

Phytosociological Studies on Tree Vegetation of Jakhu Hill, Shimla, Himachal Pradesh

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ABSTRACT

Phytosociological studies are an important parameter to understand the population structure and to estimate the species richness existing in the study area. The Jakhu hill exhibits a wide range of plant diversity, the North Eastern aspect of the hill portrays dense cover of Cedrus deodara, and Cupressus torulosa and as we elevate higher to the hill dense cover of Quercus leucotrichophora and Rhododendron arboretum is observed. The North western aspect of the hill shows dense forest of Quercus Leucotrichophora, Ilex dipyrrena, Rhododendron arboreum, cedrus deodara and a few tree of Aesculus indica. The South Eastern region along with South Western aspect of the jakhu hill exhibited different tree species like Cedrus deodara, Quercus leucotrichophora, Rhododendron Arboreum and Cupressus torulosa, and Pinus wallicinana. On the basis of importance Value index (IVI), the major tree species that dominated the area is Cedrus deodara, along with Quercus leucotrichophora and Rhododendron arboretum.

I. INTRODUCTION

Vegetation is the most important natural resource to mankind, as it is meeting all kinds of essential requirements of the humans in the form of food, fodder, fuel, medicine, timber, resins, oil, etc. (Gaur, 1999). Plant community plays a critical role in sustainable management by maintaining biodiversity and conserving the environment (Farooque and Saxena, 1996). The knowledge of the floristic composition of a plant community is essential to understand the overall structure and function of any ecosystem. The living world is composed of more or less distinct individuals, called species. They represent an important level of integration in living environment (Venu, 2002). Fundamental botanical research revolves around floristic (listing of all plants of a given area) and mono-graphic (study of a plant group for its entire range of distribution) works. A flora study enumerates plants of a particular geographical area with a purpose to identify them (Venu, 2002).

Phytosociology is the branch of science which deals with the study of plant communities, their composition, development, and relationships between the species within them. India has a rich and varied heritage of biodiversity covering ten phytogeographical zones, the trans-Himalayan, the Himalayan, the Indian desert, the semi-arid zone(s), the Western Ghats, the Deccan Peninsula, the Gangetic Plain, North-East India, and the islands and coasts (Rodgers et al 2000 India's wide range of climatic and topographical features has resulted in a high level of ecosystem diversity encompassing forests, wetlands, grasslands, deserts, coastal and marine ecosystems, each with a unique assemblage of species (Anonymous. 2002).

Mountains are remarkably diverse and globally important as centres of biological diversity. Here a wide range of altitude, rainfall, climate, geological conditions. River systems, and topography have given rise to an immense diversity of ecosystems and ultimately to immense biological diversity. The structure and composition of the Himalayan forest vegetation is primarily determined by altitude, rainfall, latitude, topography and the aspect (Singh, 1999).

Himachal Pradesh like any other mountainous region has a vast repository of plants and animal ecosystems embodying profuse variation in intra and inter-species levels. The state is endowed with extremely diversified flora and fauna. Notably, one-fourth of its geographical area is under forest cover. Its diverse physical and climatic set up largely sustains higher growth of trees. Therefore, the existing forest wealth is of immense significance both economically and in maintaining the ecological balance of soils, water, plants and wildlife. Out of total 45,000 plant species found in the country, as many as 3,295 species (7.32%) are reported in Himachal Pradesh.

Shimla the capital of Himachal Pradesh is situated on the last Traverse spur of the Central Himalayas at 31°06'16.79"N 77°10'24.52"E. It has an average altitude of 2,206 metres (7,238 ft.) above mean sea level. The Shimla hills are rich in floristic diversity as is evident from the works of Sir Henry Collett in Flora Simlensis, (Atkinson, 1882) and Lady Elisabeth Smith and H. Babington Smith in Shimla Flowers (Smith et al. 1899)

As per the latest records development of the saturated Shimla town is still going on and their urgent need to conduct phytosociological and biodiversity studies of the area of concern. Therefore, there is an urgent need to conserve the diversity of tree species before it is wiped out from the nature. Till date very few detailed and rigorous efforts leading towards assessment of the status of tree species have been made in the immediate surrounding of Shimla town. Hence it is very important to study these forest cover in and around the town. For this be need to conduct phytosociological biodiversity studies of the area of the concern.

II. MATERIAL AND METHODS

DESCRIPTION OF THE STUDY AREA

STUDY AREA

The present investigation area entitled “phytosociological studies on tree vegetation of Jakhu hill, shimla, himachal Pradesh”. Falls in the Jakhu Hill which is at a height of 2454m and is the highest peak of Shimla town, the prominent capital of Himachal Pradesh is located in the northern part of the Himalayas. It is a small state in both size and population but holds rich floral and faunal wealth. Himachal Pradesh has 12 districts and the study area falls in Shimla district. Shimla District is the third most populous district of Himachal Pradesh and as per the FSI report 2017 the forest cover of Shimla District is 5131 km. The study area is densely inhabited with prominent restricted Forest area which has mainly evergreen tree species like Cedrus deodara, Pinus wallichiana, Pinus roxburglii Rhododendron arboreum. Quercus leucotrichophora etc. The floor of these forest areas is populated by both native and exotic species of shrubs, herbs and weeds Monkeys, grey langur, common lizard and Himalayan mouse are some of the faunal wealth of Shimla urban region.

III. METHODOLOGY

Phytosociological Survey

The present study was carried out in four different sites of Jakhu hill, Shimla, Himachal Pradesh. The methodology employed for quantitative assessment of the plant species has been elaborated as follows:

Study Sites

Exploration surveys was carried out in the study area and depending upon the nature of vegetation, plant diversity, aspect, attitude, latitude, slope and the topography four different sites were identified for the imminent study. The description of the different sites are as follows:

Table 1: Characteristics of the different investigation sites in the study area.

Sr. No.	Study Site	Altitude (in)	Latitude	Longitude	Aspect
1	From Sanjauli to Jakhu temple	2250.9-2454	31°06'05" to 31°06' 3.7"	77°11'23" to 77°11'2.55"	North-East
2	From IGMC to Violet hill	2268.2-2380.6	31°06'21" to 31°06' 09"	77°10'53" to 77°11'1.31"	North-West
3	From Governor's house to Navbhahar	2259.9-2261.5	31°06'24" to 31°05' 42"	77°10'49.9" to 77°11'11.45"	South-East
4	From Woodvilla to Richmount	2454-2243.5	31°05'32.7" to 31°06' 2.45"	77°10' 39.6" to 77°10' 46"	South-West

Vegetation sampling

The phytosociological analysis of the forest cover was done by sampling 10m x 10m size quadrats on each of the slope viz. hill base, lower slope, upper slope and hill top of each of the site by nested quadrat method.

Nested quadrats are a special sample unit that include a series of different sized quadrats all placed at the same location. They are usually positioned so that all have a common corner point, causing the area sampled by smaller quadrats to be included in the progressively larger ones. The nesting allows more abundant species to be effectively assessed in the smaller quadrats while increasing the likelihood of encountering the less common species in the larger quadrats.

The size of quadrats needed was done by species area curve (Mishra 1968). A square of 2m x 2m was taken in the field and the various species present within the square was noted down. The same procedure was repeated with 4m x 4m, 6m x 6m, 8m x 8m, 10m x 10m square and so on till the number of species present in the area becomes constant. A graph was prepared with the size of the quadrat (m²) along X-axis and number of species occurring along Y-axis. The point at which curve started flattening was noted and the size of quadrat at this point was taken as the minimum size of the quadrat to be studied.

The number of quadrats needed was determined by running mean method; Running mean was calculated by dividing total number of individuals by number of quadrats, then a graph was prepared between

the number of quadrats along X-axis and mean along Y-axis. The point at which running mean shows insignificant variation was noted down and at that point number of quadrats to be studied was calculated.

The study area was divided into 4 sites depending upon the topographical features such as habitat types, altitude, aspects, slope, and different vegetation types. Representative plots of 10 x 10 m were selected in different aspects and habitats. 5 quadrates of 10 x 10 m for trees species were randomly let down within the plot in each study site. A total of 20 quadrats for tree species were laid down by the help of HFRI staff.

The vegetation data were quantitatively analyzed for density frequency and abundance following the method of (Curtis and McIntosh 1950). The relative values of frequency, density and dominance were determined as per (Philips 1959). These values were added up to represent importance value index (IVI) of individual species (Curtis 1959).

IV. Result and discussion

Phytosociological studies were conducted in four study site of Jakhu Hill.

Zone 1- From Sanjauli to Jakhu Temple:

The study was conducted at an altitude ranging from 2250.9m to 2454m. A total of 6 species of trees were recorded at the study site (Table-2). *Cedrus deodara* was the most dominant species having highest density of 700 ha followed by *Quercus leucotrichophora* (600 ha), *Cupressus torulosa* (433/ha) and *Rhododendron arboreum* (400/ha). *Cedrus deodara* has the highest value of frequency (100%) and the highest value of IVI (112.09) followed by *Quercus leucotrichophora* (IVI 63.861). *Cupressus torulosa* (IVI 46.551) and *Rhododendron arboreum* (IVI 45.936). The least IVI was shown by *Pinus wallichiana* (IVI 12.615) and *Prunus cerasoides* (IVI 18.951) because they were spotted in few places as they showed random distribution. The phytosociological results have been deciphered below:

Table-2 Phytosociological attributes of Tree species in Jakhu Hill Zone-1.

Sr. No.	Name of the Tree Species	D	F%	A	A/F	IVI
1.	<i>Cedrus deodara</i> (Roxb.) G. Don.	700	100	7	0.07	112.09
2.	<i>Quercus leucotrichophora</i> A. Camus	600	40	15	0.38	63.861
3.	<i>Rhododendron arboreum</i> Sm.	400	40	10	0.25	45.936
4.	<i>Cupressus torulosa</i> D Don ex Lamb.	433	60	7	0.12	46.551
5.	<i>Pinus wallichiana</i> A.B. Jacks	100	20	5	0.25	12.615
6.	<i>Prunus cerasoides</i> D. Don	100	40	3	0.06	18.951
	Total					300

D= Density (ha-1) F= Frequency (%); A= Abundance; IVI- Importance Value Index

Zone 2 –From IGMC to Violet Hill

Trees

The study was conducted at an altitude ranging from 2268.2m to 2380.6 A total of 9 species of trees were recorded at study site (Table-3). The most dominant species was *Cedrus deodara* having the peak density of 900 followed by *Ilex dipyrrena* (300/ha), *Quercus leucotrichophora* (225 ha) *Aesulus indica* (200/ha) *Quercus semecarpifolia* (200/ha). *Ficus neriifolia* (166/ha), *Rhododendron arboreum* (150/ha), *Prunus cerasoides* (100/ha) *Picea smithiana* (100/ha). The highest IVI was also shown by *Cedrus deodara* (118.51) and the lowest was shown by *Prunus cerasoides* (13.72).

Table 3: Phytosociological attributes of Tree Species in Jakhu Hill Zone 2

Sr. No.	Name of the Tree Species	D	F%	A	A/F	IVI
1.	<i>Cedrus deodara</i> (Roxb.) G. Don.	900.00	60	15.0	0.25	118.51
2.	<i>Quercus leucotrichophora</i> A. Camus	225.00	80	2.8	0.04	30.18
3.	<i>Rhododendron arboreum</i> Sm.	150.00	80	1.9	0.02	29.21
4.	<i>Ilex dipyrrena</i> Wall	300.00	80	3.8	0.05	32.91
5.	<i>Aesulus indica</i> Wall. X Camb Hook	200.00	20	10.0	0.50	17.79
6.	<i>Quercus semecarpifolia</i> Sm.	200.00	40	5.0	0.13	22.88
7.	<i>Ficus neriifolia</i> Sm.	166.67	60	2.8	0.05	20.81
8.	<i>Prunus cerasoides</i> D. Don	100.00	40	2.5	0.06	13.72
9.	<i>Picea smithiana</i> Wall. Boiss	100.00	20	5.0	0.25	13.99

	Total					300
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D= Density (sqkm) F= Frequency (%); A= Abundance; IVI- Importance Value Index

Zone 3-From Governorhouse to Navbhar

The study was conducted at an altitude ranging from 2259.9m to 22615m. A total of 7 species of trees were recorded at study site (Table-4). The most dominant species was *Cedrus deodara* having the highest density (1388.9/ha) and IVI (92.497). Other tree species reported during the study were *Quercus leucotrichophora*, *Quercus semecarpifolia*, *Rhododendron arboreum*, *Prunus cerasoides*, *Ficus neriifolia*, *Robinia pseudoacasia* and *Celtis australis*.

Table 4: Phytosociological attributes of Tree Species in Jakhu Hill Zone 3

Sr. No.	Name of the Tree Species	D	F%	A	A/F	IVI
1.	<i>Cedrusdeodara</i> (Roxb.) G. Don.	1388.9	60	13.89	0.23	92.497
2.	<i>Quer leucotrichophora</i> A. Camus	660.0	100	6.60	0.07	58.558
3.	<i>Rhododendron arbortum</i> Sm.	360.0	100	3.60	0.04	45.51
4.	<i>Robinia pseudoacacia</i> L.	375.0	40	3.75	0.09	20.312
5.	<i>Quercus semecapifolia</i> Sm.	1000.0	20	10.00	0.50	28.654
6.	<i>Ficus neriifolia</i> Sm.	375.0	80	3.75	0.05	34.37
7.	<i>Celtis australis</i> L	1000.0	20	10.00	0.50	20.104
	Total					300

D= Density (ha-1) F= Frequency (%); A= Abundance; IVI- Importance Value Index

Zone 4-From Woodvilla to Richmount

The study was conducted at an altitude ranging from 2268.2m to 2380. 6m. A total of 4 species of trees were recorded at study site (Table-5). Among the four tree species recorded in this area, *Cedrus deodara* was the dominant tree species having maximum density (700/ha) and (IVI 166.99) followed by *Rhododendron arboreum* (IVI 65.774) and *Quercus leucotrichophora*(IVI 48.952). The highest value of frequency and abundance was recorded for *Cedrus deodara*. The abundance of frequency ratio indicates that distribution of all the species was contiguous except *Pinus wallichiana* which shows random distribution pattern. The phytosociological results have been specified below.

Table 5: Phytosociological attributes of Tree Species in Jakhu Hill Zone 4

Sr. No.	Name of the Tree Species	D	F%	A	A/F	IVI
1.	<i>Cedrus deodara</i> (Roxb.) G. Don.	700	100	7	0.07	166.99
2.	<i>Quercus leucotrichophora</i> A. Camus	240	60	4	0.07	48.952
3.	<i>Rhododendron arboreum</i> Sm.	400	60	6.67	0.11	65.744
4.	<i>Pinus wallichiana</i> A.B. Jacks.	100	20	5	0.25	18.313
	Total					300

D= Density (ha-1) F= Frequency (%); A= Abundance; IVI- Importance Value Index

V. CONCLUSION

The present study conducted within the biodiversity rich area of Jakhu hill is one of the most ecological sensitive area of Shimla town. As the expansion of the Shimla town is going on it is the need of the hour to minutely study the protected forest area as they provide suitable strategies for the conservation of plant resources and a data base for future studies. Keeping these ideas in mind the present investigation "Phytosociological Studies on Tree Vegetation of Jakhu hill, Shimla, Himachal Pradesh" was conducted. This study was accomplished by regular field visits, collection of ground survey data and guidance of field functionaries of HFRI Staff. The main aim of the study was listing of tree species of the study area.

A total of four sites were selected along different altitudinal zones and a phytosociological data was quantitatively analysed for density, frequency, basal area, abundance and IVI etc. using standard procedures for different selected sites. The area is densely populated with different floral species. The major contributor of tree layer was *Cedrus deodara*, *Quercus leucotrichophora* *Rhododendron arboreum*.

On the basis of Importance Value Index (IVI), the major tree species that dominated the entire jakhu hill was *Cedrus deodar* having highest IVI's in the four zones (IVI 112.09, 118.51, 92.497 and 166.99).The

species diversity index for tree was higher in zone-4 ($H' = 1.19$) were as concentration of dominance for tree species was higher in zone-2 ($Cd = 0.95$). The thick cover of Jakhu hill act as a carbon sinks and purifies the air and is whom to many faunall spices. The study would provide baseline data for further studies and to detect any floristic and anthropogenic changes in Jakhu hill. The present study also offers necessary ideas for better management and utilization of plant resources of the study area.



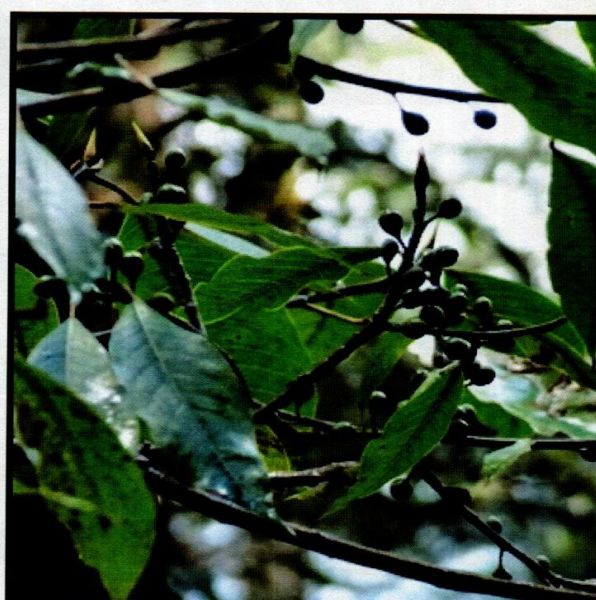
Ilex dipyrrena Wall.



Robinia pseudoacacia L.



Acacia deabata Link.



Ficus neriifolia Sm.

Fig.-2 Tree Species of Jakhu Hill



Cedrus deodara (Roxb.) G. don



Aesulus indica Wall. ex Camb Hook.



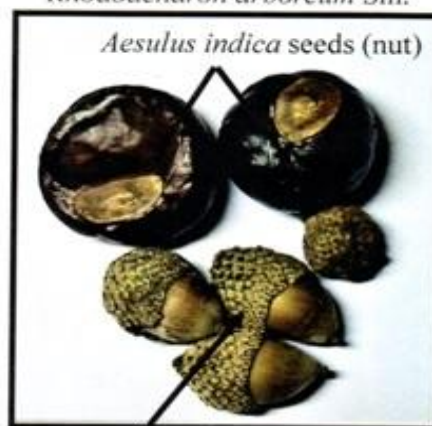
Prunus cerasoides D. Don



Rhododendron arboreum Sm.



Cunninghamia lanceolata (Lamb.) Hook.



Aesulus indica seeds (nut)

Quercus leucotrichophora seeds (acorn)

Tree species of Jakhu Hill

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