. Tree species composition, dispersion and diversity along a disturbance gradient in a dry tropical forest region of India. Forest Ecology and Management. 2003;186:61-71.
10. Choubey OP, Shukla PK. Phytodiversity vis-a-vis biotic pressure in Achanakmar Wild life Sanctuary. J Trop. Forest. 2006;22(1&2):59-69.
11. Awasthi AK, Dwivedi A, Tripathi KK, Singh P. Assessing floral diversity of Bandhavgarh National Park: A phytosociological approach. J Trop. Forest. 2007;23(1&2):63-76.
12. Tripathi KP, Singh B. Species diversity and vegetation structure across various strata in natural and plantation forests in Katerniaghat Wildlife Sanctuary, North India. Tropical Ecology. 2009;50:191-200.
13. Bajpai O, Kumar A, Mishra AK, Sahu N, Pandey J, Behera SK, *et al*. Recongregation of tree species of Katerniaghat wildlife sanctuary, Uttar Pradesh, India. Journal of Biodiversity & Environmental Sciences. 2012a;2:24-40.
14. Sarkar M, Devi A. Assessment of diversity, population structure and regeneration status of tree species in Hollongapar Gibbon Wildlife Sanctuary, Assam, Northeast India. Tropical Plant Research. 2014;1.2:26-36.
15. Sarkar AK, Dey M, Mazumder M. A comparative study of tree species composition of Panjhora forest beat and Sipchu forest beat of Chalsa forest range, West Bengal, India. Journal of Applied Biology & Biotechnology. 2017;5.2:045-052.
16. Pandey R. Ecological diversity of certain herbs of Rewa district Madhya Pradesh. Int. J Bot. Stud. 2018;3(1):33-38.
17. Greig-Smith P. Quantitative plant ecology, 3rd edition. Blackwell, London; c1983.
18. Krebs CJ. Ecological Methodology. 2nd edition. Harper and Row, New York, USA; c1989.
19. Curtis JT, McIntosh RP. The interrelations of certain analytic and synthetic phytosociological characters. Ecology. 1950;31:434-455.
20. Jongman RH, Ter Braak CJF, Van Tongeren OFR. Data Analysis in Community and Landscape Ecology. Cambridge University Press, Cambridge, UK; c1995.
21. Simpson EH. Measurement of diversity. Nature. 1949;163:688-688.
22. Cottam G, Curtis JT. The use of distance measures in phytosociological sampling. Ecology. 1956;37:451-460.
23. Ter Braak CJF, Prentice ICV. A theory of gradient analysis. Advances in Ecological Research. 1988;18:271-313.
24. Bajpai O, Kumar A, Mishra AK, Sahu N, Behera SK, Chaudhary LB, *et al*. Phenological study of two dominant tree species in tropical moist deciduous forest from the

Northern India. International Journal of Botany. 2012b;8.2:66-72.
25. Visalakshi N. Vegetation analysis of two tropical dry evergreen forests in southern India. Tropical Ecology. 1995;36:117-127.