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Article

Phytosociological Study of Herbaceous Plant Community in Yusmarg Forest: A Developing Hill Resort in Kashmir Valley

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Abstract: The present research was conducted at Yusmarg area of Kashmir region, aimed to study the present scenario of phytosociology with respect the species dominance, species diversity and to study human impact to the herb community. The research was carried out from June to December, 2010. The study was based on three study sites with marked differences in their physical and biotic features. During the study period, 41 herb species belonging to 20 different families were observed. The total importance value index was observed the highest (93.81) for *Cynadon dactylon* at site 1 and lowest (1.54) for *Leucanthemum vulgare* and *Geum* sp at site 1. The total relative density was observed the highest (52.46) for *Cynadon dactylon* at site 1 and lowest (0.06) for *Leucanthemum vulgare* and *Geum* sp at site 1. Shanon-Weaver diversity index was having small variation during the study period. Simpson's Dominance index was less than 1 which showed that the sites were not dominated by single species. The spatial distribution pattern of herbs was contagious. The Sorenson's Similarity index was the highest (69.17%) between site 2 and site 3 and lowest (46.39%) between site 1 and site 3. The results showed that there is low grazing pressure and moderate human impact on normal distribution of herb species which may cause reduction in herbaceous community in next few decades in the forest ecosystem.

Keywords: *Cynadon dactylon*; *Trifolium pretense*; *Fragaria nubicula*; Polygonaceae; Herb; Yusmarg Forest.

1. Introduction

Biodiversity is the variety of living organisms considered at all levels of organization, from gene through species, to higher organization levels including habitats and ecosystems. Biodiversity encompasses the whole of the floristic, faunal and microbial diversity present on the earth (Dar and Farooq, 1997). Unfortunately, this precious biological wealth has been eroded to an alarming level by ruthless anthropogenic activities (Kushwah and Kumar, 2001). In this backdrop, the Convention on Biological Diversity (CBD) 1992, enjoined all the member countries to undertake inventorization of the components of biological diversity on priority basis, as there remain several parts of the world, either under – or virtually un- explored (Heywood, 2001). Consequently, such a strategy would be helpful in collating of the base-line data for effective conservation policies (Gadgil, 1994). Vegetation is a key factor in determining the structure of an ecosystem. It determines many ecological parameters within a plant community such as microclimate, energy budget, photosynthesis, water regimes, surface runoff and soil temperature (Tappeiner and Cernusca, 1996). The number of species reflects the gene pool and adaptation potential of the community (Odum, 1963). Quantitative analysis of vegetation helps in understanding the structure, composition and tropic organization of any community. Species composition and diversity vary from habitat to habitat within the communities exposing identical physiognomic characteristics (Nautiyal *et al.,* 1999). Likewise, the life forms of species represent the adjustment of perennating organs and plant life history to environmental conditions (Nautiyal *et al.,* 2001). Plant species diversity in the under storey strata is an important component in ecosystem functioning (Host and Register, 1991; Arsenault and Bradfield, 1995; Brakenhielm and Lui, 1998). In general, plant species diversity in the under storey is sensitive to ecosystem conditions (Pregitzer and Barnes, 1982; Strong *et al.,* 1991; Mitchell *et al.,* 1998) as well as to disturbance such as canopy removal (Duffy and Meier, 1992) and grazing (Hadar *et al.,* 1999). The forest floor vegetation plays an important role in nutrient cycling, habitat conservation and regeneration of tree shrubs. The herbaceous floor vegetation has been reported to show high nutrient content and rapid turnover rates as influenced by climatic conditions (Spain, 1984) and vegetation characteristics (Vogt and Vogt, 1986). The floristic diversity of Kashmir is considerably rich. It can be attributed mainly to the rich variety in topography, altitude and climate. The forest herbs, which play an important role in rural communities for example, the livestock totally dependent on them for fodder and as traditional medicines, have been hardly studied from diversity standpoint (Singh and Singh, 1987). Plants enact as producers in the ecosystem functioning; therefore, the study of floristic diversity assumes much pre-eminence (Bilgrami, 1995). Kashmir Valley in our country harbors a rich repository of diverse flora due to its varied topography and spatial heterogeneity (Dar *et al.,* 2001). In this backdrop, the present study was undertaken to assess the structural aspects of the herbaceous plant community in Yusmarg forest.

Phytosociology is the study of the characteristics, classification, relationships, and distribution of plant communities (The American Heritage Dictionary, 3rd edition). The description and classification of the plant community in an ecosystem is known as phytosociology (Braun-Blanquet, 1932; Odum, 1971). It is useful to collect such data to describe the population dynamics of each species studied and how they relate to the other species in the same community. Subtle differences in species composition and structure may point to differing abiotic conditions such as soil moisture, light availability, temperature, exposure to prevailing wind, etc. Phytosociological analysis of natural vegetation is recognized as an efficient and appropriate method to select out useful plant species from natural communities (Katsuno, 1977).

2. Material and Methods

2.1. Study Area

Yusmarg is a small meadow set in the heart of mountains to the south-west of Srinagar and is approximately 47 km from the Srinagar. It lies in the Budgam district of Jammu and Kashmir within the geographic coordinates of 33º49'42" N latitude and 74º39'59"E longitude and lies at an altitude of 2500-2750 m above mean sea level. Yusmarg mesmerizes tourists with its scenic beauty and mountains comparable to European Alps. It is reputed for having some unique spring flowers. The mighty river Doodh Ganga makes this destination more thrilling. The area of Yusmarg enjoys a temperate climate and the main seasons in this area are those of summer and winter. Precipitation in Yusmarg is normally in the form of snowfall during the winter and early spring. Summers are mild and winters in Yusmarg are very cold. The temperature ranges from an average daily maximum of 31 °C and minimum of 15 °C during the summer months to an average daily maximum of 4 °C and a minimum of -4 °C during winter months.

2.2. Study Sites

Site 1. Transition zone between meadow land and a forest

This site is situated at 33°50′00.6″N latitude, and 74°40′08.6″E longitude at an elevation of 2,436 m above mean sea level on way to Nilnag Coniferous forest opposite to JK TDC HUTS and near to the grazing area, dominated with coniferous tree species and having rough and sloppy topography.

Site 2. Between upper and lower reaches of forest beat

This site is situated at 33°50′08.3″N latitude, 74°40′57.2″E longitude and 2,445 m above mean sea level and having sharp steepness compared to site 1.

Site 3. Bushy forest area

This site is situated at 33°50′16.2″N latitude, 74°39′43.9″E longitude and the altitude 2,400 m above mean sea level. The site was dominated by dense coniferous forests while herbaceous plant diversity was rich.

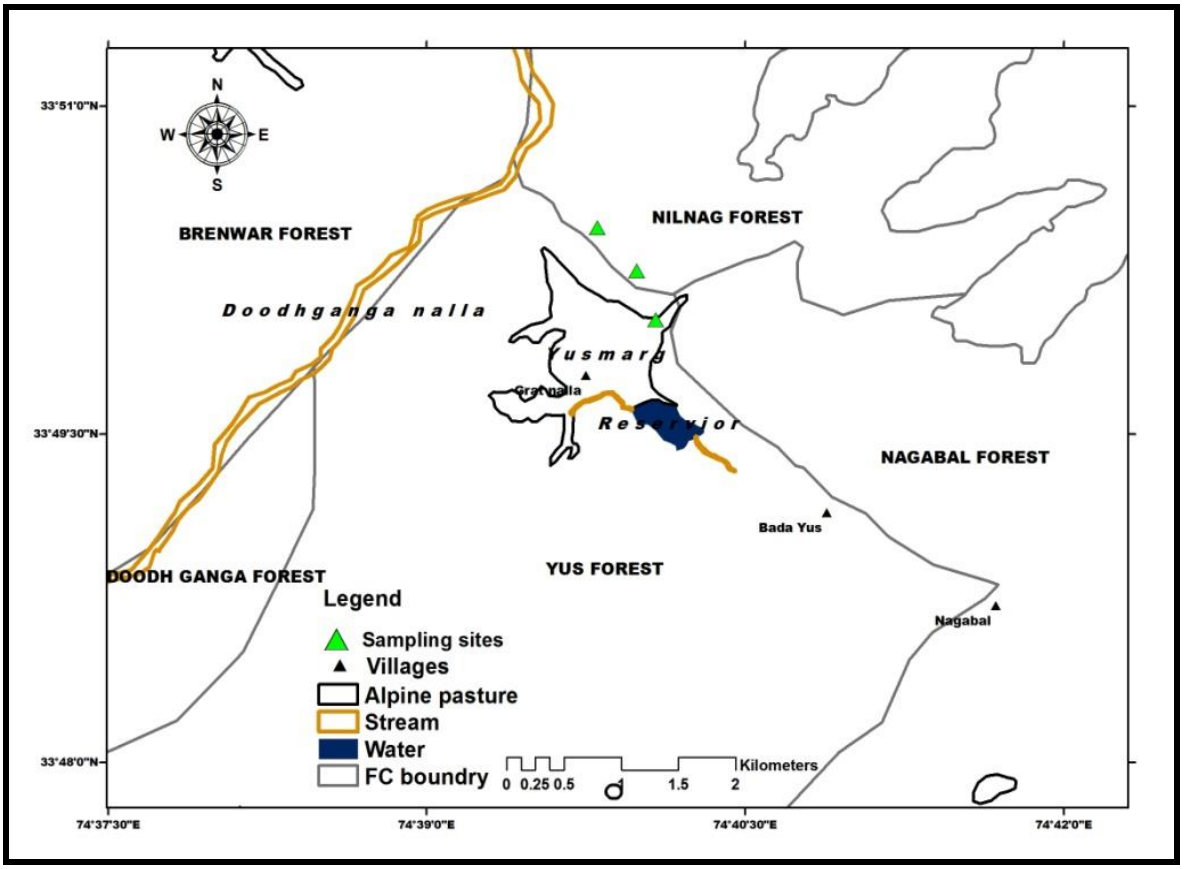


Figure 1. Map of study area (Yusmarg) and study sites.

2.3. Sampling and Collection

During the first phase of the study periodic surveys were conducted, the phytosociological analysis of herbaceous vegetation was carried out on the monthly basis at 3 study sites. The plants were collected along with underground portion with the help of trowel. In the second phase of methodology, 0.5 m × 0.2 m (0.1 m^2) Daubenmire frames or quadrats were laid randomly at 3 different sites at high altitude the conventional 1 m^2 quadrats does not yield good result. Quantitative parameters such as percentage of frequency, density and abundance of each species present in quadrats were recorded and analyzed as per the methods of Curtis and McIntosh (1950). The importance value index was calculated by summing the three relative values, viz., relative frequency, relative density and relative dominance following the methods of Curtis (1959) and Phillips (1959). The ratio of abundance

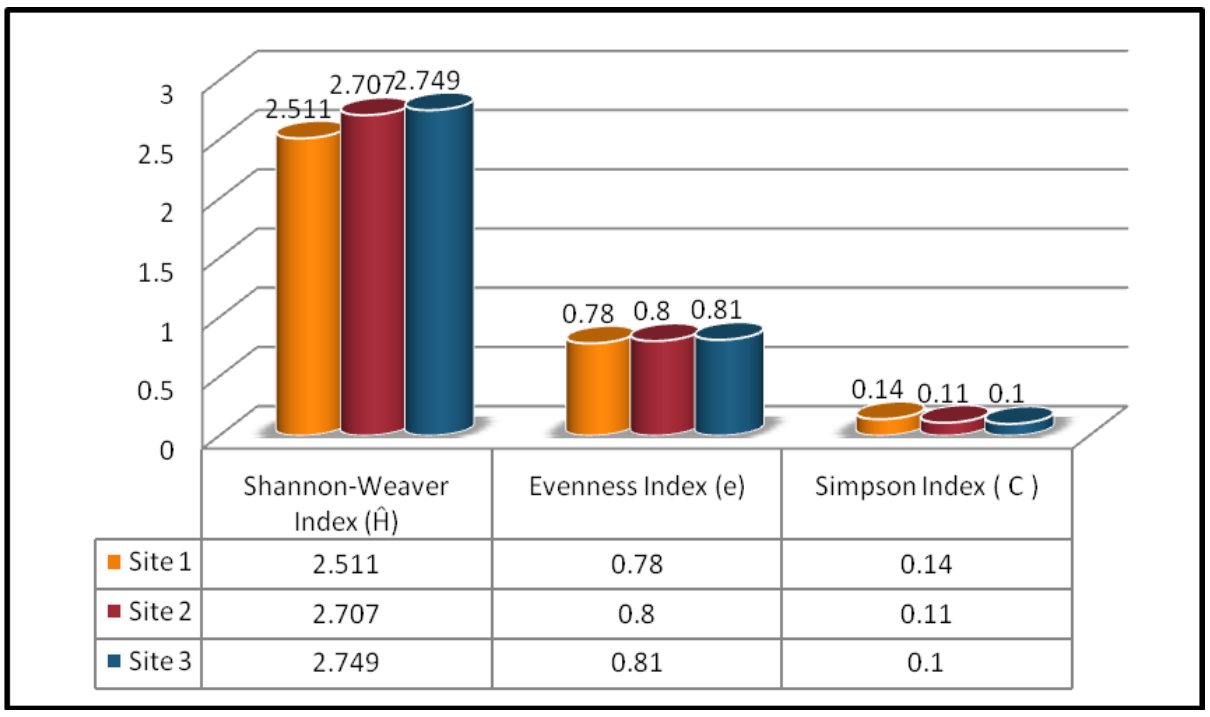
to frequency (A/F) was calculated as per the method of Curtis and Cottam (1956). The concentration of dominance (Cd) was computed by Simpson's index (Simpson, 1949). The diversity index was computed by using Shannon-Weaver index (Shannon-Weaver, 1963). Pielou evenness index (e) was used to compute species apportionment (Pielou, 1966).

3. Results

A maximum of 41 herb species were recorded from all the study sites during present investigation, belonging to 20 families. Polygonaceae was represented by 5 species, followed by Asteraceae and Lamiaceae (4 species each), 3 species were each from the families Poaceae, Fabaceae and Rosaceae, and 2 species were each from the families Plantiganaceae, Caryophyllaceae, Oxiladaceae, Boraginaceae and Primulaceae, and remaining 9 families were represented by one species each. Asteraceae was the dominant family with 4 genera, followed by Poaceae, Fabaceae, Rosaceae and Lamiaceae with 3 genera each, Boraginaceae, Caryophyllaceae and Polygonaceae with 2 genera each, and remaining 12 families were represented by single genus only. A maximum number of 25 herb species were recorded at the site 1. The research analysis of data as presented in Table 1 revealed that at site 1, the density and importance value index (IVI) was the highest in the month of June for *Cynadon dactylon* as 72.2 and 102.09, followed by *Trifolium pratense* 43.8 and 68.49 respectively. In the month of November *Cynadon dactylon* have 50.8 and 128.73 density and IVI followed by *Trfolium pretense* as 19.8 and 56.93 (Table1). In December again *Cynadon dactylon* had the highest density and IVI as 37 and 91.93, followed by *Trifolium pretense* as 10.2 and 34.63 respectively. Overall density and IVI values were obtained the highest for *Cynadon dactylon* as 53.33 and 93.81 and *Leucanthemum vulgare* and *Geum* sp had the least density and IVI values. At site 2, the maximum number of 30 herb species was recorded in all the three months. The density and IVI was the highest in the month of June for *Cynadon dactylon* as 60.8 and 115.23 respectively, followed by *Trifolium pretense* as 24 and 59.55 respectively. In the month of November density and IVI was the highest for *Cynadon dactylon* as 14.8 and 63.65, followed by *Trifolium pretense* as 9.6 and 46.82 respectively. In the month of December density and IVI had the highest values for *Cynadon dactylon* as 12 and 56.69, followed by *Fragaria nubicula* as 9.6 and 47.7 respectively. The overall values for density and IVI were obtained the highest for *Cynadon dactylon* as 29.2 and 80, followed by *Trifolium pretense* as 12.07 and 41.48, respectively. The important value index of herb species of this site revealed that *Plantago major*, *Cynoglossum*sp, *Salvia moorcroftiana* and *Rumexnepalensis* were the least dominant (Table 2). At site 3, the maximum number of 29 herb species was recorded. The density and IVI values in the month of June were the highest for *Cynadon dactylon* as 19.4 and 76.12, followed by *Fragaria nubicula* as 11 and 50.14, respectively. In the month of November density and IVI values were the highest for *Cynadon dactylon*

as 25.4 and 98.22, followed by *Trifolium pretense* as 9.2 and 45.24, respectively. In the month of December density and IVI was the highest for *Cynadon dactylon* as 11.4 and 73.13, followed by *Fragaria nubicula* as 6 and 45.24, respectively (Table 3). Overall density and IVI values were the highest for *Cynadon dactylon* as 18.73 and 75.67 (Table 4), followed by *Fragaria nubicula* as 6 and 33.07, respectively. The important value index of herb species of this site revealed that *Plantagolanceolata, Cynoglossum*sp, *Sambucuswightiana*, *Nepetacataria*, *Rumexacetosa*, *Lespedeza* sp, *Geum*sp, *Epilobiumlaxum*, *Myosotisarvensis*, *Chenopodium album* and *Rumexhastatus* were the least dominant.

The total diversity index ($\hat{H}$) in all the three months was estimated to be 2.51 at site 1, 2.7 at site 2, and 2.75 at site 3. The total evenness index (e) in all the three months was attained as 0.78 at site 1, 0.8 at site 2, and 0.81 at site 3 (Fig. 2). Abundance/Frequency (A/F) ratio was obtained 0.3133 at site 1, 0.2288 at site 2, and 0.1666 at site 3 (Table 5). These results showed contagious spatial distribution in case of herb species. Sorenson's Similarity Index was obtained 66.9% between site 1 and site 2, 46.39% between site 1 and site 3, and 69.17% between site 2 and site 3 (Table 6).



	Shannon-Weaver Index ($\hat{H}$)	Evenness Index (e)	Simpson Index (C)
Site 1	2.511	0.78	0.14
Site 2	2.707	0.8	0.11
Site 3	2.749	0.81	0.1

Figure 2. Diversity indices.

Table 1. Phytosociological attributes of herbs at site 1

Genera	June								November								December							
	F %	RF	D m-2	RD	A	RA	IVI	A/F	F %	RF	D m-2	RD	A	RA	IVI	A/F	F %	RF	D m-2	RD	A	RA	IVI	A/F
Ranunculus laetus	20	3.33	2.6	1.81	13	6.31	11.46	0.65	-	-	-	-	-	-	-	-	20	2.56	0.6	0.78	3	2.49	5.84	0.15
Rumex patentia	40	6.67	0.4	0.28	1	0.48	7.43	0.02	60	9.68	0.8	0.94	1.33	1.17	11.79	0.02	-	-	-	-	-	-	-	-
Cynodon dactylon	100	16.67	72.2	50.35	72.2	35.08	102.09	0.72	80	12.9	50.8	60.05	63.5	55.78	128.73	0.79	100	12.82	37	48.43	37	30.68	91.93	0.37
Plantago major	60	10	2.4	1.67	4	1.94	13.62	0.07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trifolium pratense	100	16.67	43.8	30.54	43.8	21.28	68.49	0.44	100	16.13	19.8	23.4	19.8	17.39	56.93	0.19	100	12.82	10.2	13.35	10.2	8.46	34.63	0.1
Cerastium cerastoides	40	6.67	5.6	3.91	14	6.8	17.37	0.35	20	3.22	1.2	1.42	6	5.27	9.91	0.3	20	2.56	0.2	0.26	1	0.83	3.65	0.05
Taraxacum officinale	40	6.67	0.4	0.28	1	0.48	7.43	0.02	40	6.45	1.4	1.65	3.5	3.07	11.18	0.09	60	7.69	2.4	3.14	4	3.32	14.15	0.07
Plantago lanceolata	20	3.33	0.2	0.14	1	0.48	3.96	0.05	20	3.22	0.4	0.47	2	1.76	5.45	0.1	40	5.13	0.8	1.05	2	1.66	7.83	0.05
Fragaria nubicola	40	6.67	5.8	4.04	14.5	7.04	17.75	0.36	20	3.22	0.2	0.24	1	0.88	4.34	0.05	20	2.56	1.2	1.57	6	4.97	9.11	0.3
***Nepeta* sp**	60	10	2.6	1.81	4.33	2.1	13.92	0.07	40	6.45	2.2	2.6	5.5	4.83	13.89	0.14	100	12.82	4.4	5.76	4.4	3.65	22.23	0.04
Oxalis corniculata	20	3.33	1	0.69	5	2.43	6.46	0.25	-	-	-	-	-	-	-	-	20	2.56	0.2	0.26	1	0.83	3.65	0.05
Stellaria media	20	3.33	0.8	0.56	4	1.94	5.83	0.2	-	-	-	-	-	-	-	-	20	2.56	0.2	0.26	10	0.83	3.65	0.05
Polygonum hydropiper	20	3.33	1	0.69	5	2.43	6.46	0.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
***Primula* sp**	20	3.33	4.6	3.21	23	11.17	17.71	1.15	100	16.13	6.2	7.33	6.2	5.45	28.9	0.06	20	2.56	0.2	0.26	1	0.83	3.65	0.05
Viola odorata									20	3.22	0.4	0.47	2	1.76	5.45	0.1	-	-	-	-	-	-	-	-
***Potentilla* sp**									40	6.45	0.4	0.47	1	0.88	7.8	0.02	60	7.69	3.8	4.97	6.33	5.25	17.92	0.1
Primula denticulata																	60	7.69	5	6.54	8.33	6.9	21.15	0.12
Cirsium falcornei									40	6.45	0.4	0.5	1	0.9	8	0.02	20	2.56	0.2	0.26	1	0.83	3.65	0.05
Salvia moorcroftiana									40	6.45	0.4	0.5	1	0.9	8	0.02	-	-	-	-	-	-	-	-
Lolium perenne																	40	5.13	6.4	8.38	16	13.27	26.77	0.4
Veronica bucabenga																	20	2.56	0.6	0.78	3	2.49	5.84	0.15

Leucanthemum vulgare																		20	2.56	0.2	0.26	1	0.83	3.65	0.05
***Geum* sp**																		20	2.56	0.2	0.26	1	0.83	3.65	0.05
***Mentha* sp**																		20	2.56	1.4	1.83	7	5.8	10.2	0.35
Rumex acetosa																		20	2.56	1.8	2.36	9	7.3	12.22	0.45

Note: **F** = Frequency (%), **RF** = Relative frequency, **D (m^{-2})** = Density, **RD** = Relative density, **A** = Abundance, **RA** = Relative abundance, and **IVI** = Importance value index.

Table 2. Phytosociological attributes of herbs at site 2

Genera	**June**								**November**								**December**							
	F %	RF	D m-2	RD	A	RA	IVI	A/F	F %	RF	D m-2	RD	A	RA	IVI	A/F	F %	RF	D m-2	RD	A	RA	IVI	A/F
Rannunculus laetus	20	2.7	1	0.97	5	3.53	7.19	0.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rumex patentia	40	5.4	0.8	0.77	2	1.41	7.59	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cynodon dactylon	100	13.51	60.8	58.8	60.8	42.91	115.23	0.61	80	14.28	14.8	30.45	18.5	18.91	63.65	0.23	80	11.76	12	26.9	15	18.02	56.69	0.19
Plantago major	20	2.7	0.2	0.19	1	0.7	3.6	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trifolium pratense	60	8.11	24	23.21	40	28.23	59.55	0.67	60	10.71	9.6	19.75	16	16.35	46.82	0.27	40	5.88	2.6	5.83	6.5	7.81	19.52	0.16
Cerastium cerastoides	20	2.7	0.6	0.58	3	2.12	5.4	0.15	-	-	-	-	-	-	-	-	20	2.94	0.4	0.89	2	2.4	6.24	0.1
Taraxacum officinale	80	10.81	1.4	1.35	1.75	1.23	13.39	0.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Plantago lanceolata	-	-	-	-	-	-	-	-	40	7.14	0.8	1.65	2	2.04	10.83	0.05	-	-	-	-	-	-	-	-
Fragaria nubicola	60	8.11	2	1.93	3.33	2.35	12.39	0.06	60	10.71	9.2	18.93	15.33	15.67	45.32	0.25	80	11.76	9.6	21.52	12	14.41	47.7	0.15
***Nepeta* sp**	100	13.51	5.8	5.61	5.8	4.09	23.22	0.06	20	3.57	1.4	2.88	7	7.15	13.61	0.35	80	11.76	3	6.72	3.75	4.5	22.99	0.05
Oxalis corniculata	20	2.7	1.2	1.16	6	4.23	8.09	0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stellaria media	-	-	-	-	-	-	-	-	40	7.14	0.8	1.65	2	2.04	10.83	0.05	-	-	-	-	-	-	-	-
***Primula* sp**	60	8.11	1.8	1.74	3	2.12	11.97	0.05	-	-	-	-	-	-	-	-	20	2.94	0.2	0.45	1	1.2	4.59	0.05

Viola odorata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	80	11.76	3.6	8.07	4.5	5.4	25.24	0.06
***Potentilla* sp**	-	-	-	-	-	-	-	-	40	7.14	2.4	4.94	6	6.13	18.21	0.15	40	5.88	0.6	1.34	1.5	1.8	9.03	0.04
Primula denticulata	-	-	-	-	-	-	-	-	40	7.14	2.8	5.76	7	7.15	20.06	0.17	20	2.94	0.8	1.79	4	4.8	9.54	0.2
Cirsium falcornei	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	40	5.88	0.8	1.79	2	2.4	10.08	0.05
Salvia moorcroftiana	-	-	-	-	-	-	-	-	20	3.57	0.2	0.41	1	1.02	5	0.05	-	-	-	-	-	-	-	-
Lolium perenne	-	-	-	-	-	-	-	-	60	10.71	3	6.17	5	5.11	21.99	0.08	40	5.88	6	13.45	15	18.02	37.35	0.37
Veronica bucabenga	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	2.94	0.6	1.34	3	3.6	7.89	0.15
***Geum* sp**	-	-	-	-	-	-	-	-	20	3.57	0.4	0.82	2	2.04	6.44	0.1	20	2.94	0.2	0.45	1	1.2	4.59	0.05
***Mentha* sp**	-	-	-	-	-	-	-	-	20	3.57	1.8	3.7	9	9.19	16.47	0.45	40	5.88	2.6	5.83	6.5	7.81	19.52	0.16
Rumex nepalinsis	-	-	-	-	-	-	-	-	20	3.57	0.2	0.41	1	1.02	5	0.05	-	-	-	-	-	-	-	-
Chenopodum album	20	2.7	0.4	0.39	2	1.41	4.5	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Poa sp	20	2.7	0.4	0.39	2	1.41	4.5	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Podophullum hexandrum	40	5.4	0.4	0.39	1	0.7	6.49	0.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
***Cynoglossum* sp**	20	2.7	0.2	0.19	1	0.7	3.6	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oxalis acetosa	-	-	-	-	-	-	-	-	20	3.57	0.8	1.65	4	4.09	9.31	0.2	-	-	-	-	-	-	-	-
***Astragalus* sp**	-	-	-	-	-	-	-	-	20	3.57	0.4	0.82	2	2.04	6.44	0.1	40	5.88	1	2.24	2.5	3	11.13	0.06
Conyza canadensis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	2.94	0.6	1.34	3	3.6	7.89	0.15

Note: **F** = Frequency (%), **RF** = Relative frequency, **D (m^{-2})** = Density, **RD** = Relative density, **A** = Abundance, **RA** = Relative abundance, and **IVI** = Importance value index.

Table 3. Phytosociological attributes of herbs at site 3

Genera	June								November								December							
	F %	RF	D m-2	RD	A	RA	IVI	A/F	F %	RF	D m-2	RD	A	RA	IVI	A/F	F %	RF	D m-2	RD	A	RA	IVI	A/F
Rannunculus laetus	40	6.45	2.6	5.22	6.5	7.05	18.72	0.16	60	9.09	4	7.81	6.67	8.78	25.69	0.11	40	6.45	1.8	5.62	4.5	7.77	19.85	0.11
Rumex patentia	20	3.22	0.2	0.4	1	1.08	4.71	0.05	60	9.09	2	3.91	3.33	4.39	17.39	0.06	-	-	-	-	-	-	-	-
Cynodon dactylon	100	16.13	19.4	38.95	19.4	21.03	76.12	0.19	100	15.15	25.4	49.61	25.4	33.46	98.22	0.25	80	12.9	11.4	35.62	14.25	24.61	73.13	0.18
Plantago major	20	3.22	0.4	0.8	2	2.17	6.19	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trifolium pratense	40	6.45	5	10.04	12.5	13.55	30.04	0.31	80	12.12	9.2	17.97	11.5	15.15	45.24	0.14	40	6.45	2.8	8.75	7	12.09	27.29	0.17
Cerastium cerastoides	-	-	-	-	-	-	-	-	20	3.03	0.6	1.17	3	3.95	8.15	0.15	20	3.22	1	3.12	5	8.63	14.98	0.25
Taraxacum officinale	-	-	-	-	-	-	-	-	20	3.03	0.2	0.39	1	1.32	4.74	0.05	40	6.45	0.6	1.87	1.5	2.59	10.92	0.04
Plantago lanceolata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	3.22	0.2	0.62	1	1.73	5.58	0.05
Fragaria nubicola	100	16.13	11	22.09	11	11.93	50.14	0.11	40	6.06	1	1.95	2.5	3.29	11.31	0.06	100	16.13	6	18.75	6	10.36	45.24	0.06
***Nepeta* sp**	20	3.22	1.2	2.41	6	6.5	12.14	0.3	80	12.12	3.6	7.03	4.5	5.93	25.08	0.056	40	6.45	1.2	3.75	3	5.18	15.38	0.07
Oxalis corniculata	40	6.45	3	6.02	7.5	8.13	20.61	0.19	-	-	-	-	-	-	-	-	20	3.22	0.4	1.25	2	3.45	7.93	0.1
Stellaria media	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	40	6.45	1.6	5	4	6.91	18.36	0.1
***Primula* sp**	20	3.22	1	2.01	5	5.42	10.65	0.25	40	6.06	1.6	3.12	4	5.27	14.45	0.1	-	-	-	-	-	-	-	-
Viola odorata	60	9.68	2.6	5.22	4.33	4.69	19.59	0.07	20	3.03	0.8	1.56	4	5.27	9.86	0.2	60	9.68	3	9.37	5	8.63	27.69	0.08
Primula denticulata	-	-	-	-	-	-	-	-	40	6.06	1.6	3.12	4	5.27	14.45	0.1	-	-	-	-	-	-	-	-
Cirsium falcornei	20	3.22	0.2	0.4	1	1.08	4.71	0.05	20	3.03	0.4	0.78	2	2.63	6.45	0.1	60	9.68	1	3.12	1.67	2.88	15.68	0.03
***Geum* sp**	-	-	-	-	-	-	-	-	20	3.03	0.2	0.39	1	1.32	4.74	0.05	-	-	-	-	-	-	-	-
Rumex acetosa	-	-	-	-	-	-	-	-	20	3.03	0.2	0.39	1	1.32	4.74	0.05	-	-	-	-	-	-	-	-
Chenopodum	20	3.22	0.2	0.4	1	1.08	4.71	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

album																								
***Cynoglossum* sp**	-	-	-	-	-	-	-	-	20	3.03	0.2	0.39	1	1.32	4.74	0.05	-	-	-	-	-	-	-	-
***Astragalus* sp**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	40	6.45	0.8	2.5	2	3.45	12.4	0.05
Epilobium laxum	20	3.22	0.2	0.4	1	1.08	4.71	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Anagallis arvensis	20	3.22	1.2	2.41	6	6.5	12.14	0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Myosotis arvensis	20	3.22	0.2	0.4	1	1.08	4.71	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rumex hastatus	20	3.22	0.2	0.4	1	1.08	4.71	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
***Convolvulus* sp**	20	3.22	1	2.01	5	5.42	10.65	0.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
***Lespedeza* sp**	20	3.22	0.2	0.4	1	1.08	4.71	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sambucus wightiana	-	-	-	-	-	-	-	-	20	3.03	0.2	0.39	1	1.32	4.74	0.05	-	-	-	-	-	-	-	-
Nepeta cataria	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	3.22	0.2	0.62	1	1.73	5.58	0.05

Note: **F** = Frequency (%), **RF** = Relative frequency, **D (m^{-2})** = Density, **RD** = Relative density, **A** = Abundance, **RA** = Relative abundance, and **IVI** = Importance value index.

Table 4. Comparison of total frequency, total relative frequency, total density, total relative density, total abundance, total relative abundance and total importance value indices of different herb species at three different sites

Genera	**Site 1**							**Site 2**							**Site 3**						
	TF %	TRF	TD m-2	TRD	TA	TRA	TIVI	TF%	TRF	TD m-2	TRD	TA	TRA	TIVI	TF%	TRF	TD m-2	TRD	TA	TRA	TIVI
Rannunculus laetus	13.33	2	1.07	1.05	8	3.83	6.88	20	3.03	0.8	1.22	4	2.65	6.9	46.67	7.29	2.8	6.31	6	5.63	19.23
Rumex patentia	33.33	5	0.4	0.39	1.2	0.57	5.97	13.33	2.02	0.27	0.41	2	1.32	3.75	26.67	4.17	0.73	1.65	2.75	2.58	8.4
Cynodon dactylon	93.33	14	53.33	52.46	57.14	27.36	93.81	86.67	13.13	29.2	44.56	33.69	22.31	80	93.33	14.58	18.73	42.25	20.07	18.83	75.67
Plantago major	20	3	0.8	0.79	4	1.91	5.7	6.67	1.01	0.07	0.1	1	0.66	1.77	6.67	1.04	0.13	0.3	2	1.88	3.22
Trifolium pratense	100	15	24.6	24.19	24.6	11.78	50.97	53.33	8.08	12.07	18.41	22.62	14.98	41.48	53.33	8.33	5.67	12.78	10.62	9.97	31.08
Cerastium cerastoides	26.67	4	2.33	2.29	8.75	4.19	10.48	13.33	2.02	0.33	0.51	2.5	1.65	4.18	13.33	2.08	0.53	1.2	4	3.75	7.04
Taraxacum officinale	46.67	7	1.4	1.38	3	1.44	9.81	26.67	4.04	0.47	0.71	1.75	1.16	5.91	33.33	5.21	0.27	0.6	0.8	0.75	6.56
Plantago lanceolata	26.67	4	0.47	0.46	1.75	0.84	5.29	20	3.03	0.6	0.91	3	1.99	5.93	6.67	1.04	0.07	0.15	1	0.94	2.13

Fragaria nubicola	26.67	4	2.4	2.36	9	4.31	10.67	66.67	10.1	6.93	10.58	10.4	6.89	27.57	80	12.5	6	13.53	7.5	7.03	33.07
***Nepeta* sp**	60	9	3.07	3.02	5.11	2.45	14.46	66.67	10.1	3.4	5.19	5.1	3.38	18.67	46.67	7.29	2	4.51	4.28	4.02	15.82
Oxalis corniculata	13.33	2	0.4	0.39	3	1.44	3.83	6.67	1.01	0.4	0.61	6	3.97	5.59	20	3.12	1.13	2.56	5.67	5.31	10.99
Stellaria media	13.33	2	0.33	0.33	2.5	1.19	3.52	13.33	2.02	0.27	0.41	2	1.32	3.75	13.33	2.08	0.53	1.2	4	3.75	7.04
***Primula* sp**	13.33	2	3.67	3.61	27.5	13.16	18.77	26.67	4.04	0.67	1.02	2.5	1.65	6.71	20	3.12	0.87	1.95	4.33	4.06	9.14
Viola odorata	6.67	1	0.13	0.13	2	0.96	2.09	26.67	4.04	1.2	1.83	4.5	2.98	8.85	46.67	7.29	2.13	4.81	4.57	4.29	16.39
***Potentilla* sp**	33.33	5	1.4	1.38	4.2	2.01	8.39	26.67	4.04	1	1.52	3.75	2.48	8.05	-	-	-	-	-	-	-
Primula denticulata	53.33	8	1.67	1.64	3.12	1.49	11.13	20	3.03	1.2	1.83	6	3.97	8.83	13.33	2.08	0.53	1.2	4	3.75	7.04
Cirsium falcornei	20	3	0.2	0.19	1	0.48	3.67	13.33	2.02	0.27	0.41	2	1.32	3.75	26.67	4.17	0.53	1.2	2	1.88	7.24
Salvia moorcroftiana	13.33	2	0.13	0.13	1	0.48	2.61	6.67	1.01	0.07	0.1	1	0.66	1.77	-	-	-	-	-	-	-
Lolium perenne	13.33	2	2.13	2.09	16	7.66	11.76	33.33	5.05	3	4.58	9	5.96	15.59	-	-	-	-	-	-	-
Veronica bucabenga	6.67	1	0.2	0.19	3	1.44	2.63	6.67	1.01	0.2	0.31	3	1.99	3.3	-	-	-	-	-	-	-
***Geum* sp**	6.67	1	0.07	0.06	1	0.48	1.54	13.33	2.02	0.2	0.31	1.5	0.99	3.32	6.67	1.04	0.07	0.15	1	0.94	2.13
***Mentha* sp**	6.67	1	0.47	0.46	7	3.35	4.81	20	3.03	1.47	2.24	7.33	4.86	10.12	-	-	-	-	-	-	-
Rumex nepalinsis	-	-	-	-	-	-	-	6.67	1.01	0.07	0.1	1	0.66	1.77	-	-	-	-	-	-	-
Chenopodum album	-	-	-	-	-	-	-	6.67	1.01	0.13	0.2	2	1.32	2.54	6.67	1.04	0.07	0.15	1	0.94	2.13
Poa sp	-	-	-	-	-	-	-	6.67	1.01	0.13	0.2	2	1.32	2.54	-	-	-	-	-	-	-
Podophullum hexandrum	-	-	-	-	-	-	-	13.33	2.02	0.13	0.2	1	0.66	2.88	-	-	-	-	-	-	-
***Cynoglossum*sp**	-	-	-	-	-	-	-	6.67	1.01	0.07	0.1	1	0.66	1.77	6.67	1.04	0.07	0.15	1	0.94	2.13
Oxalis acetosa	-	-	-	-	-	-	-	6.67	1.01	0.27	0.41	4	2.65	4.07	-	-	-	-	-	-	-
***Astragalus* sp**	-	-	-	-	-	-	-	20	3.03	0.47	0.71	2.33	1.54	5.29	13.33	2.08	0.27	0.6	2	1.88	4.56
Conyza canadensis	-	-	-	-	-	-	-	6.67	1.01	0.2	0.31	3	1.99	3.3	-	-	-	-	-	-	-
Epilobium laxum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.67	1.04	0.07	0.15	1	0.94	2.13
Anagallis arvensis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.67	1.04	0.4	0.9	6	5.63	7.57
Myosotis arvensis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.67	1.04	0.07	0.15	1	0.94	2.13
Rumex hastatus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.67	1.04	0.07	0.15	1	0.94	2.13
***Convolvulus* sp**	-	-	-	-	-	-	-		-	-	-	-	-	-	6.67	1.04	0.33	0.75	5	4.69	6.48
***Lespedeza* sp**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.67	1.04	0.07	0.15	1	0.94	2.13
Sambucus wightiana	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.67	1.04	0.07	0.15	1	0.94	2.13

Nepeta cataria	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.67	1.04	0.07	0.15	1	0.94	2.13
Leucanthemum vulgare	6.67	1	0.07	0.06	1	0.48	1.54	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polygonum hydropiper	6.67	1	0.33	0.33	5	2.39	3.72	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rumex acetosa	6.67	1	0.6	0.59	9	4.31	5.89	-	-	-	-	-	-	-	6.67	1.04	0.07	0.15	1	0.94	2.13

Note: **TF** = Total frequency (%), **TRF** = Total relative frequency, **TD (m^{-2})** = Total density, **TRD** = Total relative density, **TA** = Total abundance, **TRA** = Total relative abundance, and **TIVI** = Total importance value indices.

Table 5. Spatial distribution of species

Sites	A/F
Site 1	0.3133
Site 2	0.2288
Site 3	0.1666

Table 6. Similarity index between 3 different sites

S. No.	Sites	Similarity (Sorenson) Index
1	Site 1 & Site 2	66.9%
2	Site 1 & Site 3	46.39%
3	Site 2 & Site 3	69.17%

4. Discussion

Phytosociology is the branch of science which deals with plant communities, their composition and development, and the relationships between the species within them. The structure of a community is determined mainly by the dominating plant species and not by other characteristics (Odum, 1971). All these species are not equally important but there are only a few overtopping species which by their bulk and growth modify the habitat and control the growth of other species of the community as these species are called dominants (Gaston, 2000). The present research is an attempt to assess composition, structure and diversity of herbaceous species in Yusmarg. The research analysis of data revealed that a maximum of 41 herb species were recorded from the study sites belonging to 20 families. Polygonaceae was represented by the maximum species, followed by Asteraceae and Lamiaceae. The number of species in the herb communities was 25 at site 1, 30 at site 2, and 29 species at site 3. The differences may be due to the changes in the surrounding forest trees, anthropogenic activities and the access roads around the sites. During the present study it was found that all the three sites were dominated by *Cynadon dactylon* with the maximum IVI value. Its dominance at the specific sites was possibly on account of availability of optimum conditions for its growth. The higher value of IVI indicates that all the available resources are being utilized by that species and left over are being trapped by another species as the competitors and associates. Lower importance value of species is an index of low grazing pressure by herbivores on the study sites, as vegetation is a reflex of interactions between the plants, animals, soils and climate. Moreover, each species of a community plays specific role and there is a definite quantitative relationship between abundant and rare species (Bhandari *et al.*,

1999). The high IVI of a species indicated its dominance and ecological success, its good power of regeneration and greater ecological amplitude. Since *Cynadon dactylon* showed the maximum IVI values at all sites and therefore, emerged as dominant species of the ecosystem. A perusal of Sorenson Coefficient (S) values revealed the highest similarity between site 2 and site 3 and a marked difference in the distribution of plant species between site 1 and site 3. Site 2 and site 3 were located within the forest nearly 100 m apart while as site 1 was a transition zone between a meadow land and a forest. This could possibly explain the similarity and difference of IVI values between the different sites. Diversity represents the number of species, their relative abundance, composition, interaction among species and temporal and spatial variation in their properties. Where richness and evenness coincide, i.e., a high proportion of plant species in the vegetation is restricted, community of that area is supposed to have evolved through a long period of environmental stability (Kharkwal *et al.*, 2010). The observation in the present study showed that the site 3 was more diverse in comparison to the site 1 and site 2. Asteraceae was the dominant family in terms of number of Genera. This may be because most of the species of the family are primary succession and have different types of growth forms. This family showed basal as well as erect forms in which basal forms emerged near the ground-level with well developed petioles and formed a short-umbrella (Mehrotra, 1998). They can tolerate cool temperatures to high irradiances with low density of herb cover. Moreover, basal forms of Violaceae showed affinity to mesic and cold conditions under the three sites. Few species are able to tolerate the entire spectrum of environment and range throughout the gradient (Brown, 2001). Species richness generally increases during secondary succession when environmental and edaphic conditions are favorable with low fluctuations (Kharkwal *et al.*, 2010). Abundance and frequency (A/F) ratio reveals that regular distribution of the species was totally absent and most of the species were contagiously distributed in all sites during all seasons. This is in conformity with the observation of several workers that grasslands or grazing-lands, exhibit the dominance of aggregation due to tussock forms of grasses and specific microclimate preference of many forbs (Singh and Yadava, 1974). The contiguous distribution pattern is a characteristic pattern of nature (Odum, 1971), it was also reported for the other grazing-lands of Garhwal Himalaya (Joshi and Tiwari, 1990; Bhandari *et al.*, 1995; Pande *et al.*, 1996; Bhandari *et al.*, 1997) and for other ecosystems as well (Kershaw, 1973; Singh and Yadava, 1974; Kunhikannan *et al.*, 1998). Random distribution was found in very uniform environment only and regular distribution occurs where severe competition exists between individuals. The dominance of contagious distribution may also be due to the fact that the majority of herb species reproduce vegetative in addition to their sexuality. However, observations indicated that contagious distribution in vegetation was due to multitude of factors and the vegetative reproduction may not be the only reason (Kershaw, 1973; Saxena and Singh, 1982).

5. Conclusions

The herbaceous diversity of the study area was found to be represented by 41 plant species belonging to 34 genera under 20 families. The area is predominately covered by herbaceous flora and being less represented in terms of number of species. Out of 20 families, 9 families were represented by single species, that is, they are monotypic. *Cynodon dactylon* showed the maximum IVI values at all the 3 sites and therefore emerged as dominant species of the ecosystem. Simpson's dominance index was less than 1, which showed that the sites were not dominated by single species. The primary conclusion is that there is low grazing pressure and moderate human impact on normal distribution of herb species which may cause reduction in herbaceous community in next few decades in the forest ecosystem.

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