



Lifform classification and biological spectrum of Nandini wildlife sanctuary, Jammu, J&K, India

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Abstract

The present study gives an account of different life form categories and biological spectrum of Nandini Wildlife Sanctuary. A total of 335 species belonging to 86 families and 251 genera has been recorded from the area and has been grouped into different life forms classes according to Raunkiaer's lifeform classification. The result indicates Therophytes (40%), and Macrophanerophytes (20.59%) to be the dominant lifeforms followed by Nanophanerophytes (9.85%), Chamaephytes (9.25%) and Hemicryptophytes (9.25%). Biological spectrum on life form have also been prepared and compared with Raunkiaer's normal biological spectrum as well as the spectra of the adjoining areas prepared by other workers. On comparison with Raunkiaer's normal spectrum, the present study area depicts Thero-phanerophytic type of phytoclimate.

Keywords: *Biological spectrum, Life-form, Phytoclimate, Therophytes, Nandini wildlife sanctuary.*

Introduction

Concept of the lifeform for the first time was given by Humboldt (1806) and since then several ecologists (Warming, 1909, Raunkiaer, 1934, Dansereau, 1957, Ellenberg and Muller-Dombois, 1974, Box, 1981) have devised different systems for the description and classification of plant life forms. However, Raunkiaer's (1934) system of classification based on the position and degree of protection of the renewing buds to tide over the unfavourable conditions is most accepted and widely used system of classification of life form. The life form of the plant is the sum of all life processes and evolved directly in response to the environment (Cain, 1950). It represents all the adaptive characters of a species, thus it is an expression of the harmony between environment and a plant and is characterized by plant adaptation to certain ecological conditions (Warming, 1909, Mera *et al.*, 1999). The life form spectra are supposed to be an indication of micro and macroclimate (Shimwell, 1971) and the rate of change in structure and composition of any community is regarded as a good indicator of change in the whole environment. Therefore, it is important to study the life form spectrum of any area and to find out various phytoclimatic zones

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There in Raunkiaer (1934) grouped plant species into five main classes: phanerophytes, chamaephytes, hemicryptophytes, cryptophytes and therophytes. The percentage of various life form classes put together is called as the biological spectrum. The occurrence of similar biological spectra in different regions indicates similar climatic conditions. Differences in the life-form distribution between the normal spectrum and a biological spectrum would point out which life-form characterizes the phytoclimate or the vegetation under study (Reddy *et al.*, 2011). Biological spectra are useful in comparing geographically widely separated plant communities and are also regarded as indicators of biotic interaction, climate and habitat deterioration (Raina and Sharma, 2010). Thus, the biological spectrum of different region may be worked out and used to compare the widely separated plant communities in terms of their climatic adaptability. The biological spectra of different regions of India have been worked out by different researchers (Meher-Homaji, 1964, Sinha, 1990; Kumar and Krishnamurthi, 1993; Pandey and Parmar, 1993; Sharma and Dhakre, 1993; Singh and Arora, 1994; Reddy *et al.*, 1999, 2002; Rana *et al.*, 2002; Pattanaik *et al.*, 2007; Chauhan *et al.*, 2014 and Maitreya, 2015). In J&K, although many researchers have worked on life-form classification and biological spectrum of



different regions (Sapru, 1975; Kaul and Sarin, 1976; Kapur, 1982; Dhar and Koul, 1986; Kumar, 1987; Singh and Kachroo, 1976; Kumar, 1997; Kour, 2001; Singh, 2002; Kesar, 2002; Sharma, 2003; Jhangir, 2004; Dutt, 2005; Rai, 2007, Raina and Kumar, 2011 and Sharma *et al.*, 2014) to find out the phytoclimate of that particular region, work on this aspect in the Nandini wildlife sanctuary has not been carried out so far. Therefore, present work has been carried out to find out the assemblage of different life forms and to prepare the biological spectrum to infer the existing phytoclimate of the Nandini wildlife sanctuary.

Study area

Present study area i.e. Nandini Wildlife Sanctuary (Latitudes 32° 47' 43" and 32° 53' 23", Longitudes 74° 56' 19" and 74° 59' 39" with altitudinal range from 741 m to 843 m above m.s.l.) is notified as Wildlife Sanctuary in 1990 by J&K Govt. and covers an area of 33.34 sq km. The entire area lies in Shivalik belt having rugged and hilly terrain with moderate to steep slopes. The principal rock formations are sand stone, clay and shale. The Jammu-Srinagar highway zig-zags pass through it cutting it into almost two identical halves. The area experiences great extremities of temperature with June recorded as hottest and January as coldest month with average maximum and minimum temperature of 45.3°C and 2.9°C, respectively

Material and Methods

Extensive field survey has been conducted in the study area from May, 2013 to April 2015. Detailed floristic investigation was carried out in the study area in order to record the various lifeforms. Information on habit, habitat, flowering and fruiting period, vegetation type, the nature of perennating bodies was collected to draw a biological spectrum, following the concept of Raunkiaer (1934), based on which all species were assigned a suitable life form such as Therophytes (TH), Macrophanerophytes (MM), Nano phanerophytes (N), Chamaephytes (CH), Hemi cryptophytes (H), Lianas (L), Geophytes (G), Hydrophyte (HH) and Epiphyte (E).. The percentage life form was calculated as follows

$$\% \text{ life form} = \frac{\text{No. of species in any life form}}{\text{total no. of species in all life forms}} \times 100$$

Then the biological spectrum was prepared for the study area and was compared with the Raunkiaer (1934) normal biological spectrum as well as the spectra of the adjoining areas prepared by other workers. For the purpose of identification of plants various local, regional and National floras were used besides consulting taxonomic experts and herbarium of the region. Photography was done for entire wildlife sanctuary in different seasons to cover different stages of plants and also to depict floral status and landscape features of the region.

Results and Discussion

The forest of Nandini wildlife sanctuary falls in Northern dry mixed deciduous forest (Type 5B/C2) according to the classification given by Champion and Seth (1968). *Mallotus philipensis* has been found to be the most dominant tree species followed by *Pinus roxburghii* and *Acacia modesta*. The other tree species inhabiting the sanctuary includes *Cassia fistula*, *Lannea coromandelica*, *Phyllanthus emblica*, *Acacia catechu*, *Mitragyna parviflora*, *Terminalia chebula*, *Ziziphus mauritiana*, *Caeseria tomentosa*, *Ficus bengalensis*, *Wendlandia heyneii*, *Albizia lebbeck*, *Cordia myxa* and *Grewia optiva*.. Among the shrubby elements, *Justicia adhatoda* has been found to be most dominant and conspicuous shrub species of the sanctuary. Isolated thickets of *Carissa opaca* and *Dodonaea viscosa* have been observed to be interspersed in *Justicia adhatoda*. *Woodfordia fruticosa*, *Colebrookea oppositifolia*, *Nerium indicum*, *Punica granatum*, *Vitex negundo*, *Ziziphus nummularia*, *Gymnosporia royleana*, *Mimosa rubicaulis* are the other shrub species found to be strikingly abundant and frequently in the sanctuary. Among the herbs, which are prominent during monsoon season, the most dominant has been observed to be *Malvastrum coromandelianum* which is followed by *Oxalis corniculata*, *Boerhavia diffusa*, *Cyanadon dactylon*, *Ageratum conyzoides*, *Achyranthes aspera*, *Amaranthus viridis*, *Anagallis arvensis*, *Euphorbia hirta*, *Mazus pumilus*, *Solanum surratense*, *Trifolium repens*, *Tridax procumbens*, *Taraxacum officinale*, *Pupalia lappaceae*, *Peristrophe paniculata*, *Euphorbia prostrata*, *Evolvulus alsinoides*, *Euphorbia helioscopia*, *Commenlina bengalensis*, *Bidens bipinnata*, *Cassia tora*, *Geranium ocellatum* and *Micromeria biflora*



Life form classification and biological spectrum of

etc. Floristically, the area is represented by 335 species (belonging to 251 genera and 86 families) followed by Macrophanerophytes (20.59%), and Nanophanerophytes (9.85%). The comparison of the biological spectrum of the study area with Raunkiaer's normal biological spectrum is presented in Table 2 and Fig.1a and 1 b. Perusal of the table revealed Therophytes (40%) to be the largest class

Table-1: Total number of Species and percentage of different Life form classes

Life Form classes	No. of Species	Percentage (%)
Therophytes (TH)	134	40
Macrophanerophytes (M)	69	20.59
Nanophanerophytes(N)	31	9.85
Chamaephytes(CH)	33	9.25
Hemicryptophytes(H)	31	9.25
Lianas/Climbers(L)	25	7.46
Geophytes(G)	7	2.08
Hydrophytes(HH)	4	1.19
Epiphytes(E)	1	0.29
Total	335	100

Table-2: Comparison of biological spectrum of study area with Raunkiaer's (1934) Normal Biological Spectrum

Life Form	TH	M	N	CH	H	L	G	HH	E
Percentage life-form (present study)	40	20.59	9.85	9.25	9.25	7.46	2.08	1.19	0.29
Percentage life-form in normal spectrum	13.0	28.0	15.0	9.0	26.0	-	4.0	2.0	3.0
Percentage Deviation	+27	-7.41	-5.15	+0.25	-16.75	+7.46	-1.92	-0.81	-2.71

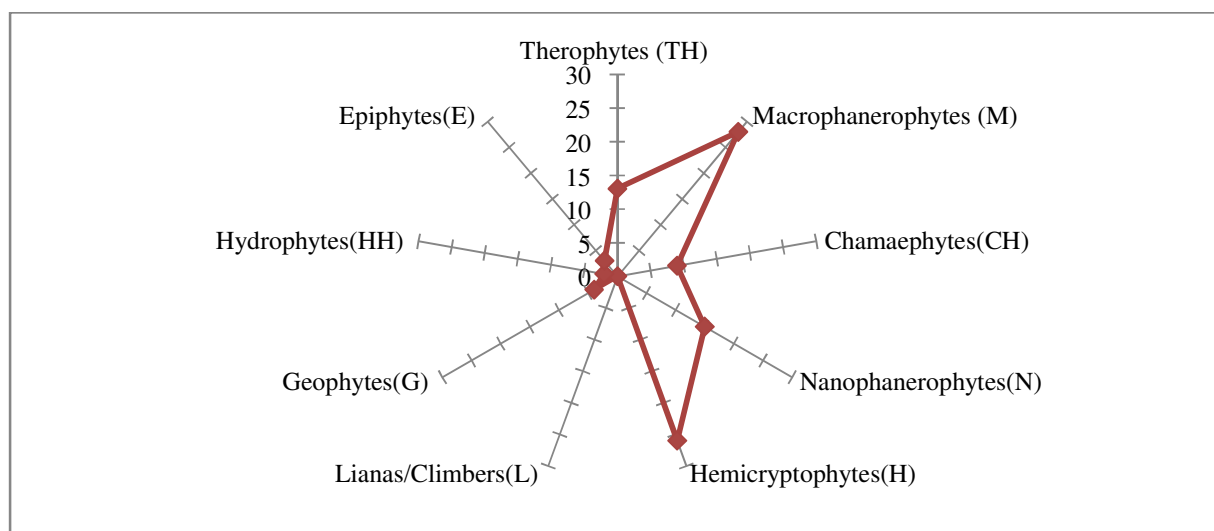


Figure 1 (a) Raunkiaer's Normal Biological Spectrum



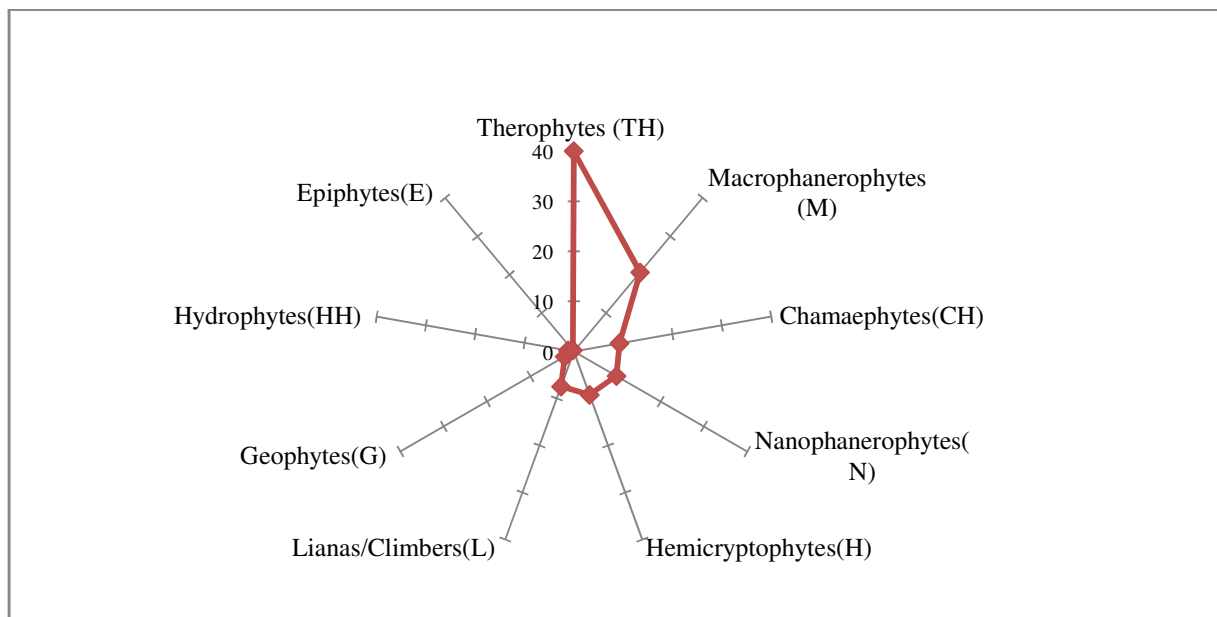


Figure 1(b) Biological Spectrum of Study area

When compared with the normal biological spectrum of Raunkiaer (1934), the phyto-spectrum of the present study shows variation and accordingly, the biological spectrum of the present study area indicates “Thero-phanerophytic” type of phytoclimate as it is indicated by the dominant life forms in biological spectrum of that region (Yadava

& Singh, 1977, Dagar & Balakrishnan, 1984, Al-Yemeni & Sher, 2010, Reddy, *et al.* 2011, Sharma, *et al.*, 2014, Thakur, 2015, Shahid & Joshi, 2015). The higher percentage of Therophytes (40%) occurring in the area is the characteristic of subtropics and often related to soil conditions and climate (Subramani *et al.*, 2007).

Table-3: Comparison of life forms of study area with adjoining areas having similar climatic conditions in North-western Himalayas.

Life Form	TH	M	N	CH	H	L	G	HH	E	Phytoclimate
Study Area	40	20.59	9.85	9.25	9.25	7.46	2.08	1.19	0.29	Thero-phanerophytic
Kalakote Range	30.89	16.57	12.35	16.85	12.64	5.61	3.65	1.40	-	Thero-chameophytic
District Jammu	35.45	16.70	11.64	13.93	9.11	8.87	2.02	1.78	0.50	Thero-phanerophytic
Mahamaya Catchment	38.45	19.50	10.99	13.82	7.44	7.08	1.06	1.06	0.70	Thero-phanerophytic
Kishtwar	33.85	11.72	10.94	14.32	18.75	3.91	4.95	1.04	0.52	Thero-chameophytic
Lamberi forest range	27.03	25.68	14.41	13.51	11.26	4.05	2.25	1.35	0.45	Thero-phanerophytic

TH= Therophytes; M= Macrophanerophytes; N= Nanophanerophytes; CH= Chamaephytes; H= Hemicryptophytes; L= Lianas; G= Geophytes; HH= Hydrophytes; E= Epiphytes



The predominance of therophytes is attributed to various factors like prevalent microclimate of the region coupled with anthropogenic activities like grazing, looping, felling, deforestation, introduction of annual weeds and biotic influences as has also been advocated by other workers (Sharma, 2003; Sher and Khan, 2007; Khan, *et al.*, 2011) and thus indicates a disturbed environmental condition (Al-Yemeni & Sher 2010). The dominance of the phanerophytes can be attributed to the fact that the area falls in Shiwaliks which provides favorable edaphic and climatic conditions for the growth of overstorey. Also, Therophytes are plants of warm and dry climate and phanerophytes of warm and moist climate (Raunkiaer, 1934). The climate of the study area in general is warm and dry during summer and warm and moist during rainy season, thus confirming the preponderance of therophytes and phanerophytes. The comparison of life forms of study area with adjoining areas having similar climatic conditions in Northwestern Himalayas is presented in Table 3. Perusal of the table reveals that some of these regions show different type of phytoclimate despite being similar to one another. This may be because of the varied amount of disturbances and latitudinal and longitudinal difference in these areas. Among these areas, the phytoclimate of the study area resembles to that of Jammu (Sharma, 2003), Mahamaya catchment (Sudan, 2007) and Lamberi forest range, (Sharma *et al.*, 2014).

Conclusion

The present study area indicates that the vegetation is predominantly of sub-tropical type showing the predominance of therophytes followed by macrophanerophytes as compared to normal biological spectrum. On the basis of this study the phytoclimate of the Nandini wildlife sanctuary as per Raunkiaer's terminology, has been described as thermo-phanerophytic type of phytoclimate. The increased number of therophytes indicates influence of anthropogenic activities (overgrazing and developmental activities) in the investigated area which favors the chances of growth of short lived annuals.

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