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Floristic composition, life form classification and biological spectrum of the catchment of Ratle H.E. project, District Kishtwar-J&K (India)

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Abstract

Based on floral inventorization of the vegetation of Ratle catchment area, biological spectrum on life form was prepared and compared with Raunkiaer's normal biological spectrum as well as the spectra of the adjoining areas prepared by other workers. The floristic list of the Ratle catchment consists of 384 species belonging to 96 families and 242 genera. Asteraceae has been recorded as the largest family (31 genera/52 species) followed by Fabaceae (12 genera /23 species), Lamiaceae (14 genera/ 23 species), Rosaceae (10 genera/ 17 species) etc. Thirty nine families show monotypic representation. The ratio of family to genera was calculated as 1:2.52; family to species as 1:4 and genera to species as 1:1.59. According to the Raunkiaerian life form classification (1934), Therophytes (33.85%) and Hemicryptophytes (18.75%) were found to be dominant thus indicating thero-hemicryptophytic type of phytoclimate in the study area.

Keywords: *Biological spectrum, life forms, phytoclimate, Ratle H.E. Project*

Introduction

Study of floristic composition and phytoclimate of an area is important as the change in structure and compositions of vegetation are sensitive indicators of whole environment. It reflects the adaptation of plants to climate and ecological conditions of an area. The life form of a plant is the physiognomic form produced as a result of all life processes after interaction with the environment. The relative proportion of different life forms for a given region or an area is called its biospectrum. Biological spectra are useful in comparing geographically widely separated plant communities and are also regarded as indicators of biotic interaction, climate and habitat deterioration. Plants can be grouped in life form classes based on their similarities in structure and function (Mueller-Dombois and Ellenberg; 1974). According to Cain (1950) life form study is an important part of vegetation description, ranking next to floristic composition.

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Different life form classifications and modification have been proposed by various workers including Raunkiaer (1905, 1918, 1934), Braun-Blanquet (1932) and Cain (1950) from time to time. However, the Raunkiaer's (1934) classification is most convincing and has been widely accepted. Raunkiaerin approach explains and helps in understanding the flora and structure of vegetation in relation to prevailing eco-biological conditions. It reflects the impact of current biotic factors, like overgrazing, over harvesting, deforestation on the overall vegetation structure and composition. It also influences the economic value of plants in various ways. The approach is useful in developing management plan for the sustainable harvest of plant resources. The Raunkiaer's Normal Spectrum prepared for the phanerogamic flora of the whole world is still widely used for comparing biological spectra of different regions. In Jammu and Kashmir, several workers have studied the floristic composition and biological spectra of different areas. This includes the works of Sapru (1975), Kaul and Sarin (1976), Kapur (1982), Dhar and Kaul (1986), Kumar (1987),

Singh and Kachroo (1994), Kumar (1997), Kour (2001), Singh (2002), Kesar (2002), Sharma (2003), Jhangir (2004), Dutt (2005), Rai (2007) and others. However, the work on this aspect in district Kishtwar has not been done so far. Therefore, in the present study, biological spectrum of the study area has been prepared by following Raunkiaer (1934) life form classification after enumeration of the floristic composition.

Study area

The study area includes the total catchment of Ratle Hydro-electric project that is a run-off the river scheme on the River Chenab with its proposed dam site at village Drabshalla in district Kishtwar, Jammu & Kashmir. The dam site is located at Latitude 32°06' N to 34°12.5'N and longitude 75°23'E to 77°48'E. The catchment area of River Chenab up to dam site of the project is estimated to be 14965 km^2. The project area falls mostly in between sub-tropical to temperate zone. In the project area, average maximum and minimum temperature during winter and summer are reported to be 25° C & -0.5° C and 43° C & 15° C, respectively (at Ratle dam site). Average annual rainfall in the project area is 843 mm. The Ratle catchment area lies in inner lesser Himalayas under Kishtwar group of rocks. All the project components lie mainly in gneiss/schist rock of Salkhalas formation.

Materials and Method

Plant diversity and floristic composition of the area was studied by making field trips from October 2007 to March 2010. The area was surveyed during all the four seasons of the year and care was taken to cover all the possible watersheds, habitats and vegetation types. Plant species were photographed and accordingly identified using local herbaria, flora and relevant literature available for the region. Taxonomic identification was done by using different floras and by consulting taxonomic experts. Utmost care was taken during survey and enumeration to avoid disturbance to flora and fauna. The plant species so inventorised have been classified into various life form classes as proposed by Raunkiaer (1934) classification.Biological spectrum of the area was prepared and was compared with the Raunkiaer's normal Spectrum as well as the spectra of the adjoining areas prepared by other workers.

Results and Discussion

The study area represents sub-tropical to temperate vegetation. The lower altitude belt near the proposed dam site is represented by sub-tropical vegetation with dominance of *Alnus nitida, Pinus roxburghii, Populus ciliata, Pyrus pashia, Robinia pseudoacacia, Dalbergia sissoo, Berberis lycium, Justicia adhatoda, Vitex negundo* etc. The temperate vegetation is prominently represented by *Quercus semicarpifolia, Pinus wallichiana, Cedrus deodara, Quercus baloot* etc.

Among the climbers, *Hedera nepalensis* is one liana that climbs mostly on *Cedrus deodara.* The other lianas of this area are *Tylophora hirsuta, Convolvulus arvensis* and *Cissampelos pareira. Cuscuta reflexa* is one of the parasites found in the region.

During the field inventorization, a total of 384 plant species belonging to 242 genera and 96 families have been recorded. The highest species representation has been observed in the family Asteraceae (52) which is followed by Fabaceae (23), Lamiaceae (23), Rosaceae (17) and others. Asteraceae has also been reported to be dominant family in the adjoining areas like Bhaderwah (Kumar, 1987); Patnitop Hills (Kumar, 1997); Trikuta Hills (Kour, 2001) and Neeru Watershed, Bhaderwah (Dutt, 2005). The comparison of dominant families recorded in the study area with that of adjoining areas have been presented in Table-1. The analysis of data reveals the presence of 363 angiosperms (330 dicots and 33 monocots), 16 pteridophytes and 5 gymnosperms in the study area. 39 families have been recorded to be monotypic in this area represented by single species. The genus with maximum number of species in the study area are *Anaphalis* (7), *Geranium* (6), *Ipomoea* (6), *Cyperus* (5), *Euphorbia* (5) and *Leucas* (5) etc. The analysis of the data further reveals that the ratio of family to genera is 1:2.52; family to species is 1:4 and genera to species is 1:1.59. The ratio of genera to species which reflects the floristic pattern in given time and space is lower than that derived for British India – 1:7 (Hooker, 1872-97); India alone – 1: 6 (Chatterjee, 1939); Himachal Pradesh – 1: 2.93 Bashar Himalayas – 1: 2.29 (Aswal and Mehrotra, 1994): Shimla – 1:20 (Collet, 1902); Great Himalayan National Park – 1:1.94 (Singh and Rawat, 2000);

Kullu – 1: 1.84 (Dhaliwal and Sharma, 1999); Kangra – 1:1.72 (Kapur, 1985); Mussourie – 1: 1.87 (Raizada and Saxena, 1978). The ratio tends to match with the Valley of flowers – 1:43 (Kala and Rawat, 2004); Sirmour – 1: 1.65 (Kaur and Sharma, 2004): Trilkuta Hills – 1:42 (Kapur and Sarin, 1990), Patnitop and adjoining areas – 1:1.44 (Kumar, 1997) and Trikuta Hills – 1:1.42 (Kour, 2001). As per the available records, the percentage of dicots and monocots species in the world flora

Table-1: Comparison of dominant families of study area with adjoining areas

S.No	Study area	Patnitop Hills (Kumar, 1997)	Bhaderwah (Kumar, 1987)	Neeru Watershed Bhaderwah (Dutt, 2005)	Trikuta Hills (Kour, 2001)
1.	Asteraceae	Asteraceae	Asteraceae	Asteraceae	Asteraceae
2.	Fabaceae	Labiatae	Poaceae	Labiatae	Fabaceae
3.	Lamiaceae	Poaceae	Apiaceae	Apiaceae	Poaceae
4.	Rosaceae	Fabaceae	Labiatae	Ranunculaceae	Labiatae
5.	Poaceae	Roasaceae	Ranunculaceae	Roasaceae	Euphorbiaceae
6.	Amaranthaceae	Ranunculaceae	Cruciferae	Cruciferae	Scrophulariaceae

is 81.3% and 18.7%, respectively. Different studies carried out in different parts of Jammu by Kumar (1987), Kumar (1997), Kour (2001) and Singh (2002) have reported higher percentage of dicots.

The present study also revealed the higher percentage of dicots (90.9%) from the study area. The ratio of the monocot to dicot families have been recorded as 1:5.3, of genera 1:8.1 and of species 1:10 (Table-2).

Table-2: Percentage and ratios of families, genera and species of dicots and monocots (excluding gymnosperms and pteridophytes)

Taxa	Dicots		Monocots		Total	Ratio	
	Total Number	Percentage (%)	Total Number	Percentage (%)		Monocots	Dicots
Families	74	84.1	14	15.9	88	1	5.3
Genera	202	89.0	25	11.0	227	1	8.1
Species	330	90.9	33	9.1	363	1	10.0

In the present study, the representative flora constituting the class therophyte is mainly characterized by species like *Chenopodium album, Euphorbia indica, Impatiens balsaminea, Malvastrum coromandelianum, Ranunculus arvensis, Solanum erianthum, Sonchus asper, Taraxacum officinale, Tridax procumbens* etc. Class hemicryptophyte is represented by *Androsace rotundifolia, Asplenium oxyphyllum, Cyperus rotundus, Gentiana kurroo, Lathyrus humilis, Leucas capitata, Plantago ovata, Saussurea costus* etc. Class chamaephyte includes species like *Achyranthes aspera, Artemisia brevifolia, Barleria cristata, Cannabis sativa, Lotus corniculatus, Rubus ellipticus, Rumex hastatus etc.* Class macrophanerophyte is represented by *Aesculus indica, Ailanthus excelsa, Albizia chinensis, Alnus nitida, Toona ciliata, Cedrus deodara, Dalbergia sissoo, Ficus palmata, Grewia optiva, Juglans regia, Pinus roxburghii, P. wallichiana, Quercus baloot, Q. floribunda, Q. glauca, Q. leucotricophora, Q. semecarpifolia, Robinia pseudoacacia* etc. whereas class nanophanerophyte is mainly constituted by *Berberis lyceum, Dendrocalamus strictus, Euphorbia royleana, Ipomoea carnea, Justicia adhatoda, Prinsepia utilis, Vitex negundo* etc.The biological spectrum of study area reveals the

dominance of Therophytes (33.85%) followed by Hemicryptophytes (18.75%), Chamaephytes (14.32%), Macrophanerophytes (11.72%), Nanophanerophytes (10.94%), Geophytes (4.95%), Lianas (3.91%), Hydrophytes (1.04%) and Epiphytes (0.52%). The total species count and percent values of life form classes found in study area has been summarised in Table-3. From this, it can be derived that the phytoclimate of the study area is of Thero-Hemicryptophytic type. The comparison of the biological spectrum of the study area with Raunkiaer's normal biological spectrum is presented in the Table-4.

The thero-hemicryptophytic climate of the area is attributed to various factors like prevalent microclimate of the region coupled with anthropogenic activities like grazing, developmental activities and longitudinal and latitudinal difference, as has also been advocated by other workers (Kumar, 1997; Kour, 2001; Kesar, 2002; and Singh 2003).The predominance of therophytes indicates a disturbed environmental condition where phanerophytes cannot establish themselves. Anthropogenic activities including overgrazing, overharvesting and developmental activities reduce the macro element of the vegetation. This facilitates the dominance of other life form classes. Sher *et al*. (2004a) have also reported that extensive biotic influences increased short lived annuals. Ansari & Singh (1979) and Sharma & Dhakre (1993) also attributed the biotic interference, overgrazing etc. for the dominance of therophytes in their respective study areas.

The comparison of life forms of study area with adjoining areas having similar climatic conditions in Northwestern Himalayas is represented in the Table 5. Perusal of the table reveals that all these regions show different type of phytoclimate despite being similar to one another. This may be because of the varied amount of disturbances and longitudinal and latitudinal difference in these areas. Among these areas, the phytoclimate of study area resembles to that of Patnitop (Kumar, 1997) and Trikuta hills (Kour, 2001).

Table-3: Total number of species and percentage of different life form classes

Lifeform class	No. of species	Percentage (%)
Therophytes (TH)	130	33.85
Hemicryptophytes (H)	72	18.75
Chamaephyte (CH)	55	14.32
Macrophanerophytes (M)	45	11.72
Nanophanerophytes (N)	42	10.94
Geophytes (G)	19	4.95
Lianas(L)	15	3.91
Hydrophytes and Helophytes (HH)	4	1.04
Epiphytes (E)	2	0.52
Total	384	100

Table-4: Comparison of biological spectrum of study area with Raunkiaer's (1934) Normal Biological Spectrum

Life Form	TH	HH	G	H	CH	N	M	L	E
Percentage lifeform (present study)	33.85	1.04	4.95	18.75	14.32	10.94	11.72	3.91	0.52
Percentage lifeform in normal spectrum	13	2.0	4.0	26.0	9.0	15.0	28.0	–	3.0
Percentage deviation	+20.85	-0.96	+0.95	-7.25	+5.32	-4.06	-16.28	+3.91	-2.48

Table-5: Comparison of life forms of study area with adjoining areas having similar climatic conditions in Northwestern Himalayas

Life forms		TH	HH	G	H	CH	N	M	L	E
Study Area	Author	33.85	1.04	4.95	18.75	14.32	10.94	11.72	3.91	0.52
Bhaderwah	Kumar, 1987	29.30	3.27	4.50	37.09	11.47	6.14	6.35	1.43	0.40
Patnitop	Kumar, 1997	29.8	3.2	3.5	26.4	15.2	8.5	10.4	2.6	0.2
Trikuta Hills	Kour, 2001	27.31	3.09	7.73	26.00	16.49	15.0	28.0	1.03	3.0
Kalakote Forest Range	Singh, 2002	30.89	1.40	3.65	12.64	16.85	12.35	16.57	5.61	-
District Jammu	Sharma, 2003	35.45	1.78	2.02	9.11	13.93	11.64	16.70	8.87	0.50
District Kathua	Jhangir, 2004	32.89	1.27	2.55	15.77	12.36	12.79	16.63	5.11	0.63
Mansar-Surinsar Wildlife Sanctuary	Rai, 2007	34.70	4.46	2.06	7.56	15.46	10.65	15.80	8.59	0.68

Conclusion

The forests of the study area represent sub-tropical to temperate vegetation. During the floristic survey Asteraceae, Fabaceae, Lamiaceae and Rosaceae have been found to be dominant families. Phytoclimate of the study area has been worked out to be of Thero-Hemicryptophytic type. The therophytes, chamaephytes and geophytes constitute the higher percentage than the normal spectrum. It clearly indicates that some anthropogenic (overgrazing and developmental activities) are operating together and favouring the chances of growth of short lived annuals.

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