

Original Research Article

DOI: 10.26479/2018.0405.20

THE PHYTODIVERSITY AND COMPARATIVE ACCOUNT OF BIOLOGICAL SPECTRUM OF DEHRADUN AND MUSSOORIE REGION

Vishal Sharma*, Nandini Paul Sharma

Post Graduate Government College for Girls -11, Chandigarh, India.

ABSTRACT: The present paper gives an account of different life forms and biological spectrum of Dehradun and Mussoorie, constructed after enumeration of floristic composition of the region. Phanero-therophytes & Hemicryptophytes predominated the Dehradun and Mussoorie respective areas. In Mussoorie Hemi cryptophytes, showed maximum deviation (+24%) followed by Phanerophytes (+12% Dehradun) with normal biological spectrum of Raunkiaer Biological spectrum. Biological spectrum is a mirror reflection of the floristic composition of the area and in Dehradun, Sal (Shorea robusta) forms dominant vegetation and shows maximum frequency, abundance, density and presence & constance. The dominance of Phanero-therophytes in Dehradun attributed to humid bio-climates and xeric conditions. Mussoorie which is near to Dehradun shows wide disparity due probably to high altitude which make the prevailing climate cold and temperate in nature. The biological spectrum is thus useful as an index of the health status of a forest and the mirror reflection of area phytoclimate.

KEYWORDS: Life-forms, Floristic composition, Biological spectrum, Dehradun, Mussoorie.

Corresponding Author: Dr. Vishal Sharma*Ph.D.

Post Graduate Government College for Girls -11, Chandigarh, India.

Email Address: Vishal_2370@yahoo.com

1. INTRODUCTION

The life forms refers to sum of all life processes evolved in response to environment total of adaptation of their perennating organs and evolved directly in response to the environment [1]. The concept of life forms is pioneered [2] and used it as descriptive tool for classifying the life forms into five main classes; phanerophytes, chamaephytes, hemicryptophytes, cryptophytes and therophytes and mirror reflection of the floristic composition of the area. The percentage of

various life form classes put together is called as the biological spectrum, an indicator of phytoclimate of the area under study and to compare the widely separated plant communities with respect to their climatic adaptability. The Floristic composition of an area is important aspect of the ecosystem, a mirror reflect of the area and sociological interaction of species. The study of floristic composition of different regions in India have been worked out by different researchers [3];[4],[5],[6]. However, the study on different agro-climatic zones is few and far between. The study area experiences alternation of dry spell with moderate rainfall and cold moist temperate climate are characteristics of this area and these climatic condition are responsible for phanerotherophytic and Hemi & cryptophytes dominance respectively. Presently, a shade increase of Phanero-therophytes in Dehradun area attributed to grazing, is an indicator of biotic pressure and warm climate [7];[8]. The present paper deals with the pioneer studies on the comparative account of floristic study of different agro-climatic zones.

2. MATERIALS AND METHODS

Experimental Site

In the present study, two sites Mussoorie and Dehradun are studied. In these sites, 10 quadrats (each one with 10 m²) were set up to assess the phytogeography of the region. Mussoorie has latitude – 30° 27' 0" N ; longitude 78° 5' 0" E ; altitude 1,880 m. (6,170 ft.). Lal Tibba highest point 2,290 m. (7,510). Summer temp. 10 – 30°C ; winter 1-10°C. Dehradun, an ecotone, is saucer shaped valley bounded on east side with river Ganga, west (Yamuna) and famous Mussoorie on the north and Shiwalik hills on its southern side. Dehradun (Doon) valley longitude & latitude of is 77° 34' E & 78° 18' E ; 29° 58' N & 31° 2' N. It has the average maximum and minimum temperature are 28°C and 14°C respectively and the average rainfall is 207.33 cm. Presently ten quadrats are randomly surveyed in the month of March and classified all vascular plants in life forms following Raunkiaer's system. Life forms depending upon the perennating buds has been classified into five life forms (Fig.1).

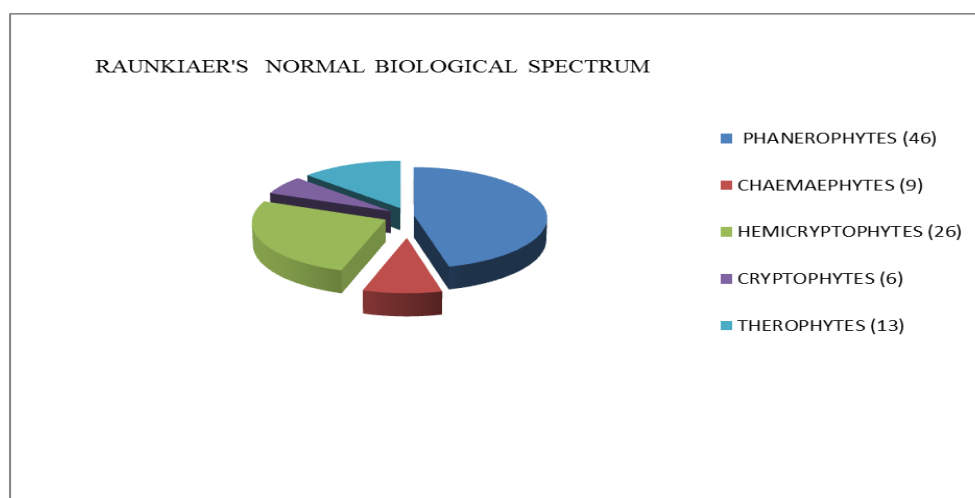


Fig 1: Raunkiaer Normal Biological spectrum

Sampling Population:

The study of floristic composition of a community the sampling should be done at random and covering at least 10-20% of the total area studied. In order to get accurate sampling of quantitative characteristics of a community, the following techniques are used:

(1) Transects

A cross section of sample area used for recording, mapping or study of vegetation is called transect. It may be a line, bisect or belt across the sample area.

(a) Line Transect

Line transect is one dimensional transect which is used for measuring frequency & cover of a species. A steel tape or chain is stretched between two points which are usually kept at distance of one chain or 33.5 m. The line is taken as 1 cm wide belt. The observer walks along the transect and records plant species and the distance they cover along the line. The cover distance is measured at the ground level in case of grasses and herbs for trees and shrubs the crown or shadow cover is recorded. 20-30 line transect are studied to completely sample the area.

(b) Quadrats

Quadrats are squarish or rectangular (10m²) plots which are used for sampling floristic composition of the area. The names of the species and the number of individuals of each species is also recorded in each quadrats. Subsequently vegetation of the sites was quantitatively analyzed for frequency, density and dominance. Relative frequency, density and dominance were computed with the help of the formulae :

$$\text{Relative Frequency} = \frac{\text{No. of occurrence of a species}}{\text{No. of occurrence of all the species}} \times 100$$

No. of occurrence of all the species

$$\text{Relative Density} = \frac{\text{No. of individuals of a species}}{\text{No. of individuals of all the species}} \times 100$$

No. of individuals of all the species

$$\text{Relative Dominance} = \frac{\text{No. of occurrence of a species}}{\text{No. of occurrence of species in Quadrats studied}} \times 100$$

No. of occurrence of species in Quadrats studied

(a) Abundance:

It is the number of individuals of a species per unit area. Sampling is done at random & number of individuals is added for all samples.

Abundance of a species = number of individuals in all samples / number of samples in which species occurred

There are five classes of abundance:

- a) Rare (R) - 1-4
- b) Occasional (=infrequent or IF) - 5-14.
- c) Frequent (F) - 15-29.
- d) Abundant (A) - 30-99.

e) Very abundant (VA) .100+

(b) Frequency

It is the degree of dispersion in terms of percentage occurrence. Frequency is calculated statistically by finding the percentage number of plots or sample in which a species occurs divided by number of plots studied.

Raunkiaer (1934) has recognised the five frequency classes:

Class A	1-20% Frequency
Class B	21-40% Frequency
Class C	41-60% Frequency
Class D	61-80% Frequency
Class E	81-100% Frequency

Frequency law provides information about homogeneous and heterogeneous nature of vegetation.

(c) Presence or Constancy

The regular occurrence of a species in a number of stands is called presence or constancy. If the sampling plots are of equal size, the term constancy is employed. Presence denotes the occurrence in different sizes of sampled plots. There are four classes of constancy:

Class 1	1-20% (rare)
Class 2	21-40% (seldom present)
Class 3	41-60% (often present)
Class 4	61-80% (mostly present)
Class 5	81-100% (constantly present)

Large number of species belonging to classes 4 & 5 indicates floristic homogeneity and heterogeneity favourable environment

3. RESULTS AND DISCUSSION

Floristic composition, ecological structure and sociological interaction are the key indicators of the Forest homo or heterogeneity and pioneer in the distribution & eco-functioning of the community [9]. The contiguous distribution found in Dehradun area is in compliance with earlier reports [10]; [11] About 52% of the Dehradun (Doon) valley encompasses subtropical deciduous forest with homogeneity population of *Shorea robusta* (Sal) trees, which are threatened due to their diversification, ever increasing population, rapid economic development, urbanization, illegal encroachments, heavy grazing pressure & loss of the aesthetic values, change towards heterogeneity in compliance with earlier studies [12]. These factors result in depleting natural Sal forests causing canopy gaps subjected to over-grazing pressures and water run off soil erosion. This results in significant increase of invasive species (*Eupatorium adenophorum*) threatening the integrity and diversity of Dehradun floristic composition and influence mesic to xeric conditions which attributed to phanerophytes vegetation. The floristic composition of

Dehradun(Doonvalley) shows drastic change due to dominance of invasive species such as *Adhatodavesica*, *Ageratum conyzoides*, *Eupatorium adenophorum*, *Euphorbia hirta*, *Lantana camara*, *Parthenium hysterophorus*, *S. surrattense*(= *xanthocarpum*). The mosaics of species distribution in forest are governed by various environmental factors[13]. The floristic composition, a mirror reflection of area is interaction products of factors like meso-topographic gradients, soil and anthropogenic disturbances. Anthropogenic disturbances disturbs agro-climatic conditions making the conditions xeric[14]. However, variation in distribution pattern is influenced with micro-environmental and biotic factors[15]. In present studies at Mussoorie, the pre-dominant life form found is Hemicryptophytes(50%) followed by Cryptophytes(24%), showed maximum divergence at study sites. The dominance of Hemicryptophytes and cryptophytes, is indicator of high altitude and colder climate while phanero-therophytes in Dehradun are characterized of dry and humid climate. The present findings regarding the dominance of of hemicryptophytes and cryptophytes is in compliance with earlier reports [16];[17];[18];[19];[20]. Presently, the phyto-spectrum of Mussoorie shows variation from the normal biological spectrum (Fig.1). The name of famous hill station Mussoorie is due to shrub *Coriarianepalensis*, which is very dominant species, stands in class E of frequency(81-100%) and the Presence of Constance is in class 5. The co-dominant species found in Mussoorie quadrats is BichhuButi(*Utricadioca*) and the interesting point to note is co-existence of *Utricadioca* with *Polygonum capitatum*, the natural medicine of the BichhuButi; a remarkable gift of nature to human welfare. A steady decrease in *Quercus leucotrichophora* (Banj) and *Grewia potiva*, a wonder tree and life line to locals attributed to complex interaction of logging, pests, chronic & environmental stress. The decline of both trees is of great concern to environmentalist due to its vital role in soil conservation and preventing landslide and has an adverse impact on under-storey shrubs(*Coriarianepalense*, *Daphnepapyraceae*, *Mahonianepalense* *Sarcococcaligyne*). The occurrence of *Barberis apiculata* in the region was an indicator of habitat degradation in the temperate region due to their thorny stem & unpalatable shoots[21]. However, dominance of phanero-therophytes in Dehradun is expression of humid bio-climates[22]. The floristic analysis of vegetation life form, reveals that 58% individual belongs to phanerophytes followed by therophytes(16%), Chamephytes(12%), hemicryptophytes (8%), and cryptophytes (6%) which infer humid/tropical arid climate in Dehradun [23]. The predominance of thermo-phanerophytic unique to arid and semi-arid regions attributed to the dry climate, topographic variation, hence the life form is the manifestation of the adaptations of species to the climatic variations[24];[25]. The life form composition of the community is the manifestation of the adaptations of its component species to the climatic condition, contributes to community architecture. The increased density and abundance of *Achyranthes aspera*, *Adhatodavesica*, *Ageratum conyzoides*, *Chenopodium album*, *Cynodon dactylon*,

Eupatorium adenophorum, *Euphorbia hirta*, *Lantanacamara*, *Parthenium hysterophorus*, *Solanumnigrum*, *S. surrattense*(= *xanthocarpum*),, poses a threat to native species and results in the decrease of the biomass, diversity and ecological indices[26].The dominant life forms in biological spectrum are mirror reflection of are phytoclimate[27].Floristic spectra are taken into account all the species regardless of their frequency and abundance. Floristic & biological spectra of Dehradun shows Sal(*Shorea robusta*) as dominant species with homegenity populaton ,stands in ‘E’ class of frequency and class5 of presence and constancybut now the species is masked with the presence of weeds *Achyranthesaspera*, *Adhatodavesica*, *Ageratumconyzoides*, *Chenopodiumalbum*, *Cynodondactylon*,*Eupatorium adenophorum*, *Euphorbiahirta*, *Lantanacamara*, *Parthenium hysterophorus*, *Solanumnigrum*,*S.surrattense*(= *xanthocarpum*), and now these species shows maximum frequency, adundance ,density and presence &constance

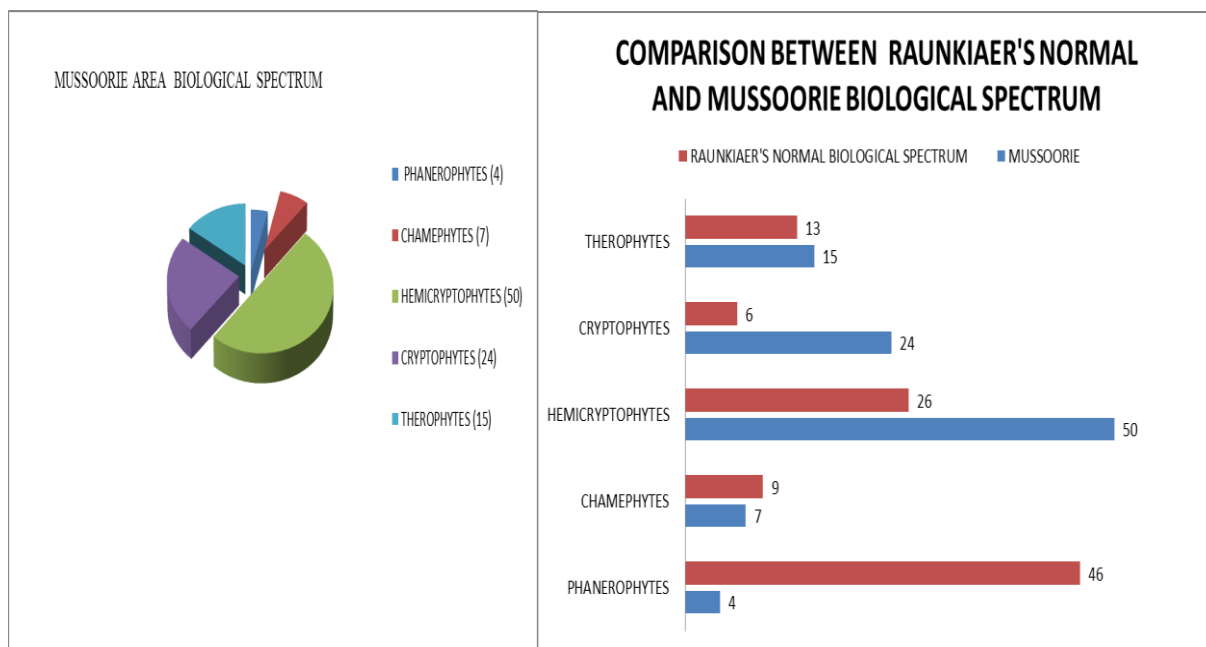


Fig 2: Floristic composition and Biological spectrum of Mussoorie

Table 1: List of Genera/species present in Mussoorie

S.No	Spp.	QUADRATS									
		I	II	III	IV	V	VI	V11	V111	IX	X
1	<i>Berberis apiculata</i>	2	2	1	2	2	3	3	2	2	2
2	<i>Capsella bursa-pastoris</i>	4	4	6	-	-	-	-	-	-	-
3	<i>Cedrus deodara</i>	-	-	-	-	6	6	6	5	-	-
4	<i>Clematis grata/connata</i>	10	6	-	-	-	-	-	-	-	-
5	<i>Coriaria nepalensis</i>	25	30	28	38	50	40	32	38	42	28
6	<i>Cupressus torulosa</i>	2	2	1	2	2	3	3	2	1	2

7	<i>Geranium nepalense</i>	5	-	-	-	-	-	3	-	-	-
8	<i>Gravelia robusta</i>	4	2	1	2	1	2	2	3	2	2
9	<i>Grewia optiva(Bhimal)</i>	2	4	1	4	2	2	2	3	4	3
10	<i>Mahonia napelense</i>	4	6	4	2	2	2	2	3	5	4
11	<i>Pinus roxburghii</i>	-	-	-	2	-	-	1	-	-	1
12	<i>Pinus wallichiana</i>	-	2	-	-	-	2	-	1	-	-
13	<i>Podocarpus gracilior</i>	2	1	1	2	2	3	2	3	1	1
14	<i>Polygonum capitatum</i>	20	20	25	16	13	15	16	12	19	24
15	<i>Pteris biavrita</i>	-	3	3	8	1	2	4	2	1	3
16	<i>Quercus leucotrichophora</i>	2	2	2	2	2	2	4	2	1	2
17	<i>Urtica dioica</i>	16	14	22	16	15	16	17	18	20	24
18	<i>Viola canescens</i>	2	4	6	2	2	2	4	6	2	4

Table 2: List of Genera/species present in Dehradun

QUADRATS

S.No	Spp.	I	II	III	IV	V	VI	V11	V111	IX	X
1	<i>Shorea robusta(sal)</i>	30	31	33	32	31	30	28	30	32	31
2	<i>Mallotis philippensis</i>	15	12	10	8	9	7	6	12	11	10
3	<i>Syzygium cumini</i>	10	8	4	6	6	4	3	4	2	2
4	<i>Murraya koenigii</i>	2	3	4	3	2	1	5	3	2	2
5	<i>Terminalia alata</i>	3	2	4	3	2	-	-	-	-	-
6	<i>Terminalia bellirica</i>	2	2	3	5	3	-	-	-	-	-
7	<i>Bombax ceiba</i>	4	2	3	4	2	1	-	-	2	-
8	<i>Adina cordifolia</i>	2	1	2	2	3	2	2	-	-	-
9	<i>Ficus benghalensis</i>	2	2	2	1	2	2	2	-	1	-
10	<i>Cassia fistula</i>	4	4	4	3	2	1	1	1	2	3
11	<i>Salix tetrasperma</i>	2	2	1	-	-	-	1	-	-	-
12	<i>Centeela asiatica</i>	2	1	1	2	-	-	-	-	-	-
13	<i>Eclipta prostrata</i>	2	3	2	3	2	-	-	-	-	-
14	<i>Bauhinia vahlli</i>	4	4	-	10	-	-	-	4	10	-
15	<i>Bauhinia variegata</i>	4	2	2	2	2	-	-	-	-	-
16	<i>Schizandra grandiflora</i>	6	6	-	-	-	4	4	-	-	-
17	<i>Albizzia chinensis</i>	-	-	-	-	-	-	-	10	-	3
21	<i>Ageratum conyzoides</i>	20	24	20	-	-	25	-	8	10	-
22	<i>Lantana camara</i>	7	20	2	12	-	-	-	-	-	-

23	<i>Parthenium hysterophorus</i>	14	10	4	6	-	-	-	8	4	-
24	<i>Achyranthes aspera</i>	8	6	-	-	-	-	4	-	-	-
25	<i>Euphorbia hirta</i>	4	3	2	4	-	3	-	4	-	4
26	<i>Tridax procumbensi</i>	6	3	4	6	-	4	3	-	-	-
27	<i>Solanum surrattense (xanthocarpum)</i>	10	2	3	4	20	-	-	-	24	-
28	<i>Adhatoda zeylanica</i>	2	8	4	4	-	-	5	6	-	-
29	<i>Clerodendron viscosum</i>	2	1	2	2	-	-	-	4	-	-
30	<i>Solanum nigrum</i>	2	2	3	2	-	-	-	2	-	-

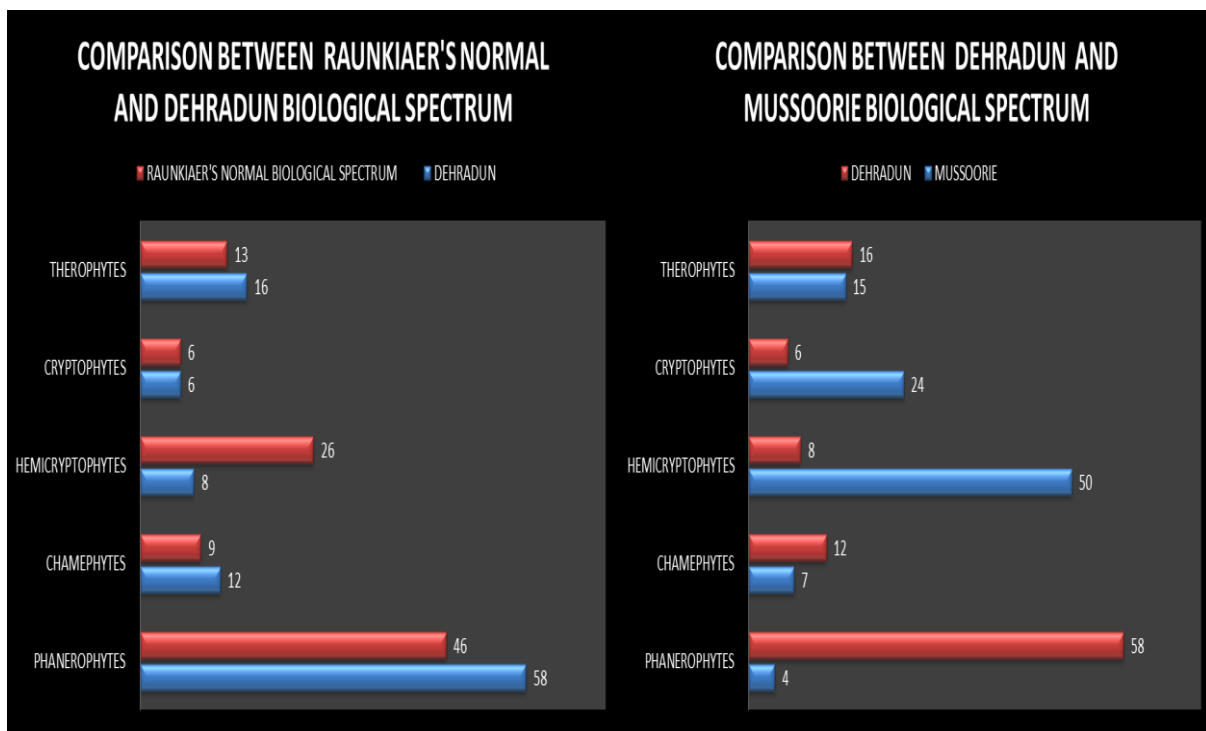


Fig 3: Comparison between Dehradun and Mussoorie Biological spectrum

4. CONCLUSION

The floristic composition of the Sal forests from homo to heterogeneity is influenced with micro environment and anthropogenic factors. The anthropogenic factors and Phytosociological interaction of a plant community is the basis of ecological study and structure of community. Biological spectrum more accurately describes the vegetation physio-gnomy, show great similarity to plains due probably to valley nature of Dehradun with humid/tropical climate.

ACKNOWLEDGEMENT

The authors are thankful to Prof(Dr) Anita Kaushal,Principal PGGCG-11,Chandigarh for her constant inspiration and support during the present investigation.

CONFLICT OF INTEREST

The authors have declared that they have no conflict of interest.

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