Life-forms and Biological Spectrum of Dry Deciduous Forests in Doon Valley, Uttarakhand, India

Mohommad Shahid* and Shambhu Prasad Joshi

Ecology Research Laboratory, Department of Botany, D.A.V. (P.G.) College, Dehra Dun, Uttarakhand, India
Email: mdshahid07@yahoo.com, Mobile Number: +91-9411762435

Abstract: The paper deals with the life forms and biological spectrum of dry deciduous forests of Barkot Forest Range of Doon Valley, Uttarakhand, India. The study enumerated 266 plant species, 201 genera and 67 families of angiosperms. Analysis was done to find out the biological spectrum of the study area. Therophytes represent the highest 44% life forms followed by Phanerophytes with 37% and Hemicryptophytes with 5%. The study area is in under threat from various anthropogenic activities like livestock grazing, fuelwood and fodder collection, etc.
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1. Introduction

Phytodiversity is an essential component of ecosystems, where species interacts with each other and with their abiotic environment to form a plant community. Biological spectrum of vegetation is the index of the phytoclimate of the site, deduction of which is based on different life-forms composing the flora of the site. The life-form is the ultimate manifestation of the sum of all the adaptations undergone by a plant to the climate in which it resides (Tripti and Ambarish, 2011). Raunkiaer (1934) proposed the "Biological Spectrum" to express both the life-form distribution in a flora and the phytoclimate under which the prevailing life-forms evolved. Life-form is thus an important part of vegetation description, ranking next to floristic composition.

Plants can be grouped into life-form on the basis of similarities in structure and function (Mueller-Dombois & Ellenberg, 1974). The life-form characteristics are said to be the indicators of micro and macroclimate (Shimwell, 1971). Raunkiaer (1934) classified plant life-form based on the position and degree of protection to the renewing buds, which are responsible for the renewal of the plant's aerial body when the favourable conditions arrive. According to this system, plants can be divided into Chamaephytes (with surviving buds situated near to the ground), Phanerophytes (with surviving buds projecting freely into the air), Cryptophytes (with surviving buds perfectly hidden in the ground or at the bottom of the water), Hemicryptophytes (with surviving buds exactly in the soil-surface) and Therophytes (finishing their life-cycle within a season and remaining dormant as seed during the contrary time) Bloch-Petersen *et* al., (2006).

It is important to study the floristic composition and life forms of different plants to find out phytoclimatic zones of the area. Several workers have studied the life forms and biological spectrum of different regions of India (Meher-Homji, 1981; Gupta and Kachroo, 1983; Ghildiyal and Srivastava, 1990; Baruah, 2003; Dobhal *et* al., 2010; Kususm *et* al., 2010; Thakur *et* al., 2012; Sidanand and Kotresha, 2012; Vediya and Kharadi, 2012).

2. Materials And Methods

2.1 Study Area

The study was carried out in Barkot Forest Range of Dehra Dun Forest Division of district Dehra Dun, Uttarakhand, India. The average maximum temperature for the Dehra Dun is 27.65°C and the average minimum temperature is 13.8°C, with average maxima in June (40.00°C) and average minima in January (1.80°C). The area received an average annual rainfall of 2000 mm. The soils under Sal Forests of Dehra Dun are generally classified as coarse loamy, having acidic to near neutral reaction and texture from loam to loamy sand throughout the depth with embedded gravels and pebbles.

The most dominant species reported from the study area in the herbs category are *Justicia diffusa* followed by *Euphorbia hirta*, *Lindernia ciliata*, *Setaria glauca* and *Fimbristylis dichotoma*. In the Shrub layer, *Clerodendrum viscosum* is the most dominant shrub followed by *Ardisia solanacea* and *Urena lobata*. In the Tree layer, *Shorea robusta* is the most dominant while co-dominants are *Mallotus philippinensis* and *Ehretia laevis*.

2.2 Methodology

Extensive field studies were conducted during the year 2010-11. Usual methods of collection, preservation and maintenance of specimens in the Herbarium were followed (Jain & Rao, 1977). Plants specimen in flowering and fruiting stages were collected at regular intervals during different seasons

throughout the year. The growth form, habit, and nature of the penetrating buds of different plant species were recorded and classification was done as per Raunkiaer (1934) and modified by Dansereau (1957), Ellenberg and Muller-Dombois (1967) and Muller-Dombois and Ellenberg (1974). The representative specimens collected during field visit were processed for herbarium preservation and taxonomically worked out for confirming identification with the help of literature (Babu, 1977; Gaur, 1999). The vegetation of the Dehra Dun has been explored from time to time by various workers (Kanjilal, 1901; Sharma and Joshi, 2009; Dobhal *et* al., 2010).

3. Results

A total of 266 plant species belonging to 201 Genera and 67 families were encountered during the field visit. In the study area, the ratio of Family: Genera, Family: Species and Genera: Species recorded were 1:3, 1:3.97 and 1:1.32 respectively (Table 1). 170 Herbs and 39 shrubs and 57 Tree species are recorded (Figure 1) of which Dicots includes 200 Species and Monocots 66 Species. Dicots are represented by 57 Families and 159 Genera while the Monocots are represented by 10 Families and 42 Genera (Table 2). The contribution of Species included 75.19% and 24.81% respectively for dicots and monocots. The contribution of monocots at the rank of family included Poaceae with 32 Species followed by Cyperaceae with 19 Species, Orchidaceae with 5 Species and Commelinaceae with 4 Species. Six families contributed one Species each (Appendix I).

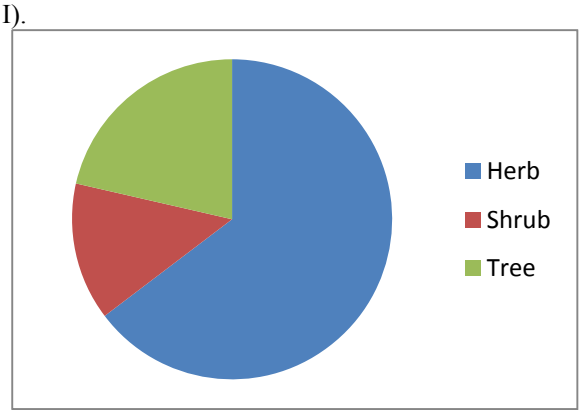

Figure 1. Habit of the plant species from the study area.

Table 1. Ratio Of Species, Genera And Families In The Study Sites.

	Family: Genera	Family: Species	Genera: Species
Total Number	67:201	67:266	201:266
Ratio	1:3	1:3.97	1:1.32

Table 2. Analysis of the Plants of Study Area.

	Family		Genera		Species	
	No.	%	No.	%	No.	%
Dicots	57	85.07	159	79.10	200	75.19
Monocots	10	14.93	42	20.90	66	24.81
Total	67		201		266	

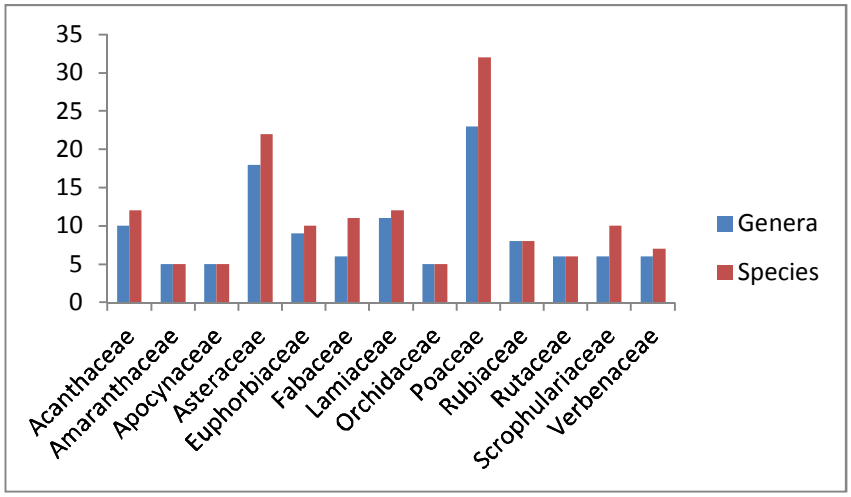

Figure 2. Dominant Families of the Study area (Families>=5Genera).

Results reveal that maximum number of plant species belong to family Poaceae with 23 Genera and 32 Species, Asteraceae with 18 Genera and 22 species and Lamiaceae with 11 Genera and 12 Species followed by Acanthaceae with 10 Genera and 12 Species. The other dominated families are Euphorbiaceae (9 Genera/10 Species), Rubiaceae (8 Genera/8 Species), Fabaceae (6 Genera/11 Species), Scrophulariaceae (6 Genera/10 Species), Rutaceae (6 Genera/6 Species), Amaranthaceae (5 Genera/5 Species), Orchidaceae (5 Genera/5 Species), and Apocynaceae (5 Genera/5 Species) (Figure 2).

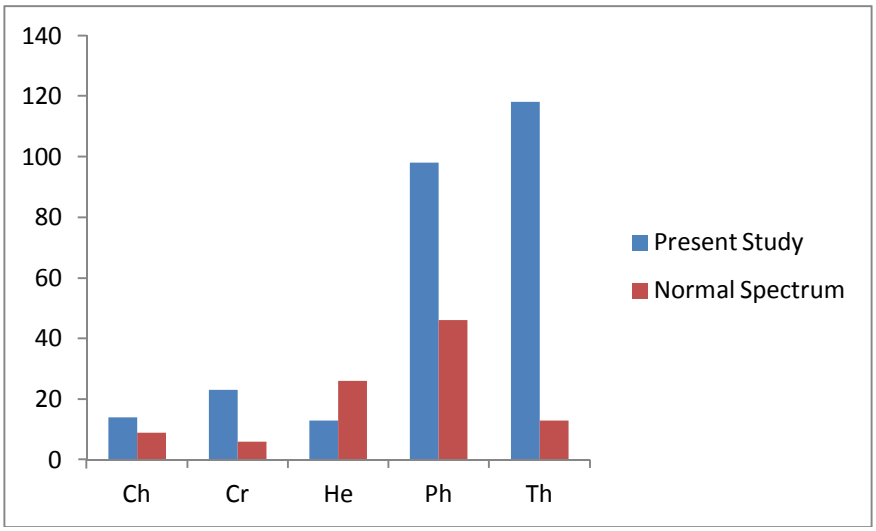

Figure 3. Biological Spectrum of Life-Forms of present study and its comparison with the Raunkiaer's Normal Biological Spectrum.

Comparison of the percentage of the life form classes of the Barkot Forest Range with Raunkiaer Normal Spectrum indicates that therophytes is the largest life form class and their percentage is much higher (44%) than that of the normal biological spectrum (13%). The Phanerophytes forms the second highest class with 37%. Hemicryptophytes recorded from the study area are 5% while Chamaephytes and Cryptophytes are 5% and 9 % respectively (Figure 3).

4. Discussion

A biospectrum is established when all plant species of a community is classified into life forms and their ratio expressed in percentage or number (Saxena *et* al., 1987). Biological spectrums are beneficial in comparing plant communities which are separated geographically and are also regarded as an indicator of prevailing environmental conditions. Occurrence of similar biological spectra in different regions indicates similar climatic conditions. According to Raunkiaer (1934), the climate of a region is characterized by life form, while the biological spectrum of the region exceeds the percentage of the same life form. However, the proportion of life form is altered due to biological disturbance. Biological spectrum may be changed due to the anthropogenic pressure like grazing, trampling, invasive species which are highly affecting the forests of the study area. The overall vegetation in the present study is dominated by Therophytes followed by Phanerophytes. The predominance of Therophytes indicates that the study area is disturbed. Anthropogenic activities like fuel wood collection, animal grazing, forest fire and fodder collection have increased pressure on the area and have lead to decline of plant species. Predominance of Therophytes may be likely due to one of the following reasons: (1) Relatively dry soil conditions prevailing during the year of study (Dadhich, 1982) or (2) Biotic pressures like grazing, fuelwood, fibre, lopping and falling of trees (Bharucha and Dave 1944; Rajwar and Gupta, 1981; Dayama, 1987 and Dobhal *et* al., 2010).

Based on the dominance of Therophytes and Phanerophytes, the phytoclimate of the Doon Valley may be called as Thero-phanerophytic in accordance with Raunkiaer's terminology. Similar phytoclimatic association has also been reported by Lakshmanan (1962) and Ghildiyal and Srivastava (1990).

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***Correspondence to**
Mohommad Shahid
Ecology Research Laboratory
Department of Botany
D.A.V. (P.G.) College,
Dehra Dun
Pine Code No. 248001
Uttarakhand, India
Email: mdshahid07@yahoo.com
Mobile Number: +91-9411762435

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