ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 8.4
IJAR 2023; SP4: 133-135

Sahil Ahuja
D.P.G Degree College, Near Hero Honda, Behind Marble Market, Sector 72A, Sector 34, Gurugram, Haryana

Nidhi Jain
Assistant Professor, Department of Botany, D.P.G Degree College, Near Hero Honda, Behind Marble Market, Sector 72A, Sector 34, Gurugram, Haryana

Correspondence
Nidhi Jain
Assistant Professor, Department of Botany, D.P.G Degree College, Near Hero Honda, Behind Marble Market. Sector 72A, Sector 34, Gurugram, Haryana

(*Special Issue*)
"National Conference on Multidisciplinary research for sustainable development"

Plant-sociological analysis including diversity, dominance and biomass estimation of trees species of Kamla Nehru Ridge, New Delhi, India

Sahil Ahuja and Nidhi Jain

Abstract
The interaction between biodiversity and the physical environment is the foundation of sustainable development. The world's forests cover more than 4 billion hectares, or 31% of the total land area, or 0.6 hectares per person. Indian tropical forests, which are mostly deciduous, are poorly understood in terms of plant diversity, plant sociology, and quantification systems. Delhi's ridge forests are of great interest for biodiversity management in the city. Plant diversity inventories form the basis for other forest management research and initiatives. The North Delhi Ridge, also known as the Kamla Nehru Ridge, is located in the current study area of Delhi, India. This is one of the key areas of biodiversity richness in Delhi to assess the plant sociological characteristics of tree species from sample inventories. The study found an average tree density of 322 trees/ha in the northern ridge forest. The forest is home to many rare and endangered plant species such as *Acacia catechu*, *Chlorophytum borivilianum* and *Marotas philippensis*. Plant community dispersal patterns in the Kamla Nehru Ridge are influenced by many factors, including soil type, topography, and climatic conditions. Ridges have multiple microhabitats that support a variety of plant communities, ranging from dry deciduous forests to thorny scrublands.

Keywords: Sustainable development, north Delhi ridge, plant sociological characteristics

Introduction
The study of social interactions and the organization of species in communities is called vegetation ecology (Wildi, O., 2017) [1]. Such studies are a source of information on community organization, niche resource distribution, species diversity, and species turnover in ecosystems.

Plant sociology is the study of quantifying forest vegetation, classifying and describing vegetation patterns, and predicting their future distribution patterns Blasi, C., and R. Frondoni., 2011) [2].

Plant sociological analysis is important for ecological studies of forests, with an emphasis on structure and function. Proper monitoring and management are required to maintain tree species and habitat diversity. These aspects are very important to the direct inheritance process. Tree species inventories are useful tools for providing information on forest diversity and maximizing biodiversity conservation.

Materials and Methods Research Fields
North Delhi Ridge, also known as Kamla Nehru Ridge, is an 87-hectare forest area near Delhi University. Because of its ridge, it is geographically called Ridge. The North Ridge of Delhi lies between 28°41'36.03" to 28°40'3.71" north latitude and 77°12'39.42"E to 77°13'1.87"E longitude(Mann, M., & Sehrawat, S., 2009) [3]. Northridge is one of Delhi's Four Ridge Forests, part of the Aravalli Hill Range. The climate in this area is semi-arid with low rainfall (66.6 cm per year), but there is significant rainfall during the monsoon season.

North Ridge vegetation is of the soft, horny, scrub type, similar to arid and semi-arid areas. The area falls under the category of boreal tropical thorn forest forest type (Mohan, M., 2000) [4]. Along with other native species such as *Prosopis cineraria, Acacia nilotica, Salvadora oleoides, Acacia nilotica* and *Acacia leucophloea, Prosopis juliflora* forms the dominant tree species in the region.

Sampling method

After a brief survey of the study site, a random sampling method sampling a forest area was selected for the study. A random sampling method was used to randomize the squares to obtain unbiased forest data. There are random squares of 10 x 10 meters, each covering one area (About 100-meter squares each). Community analysis was performed while maintaining a total area of the forest site using the quadrat method of sampling (Bormann, Frederick Herbert, 1953) [5].

Phytosociological analysis

Quantitative analysis was performed on trees. Surrounding trees greater than 31.4 cm at chest height (1.37 m above ground) were considered trees. For all tree species he calculated density, frequency, basal area, abundance and dominance, and from their relative values he calculated the Importance Value Index (IVI) (Woldemichael LK *et al*., 2010) [7]. The Importance Value Index Chart and Photograph were created to understand the sociology of forests. Community analysis was performed using the following formula for tree species:

- Tree density = total number of trees per hectare
- Density = (number of individuals in all square species /
- total square examined)
- Relative Density (%) = (total number of individuals of one species in all squares / all individuals of all species in all squares) X100
- Frequency = (all squares where seeds occur / all squares examined)
- Relative frequency (%) = (all squares where species occurred / all squares examined) x 100
- Relative Dominance (%) = (total floor area of species / total square floor area of all species examined) x 100
- Abundance = (number of individuals of a species in all squares / total number of squares in which the species appeared)
- Relative abundance (%) = (species abundance per square / sum of frequency values for all species) x 100 (Kumar, Ravi, *et al*., 2021) [6]."
- Importance Value Index (IVI) = Relative Density + Relative Frequency + Relative Dominance
- Basal Area (cm square) = πr^2 r is radius of tree form canopy base height Various formulas used in various diversity studies

Diversity Index	Formula	Denotations
Margalef index of species richness	$SR = S - \frac{1}{\ln(N)}$	S = Number of species N = total number of individuals.
Menhinick's index of species richness	$MeI = \frac{S}{\sqrt{N}}$	S= number of species. N= total number of individuals.
Shannon-Wiener diversity index	$H' = -\sum \frac{ni}{n} * \ln\left(\frac{ni}{n}\right)$	ni = the IVI value of a species. n = sum of total IVI values of all species
Simpson's concentration of dominance	$Cd = \sum \left(\frac{ni}{n}\right)^2$	ni = the IVI value of a species. n = sum of total IVI values of all species
Simpson's diversity index	$D = 1 - Cd$	Cd = Simpson's concentration of dominance
Pielou's Evenness index	$J = -\frac{Cd}{\ln n}$	H′=Shannon-Wiener information index n = sum of total IVI values of all species

Plant Sociology Results and Considerations

Table 1: Showing values for plant sociological parameters

S No.	Tree Specie	ni/n	ln (ni/n)	(ni/n)* (ln (ni/n))	((ni/n)^2)*0.001
1	*Acacia leucophloea*	0.0147	-4.21	-0.062	0.216
2	*Aegle marmelos*	0.011	-4.5	-0.0405	0.121
3	*Bauhinia variegata*	0.0227	-3.78	-0.085	0.515
4	*Ceiba speciosa*	0.0241	-3.72	-0.089	0.58
5	*Cassia fistula*	0.036	-3.32	-0.099	1.296
6	*Dryopteris roxburghii*	0.1271	-2.06	-0.262	16.15
7	*Ehretia laevis*	0.1497	-1.89	-0.275	22.41
8	*Limnia sp.*	0.011	-4.5	-0.049	0.121
9	*Morus alba*	0.043	-3.14	-0.135	1.849
10	*Morus rubra*	0.063	-2.76	-0.174	3.969
11	*Prosopis juliflora*	0.249	-1.39	-0.346	82.001
12	*Pongamia pinnata*	0.013	-2.62	-0.191	5.329
13	*Pterospermum sp.*	0.022	-3.82	-0.084	0.484
14	*Pithecellobium*	0.0241	-3.73	-0.089	0.58

15	*Senna sianea*	0.011	-4.51	-0.049	0.121
16	*Thevetia peruviana*	0.056	-2.88	-0.161	3.136
17	*Wrightia lindina*	0.068	-2.69	-0.183	4.624
18	*Crateva sp.*	0.012	-4.42	-0.053	0.144

Highest value of IVI (Dhaulkhandi, Manoj, *et al*., 2008) [8] i.e. 74.188refers to the dominant specie *Prosopis julifera* whereas the lowest IVI i.e.3.217 refers to the rare species of *Limonia.*

The Abundance/Frequency of all the species is less than 0.05 except *Morus rubra* i.e.0.032

Table 2: Raunkier's frequency distribution

Frequency Class	Frequency Range	Number of Species	Percentage
A	1%-20%	13	72.20%
B	21%-40%	4	22.2%
C	41%-60%	1	5.5%
D	61%-80%	-	-
E	81%-100%	-	-

Total species richness=18;
Shanon-Weiner Index=2.474;
Simpson's Index=0.1039;
Simpson's Index of Diversity=0.8961;
Margalif's Richness=8.667;
Pielov's Index=0.855.

Discussion

The importance value index tells about the dominance of species in a given per ecosystem. *Prosopis juliflora* is the most dominant species having IVI =74.188 because of the greater basal area. Co-dominant species *Eretria laevis* is having the second highest IVI=44.48 due to high relative density and frequency as predominant factors, while the other species are considered as sub-species or rare species.

The abundance/Frequency ratio tells the distribution pattern of an ecosystem. Here all the species have observed value to be less than 0.05 except *Morus rubra*i.e.0.032, considered as randomly distributed in the ecosystem.

Clumping up of species is observed due to the biased observation from randomization but in nature, there is no bias.

Shanon-Weiner Index, 2.774>1 this indicates that the specie diversity is very high. Simpson's Index usually ranges from 0 to1 and as the value came out to be 0.1039 which is closer to 0, representing that dominance is less indicating greater specie diversity. (Garg *et al*., 2022) [9]

The value of species diversity is very high as the value of Simpson's Index of Diversity is 0.8961 which is closer to 1

Margalif's Richness being 8.667 indicates higher species richness.

References

1. Wildi O. Data analysis in vegetation ecology. Cabi; c2017.
2. Blasi C, Frondoni R. Modern perspectives for plant sociology: The case of ecological land classification and the ecoregions of Italy. Plant Biosystems-An International Journal Dealing with all Aspects of Plant Biology. 2011;145(sup1):30-37.
3. Mann M, Sehrawat S. A city with a view: the afforestation of the Delhi Ridge, 1883–1913. Modern Asian Studies. 2009;43(2):543-570.
4. Mohan M. Climate change: evaluation of ecological restoration of delhi ridge using remote sensing and GIS technologies. International Archives of Photogrammetry and Remote Sensing. 2000;33(B7/2; PART 7):886-894.
5. Bormann, Frederick Herbert. The statistical efficiency of sample plot size and shape in forest ecology. Ecology. 1953;34(3):474-487.
6. Kumar, Ravi, *et al*. Phytosociology and Diversity Assessment of tree species of Northern Delhi Ridge Forest; c2021.
7. Woldemichael LK, Bekele T, Nemomissa S. Vegetation composition in Hugumbirda-Gratkhassu national forest priority area, South Tigray. Momona Ethiopian Journal of Science. 2010;2(2):27-48.
8. Dhaulkhandi, Manoj, *et al*. Community structure and regeneration potential of natural forest site in Gangotri, India. Journal of Basic and Applied sciences. 2008;4(1):49-52.
9. Garg, Shriya, Rajendra Kr Joshi, Satish Chandra Garkoti. Effect of tree canopy on herbaceous vegetation and soil characteristics in semi-arid forests of the Aravalli hills. Arid Land Research and Management. 2022;36(2):224-242.