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Seasonal variation in herbaceous vegetation along three different altitudes of Benhama, Kashmir

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Abstract
The present study entitled "Seasonal Variation in herbaceous vegetation along three different altitudes of Benhama, Kashmir" was conducted at Faculty of forestry, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Benhama, Ganderbal, Jammu and Kashmir during the year 2015-2016 with the aim to assess the seasonal change in floristic composition and phytosociology of herbaceous species at selected site. The Vegetational analysis was done by harvesting sampling plots. Study site was divided three alitudes. At each altitude, five quadrats of size 1.25m x 1.25m were laid for herbaceous species. The floristic surveys conducted in the study area during the study period resulted in the identification of 64 plant species belonging to 18 families. The phytosociology of the different elevations revealed that *Cynodon dactylon* dominates all the three altitudes at the site. The phytosociological attributes of herbaceous species decreased along the altitudinal gradient. There is an increasing trend in the number of species mostly during spring and summer season and declining trend towards autumn season.

Keywords: Altitude, phytosociology, season, vegetation

Introduction
Vegetation is an important part of the ecosystem that reflects the effects of the entire environment [2]. Vegetation complex fluctuates from season to season in a cyclic way, and over the years in a successional manner; these fluctuations suggest a response by each species population to the prevailing heat, moisture, and light as modified by the vegetation itself. The development and death or decay of plant species alters the pattern of the species distribution in a community [19]. Vegetation ecology includes the investigation of species composition and the sociological interaction of species in communities [2]. It puts emphasis on the study of composition, development, geographic distribution, and environmental relationships of plant communities [12]. A detailed vegetation analysis provides information about species diversity, community organization, niche resources apportionment, and turnover rate of species in a forest ecosystem. Plants growing together have a mutual relationship among themselves and with the environment [14]. The quantitative relationship between rare and profusely growing species is an important structural property of a community. The quantitative study of vegetation is called Phytosociology [5], and its principal aim is to describe the vegetation, explain or predict its pattern, and classify it in a meaningful manner [16]. Phytosociological analysis of a plant community is first and foremost the basis of the ecological study of any piece of vegetation, and this study is important for understanding the functioning of any community [18].

Vegetations are of immense importance in soil stabilization and erosion control especially in mountainous and hilly regions. They also protect and conserve water supplies and prevent floods. Small groups of trees and even single trees have a similar role locally in preventing washouts and in holding stream banks, they contribute significantly to nutrient recycling, carbon dioxide absorption, and oxygen generation. The vegetation analysis is very important in order to estimate the vegetation of the area. Through vegetation analysis, the given vegetation is classified for homogeneity of composition, stature etc. into different vegetation classes. The vegetation analysis is carried out to study the vegetation of a particular area in terms of species, its density, frequency, abundance, dominance and Importance Value Index [20]. Analysis on the regional patterns of floristic richness showed that the main determining factors are those related to environmental heterogeneity (relief, substrates and climates).

Plant species richness is also positively related to temperature and to water availability [17].

Materials and Methods

Location

The present investigation was conducted at Faculty campus of Faculty of Forestry located at Benhama, Ganderbal, Jammu and Kashmir spread over 50 ha at an altitude of 1720m-1843m above mean sea level. The plantation site lies on the southern aspect at 34^0-16/ N and 74^0- 46/ E longitude. The existing land of the study site composed of three types of land problems namely: degraded underutilized (scrub dominated), degraded pastures/grazing lands, barren rocky/stony wasteland. The study site falls in a mid to high altitude characterized by hot summers and very cold winters. The soil formation and soil deposits are essential pre-requisites for the growth and nature of plant life. The effect of climate, topography, parent rock material and time are important in soil formation and soil texture. The soil of the study site is sandy loam in texture; high in organic carbon with slightly neutral in pH and normal in electrical conductivity. The present study on vegetation analysis was carried out by dividing the whole area of selected site (50 hactares) into three altitudes; Lower altitude: 1720 meters-1761 meters above mean sea level; Mid altitude: 1761 meters-1802 meters above mean sea level; Upper altitude: 1802 meters-1843 meters above mean sea level

Sampling procedure

Sampling was carried out by stratified random sampling. Study site was divided into three altitudes and five (5) quadrats of 5m × 5m for shrubs and five (5) quadrats of 1.25 m × 1.25 m for herbaceous species were laid down per altitude. The vegetation of selected forest range will be recorded in all the quadrates laid at three altitudes. Vegetation data will be quantatively analysed for the frequency, density, abundance and IVI according to procedures followed by Curtis and McIntosh (1950) [7].

Results

The phytosociological parameters such as, species composition, density (D), per cent frequency (% F), abundance (A), importance value index (IVI), have been tabulated in Tables 1 to 2 for lower, middle and upper altitudes of Benhama, Ganderbal, Kashmir. The floristic diversity in the study area resulted in the identification of 64 plant species belonging to 16 families (Table 1).

Out of the total families recorded, Asteraceae is the dominant family represented by thirteen (13) species, followed by Poaceae, Fabaceae, and Lamiaceae with eight (8), seven (7) and seven (7) species, respectively, followed by Polygonaceae represented by three (3) species, followed by Geraniaceae, Brasicaceae, Borogoniacea, plantiganaceae, Apiceae, represented by two (2) species each. While as other sixteen families are represented by only one (1) species each. Out of the total genera recorded, the highest number of three species is respresented by one (1) genera viz. Artemisia by (*A. abscinthium, A. indica* and *A. maritima*) followed by two species represented by six (4) genera viz. Medicago by (*M. minima* and *M. polymorpha*), Poa by (*P. annua* and *P. bulbosa*), Rumex by (*R. histatus* and *R. nepalensis*) and Trifolium by (*T. pratense* and *T. repens*). While as other fifty eight (53) generas are represented by a single species (Table 1).

Table 1: Species composition at different altitudes (lower: 1720 m- 1761m amsl, middle: 1761 m- 1802m amsl, upper: 1802m-1843m amsl) in Benhama, Ganderbal, Kashmir

S. No.	Species	Habit	Family	English name/local name	Lower	Middle	Upper
1	*Achillea millefolium*	H	Asteraceae	Common yarrow/Pahel gass	+	-	-
2	*Ajuga parviflora*	H	Lamiaceae	Ground pine/Jane adam	+	-	-
3	*Amaranthus viriddi*	H	Amaranthaceae	Foxtail Amaranth/lissa	+	+	-
4	*Artemisia indica*	H	Asteraceae	Mugwort/Tethwan	+	+	-
5	*Artemisia maritime*	H	Asteraceae	Sea wormwood/Tethwan	-	+	-
6	*Artemisia abscinthium*	H	Asteraceae	Wormwood/Tethwen	+	+	-
7	*Asplenium* spp	H	Aspleniaceae	Birds nest fern	+	-	-
8	*Avena fatua*	H	Poaceae	Wild oat/Hoon vishke	+	+	+
9	*Bromus japonicas*	H	Poaceae	Brome grass	+	+	+
10	*Capsella bursa pastoris*	H	Brassicaceae	Shepherd's purse/Kralmund	+	+	+
11	*Chenopodium album*	H	Chenopodiaceae	Lamb's quarters/Kunah	+	+	-
12	*Cirsium arvense*	H	Asteraceae	Creeping thistle	+	+	+
13	*Centurea iberica*	H	Asteraceae	Knapweed/Kretch	+	+	+
14	*Clinopodium umbrossum*	H	Lamiaceae	Shady calamint	+	-	-
15	*Convolvulus arvense*	H	Convolvulaceae	Field bindweed/Threer	+	+	+
16	*Conyza Canadensis*	H	Asteraceae	Fox tail/Shal lut	+	+	+
17	*Crepis* spp	H	Asteraceae	Italian hawksbeard	-	-	+
18	*Chaerophyllum villossum*	H	Apiaceae	Wild chervil/Mohare monji gass	+	+	-
19	*Cynoglossum lanceolatum*	H	Boroginaceae	Hound's tongue	+	+	-
20	*Cynodon dactylon*	H	Poaceae	Conch grass/Dramun	+	+	+
21	*Daccus carrota*	H	Umbelliferaceae	Wild carrot/Gazri gassa	+	+	-
22	*Echinochloa colonum*	H	Poaceae	Jungle rice	+	+	-
23	*Erodium cicutarium*	H	Geraniaceae	Pin weed	+	+	-
24	*Euphorbia helisocopia*	H	Euphorbiaceae	Wild mallow/Gur sochal	+	+	+
25	*Gallium aparine*	H	Rubiaceae	Goose grass/Ranghe	+	+	-
26	*Geranium pretense*	H	Geraminaceae	Meadow cranesbill	+	+	-
27	*Hypericum perforatum*	H	Hypericaceae	St. John's wort/Chaii gassa	+	-	-
28	*Lactuca dissecta*	H	Asteraceae	Lettuce	-	+	+
29	*Lepidium rudrale*	H	Brassicaceae	Pepper grass	+	+	+
30	*Lespedeza capitata*	H	Fabaceae	Roundhead Bush clovers	+	+	+

31	*Lollium* spp	H	Poaceae	Rye grass	+	+	+
32	*Marrubium vulgare*	H	Lamiaceae	Common horehound	+	+	-
33	*Matricaria chamomilla*	H	Asteraceae	Scented may weed/Fukh gass	+	+	+
34	*Medicago minima*	H	Fabaceae	Small medick/Posh gass	+	+	+
35	*Medicago polymorpha*	H	Fabaceae	Black medick	+	-	-
36	*Melilotus alba*	H	Fabaceae	Sweet white clover/Katsi gass	+	-	-
37	*Myosotis arvensis*	H	Boroginaceae	Field forget me not/Tse'r gass	+	-	-
38	*Oenothera rosea*	H	Onagraceae	Rose Evening primrose	+	+	+
39	*xalis corniculata*	H	Oxalidaceae	Creeping yellow sorrel/chok chin	+	+	+
40	*Papaver rosea*	H	Papaveraceae	Red poppy/Gulal	+	+	-
41	*Plantago lanceolata*	H	Plantanginaceae	Narrow leaved plantain/Nick gull	+	+	+
42	*Poa bulbusa*	H	Poaceae	Bulbosa meadow grass	+	+	+
43	*Poa annua*	H	Poaceae	Annul meadow weed	+	+	+
44	*Polygonum plebeium*	H	Polygonaceae	Knot weed/Drub	+	+	+
45	*Prunella vulgaris*	H	Lamiaceae	Self heal/Kalveuth	+	+	-
46	*Ranunculus arvense*	H	Ranunculaceae	Buttercup/Chrim	+	+	-
47	*Rumex histatus*	H	Polygonaceae	Arrowleaf dock/ Khatti ambi	+	+	+
48	*Rabdosia rugosa*	H	Lamiaceae	Rugose rabdosia/Maldah	+	-	-
49	*Rumex nepalensis*	H	Polygonaceae	Common sorrel/Abij	+	+	-
50	*Salvia moorcroftiana*	H	Lamiaceae	Kasmir salvia	+	+	+
51	*Scandix pectin veneris*	H	Apiaceae	Shepherds needle	+	-	-
52	*Sochus Oleraceous*	H	Asteraceae	Common sow thistle/Dudije	+	+	+
53	*Solanum nigrum*	H	Solanaceae	Black night shade/Kam'bai	+	+	-
54	*Sorghum halepensis*	H	Poaceae	Johnson grass/Durham	+	+	+
55	*Stellaria media*	H	Carophyllaceae	Chickweed/Naramnor	+	+	+
56	*Taraxicum officinale*	H	Asteraceae	Common dandelion/Hand	+	+	+
57	*Thymus linearis*	H	Lamiaceae	Himalayan Thyme/Javaend	+	+	-
58	*Trifolium pretense*	H	Fabaceae	Pink clover/ Bud'nej	+	+	+
59	*Trifolium repens*	H	Fabaceae	White clover/Tri'patur	+	+	+
60	*Utrica dioica*	H	Utricaceae	Stinging nettle/Soi	+	+	+
61	*Verbascum Thapsus*	H	Scrophulariaceae	Common mullien/Bu'der tan'd	+	+	+
62	*Veronica persica*	H	Plantaginaceae	Birds eye speedwell/Tsari gasa	+	+	+
63	*Vicia sepia*	H	Fabaceae	Buch vetch/Ha'bil hemb	+	-	-
64	*Xanthium spinosum*	H	Asteraceae	Prickly burwood	+	+	+

Where, S = Shrub, H = Herb, (+) = Presence, (-) =Absence

Floristic composition

Density (Plants/m^2)

Spring season

The data pertaining to the lower altitude revealed the presence of fifty-five herb species in this season. Highest density was shown by *Cynodon dactylon* (66.30/m^2) followed by *Conyza Canadensis* (7.68/m^2), *Trifolium repens* (6.48/m^2), *Trifolium pretense* (6.48/m^2) *Convulvulus arvense*, whereas lowest value was recorded in *Asplenium spp.* (0.98/m^2). In the middle altitude, amongst all the fifty-one species of herbs, forty-three were found in this season with highest density shown by *Cynodon dactylon* (53.12/m^2) followed by *Medicago minima* (6.82/m^2), *Capsella bursa pastoris* (6.69/m^2), *Conyza canadensis* (5.76/m^2), *Trifolium repens* (5.37/m^2), and lowest value was recorded by *Utrica dioica* (1.02/m^2). However, the upper altitude showed the presence of twenty-nine herb species in spring season, maximum density was found in *Cynodon dactylon* (48.45/m^2) followed by *Poa bulbosa* (4.35/m^2), *Poa annua* (4.01/m^2), *Oxalis corniculata* (4.01/m^2), *Conyza Canadensis* (3.58/m^2), with lowest value in *Oenothera rosea* (0.64/m^2).

Summer season

The investigation revealed that that out of the sixty-four herbaceous species, a total of sixty-one were recorded in summer season in lower altitude. *Cynodon dactylon* (72.36/m^2) recorded the maximum density followed by *Conyza canadensis* (9.04m^2), *Medicago minima* (8.74/m^2), *Trifolium repens* (8.49/m^2), *Convulvulus arvense* (8.10/m^2) and lowest value was recorded in *Utrica dioca* (1.28/m^2). Similarly, the findings in the study revealed the presence of fifty-one species in summer season in middle altitude and maximum density was recorded in *Cynodon dactylon* (62.29/m^2) followed by *Capsella bursa pastoris* (8.32/m^2), *Medicago minima* (7.8/m^2), *Conyza Canadensis* (7.55/m^2), *Trifolium repens* (6.69/m^2), and the least vaue was found in *Utrica dioica* (1.15/m^2). Amongst all the species present at the upper altitude, all the thirty-four species were found in this season with maximum density observed in *Cynodon dactylon* (57.65/m^2), followed by *Poa bulbusa* (5.76/m^2), *Poa annua* (5.59/m^2), *Sonchus oleraceous* (5.59/m^2), *Veronica persica* (5.56/m^2) and minimum value was observed in *Xanthium spinosum* (0.98/m^2).

Autumn Season

Persual of Table 2 revealed that fifty-five species were found in autumn season amongst the sixty-four species reported at the lower altitude. Maximum density was again recorded in *Cynodon dactylon* (56.27/m^2) followed by *Conyza canadensis* (5.88/m^2), *Trifolium repens* (5.76/m^2), *Medicago minima* (5.33/m^2) and lowest value was recorded in *Utrica dioica* (0.49/m^2). At the middle altitude, a total of forty-three species were reported in this season with *Cynodon dactylon* showing maximum density (50.43) followed by *Capsella bursa pastoris* (5.24/m^2), *Conyza canadensis* (5.07/m^2), *Trifolium repens(* (5.03/m^2), whereas minimum density was recorded in *Artemisia maritima* (0.38/m^2). Also in case of upper altitude, a total of twenty-six species were recorded in the season having maximum density in *Cynodon dactylon* (46.16/m^2) followed by *Poa bulbosa* (4.39/m^2), *Poa annua* (3.88/m^2), *Conyza canadensis* (3.58/m^2), *Oxalis corniculata* (3.28/m^2)

and the lowest value was recorded in *Oenothera rosea* (0.21/m^2) .

Frequency (%)

Spring season

It is clear from the analysed data that in lower altitude, maximum frequency was observed in *Cynodon dactylon* (93.33%) followed by *Medicago minima* (66.67%), *Poa annua* (66.67%) and *Conyza canadensis* (53.33%), whereas, lowest value was recorded in *Asplenium spp* (33.33%). At middle altitude, maximum frequency was found in *Cynodon dactylon* (86.67%) followed by *Plantago lanceolata* (66.67%), *Medicago minima* (66.67%), *Marubium vulgare* (66.67%) and lowest value was shown in *Utrica dioica* **(**26.67%). However in upper altitude, maximum frequency was found in *Cynodon dactylon* (80%), *Conyza canadensis* (60%), *Poa bulbusa* (60%), *Poa annua* (60%), *Lespidiza capitata* (60%) while lowest value was observed in *Euphorbia helioscopia* (20%) and *Oenothera rosea* (20%).

Summer season

During this season the maximum frequency in lower aititude was observed in *Cynodon dactylon* (99.33%) followed by *Conyza canadensis* (80%), *Artemisia indica* (80%), *Poa annua* (73.33%), *Erodium circutanum* (73.33%), *Ranunculus arvense* (73.33%) and the minimum value was reported in *Utrica dioica* (33.33%). Similarly, maximum frequency in middle altitude was observed in *Cynodon dactylon* (93.33%) followed by *Marubium vulgare* (73.33%), *Plantago lanceolata* (73.33%), *Poa annua* (73.33%) whereas, minimum in *Utrica dioca* (33.33%). Highest frequency in case of upper altitude was observed in *Cynodon dactylon* (93.33%) followed by *Conyza Canadensis* (66.67%), *Convolvulus arvense* (66.67%), *Lespidiza capitata* (66.67%), *Poa bulbusa* (66.67%) whereas, the lowest value was recorded in *Matricaria chamomilla* (33.33%), *Salvia moorcraftiana* (33.33%), *Utrica dioica* (33.33%) and *Xanthium spinosum* (33.33%).

Autumn season

At lower altitude, maximum frequency was recorded in *Cynodon dactylon* (93.33%), *followed by Achillea millefolium* (60%), *Avena sativa* (60%), *Cinopodium umbrossum* (60%) whereas minimum frequency (13.33%) was recorded in *Stellaria media and Veronica persica.* At middle altitude, maximum frequency was observed in *Cynodon dactylon* (86.66%) followed by *Conyza Canadensis* (60%) and *Poa bulbusa* (60%) and minimum value was observed in *Artemisia maritima* (13.33%) *and Oxalis corniculata* (13.33%). Similarly, in upper altitude, maximum value for frequency was observed in *Cynodon dactylon* (80%) followed by *Conyza canadensis* (66.67%) and *Oenothera rosea* (66.67%) and lowest in *Euphorbia helioscopia* (13.33%).

Abundance (Plants/m^2)

Spring season

It is evident from the analysed data that the highest abundance was reported in *Cynodon dactylon* (71.08/m^2) followed by *Conyza canadensis* (12.8/m^2), *Trifolium ripens* (11.59/m^2), *Convulvulus arvense* (11.34/m^2), *Oxalis corniculata* (11.34/m^2) and lowest value was recorded in *Artemisia absinthium* (2.66/m^2) in lower altitude. The data pertaining to the middle altitude revealed that maximum value for abundance was shown by *Cynodon dactylon* (61.01/m^2) followed by *Capsella bursa pastoris* (12.72/m^2), *Veronica persica* (11.84/m^2), *Trifolium pratense* (11.80/m^2), *Conyza canadensis* (10.77/m^2) and and the value for lowest abundance was shown by *Artemisia absinthium* (2.34/m^2). The most abundant species in upper altitude was *Cynodon dactylon* (60.95/m^2) followed by *Oxalis corniculata* (7.58/m^2), *Poa bulbosa* (7.26/m^2), *Trifolium repens* (7.19/m^2), *Poa annua* (6.69/m^2) and the lowest value was reported in *Xanthium spinosum* (1.70/m^2) .

Summer season

During the study, the data pertaining to the lower altitude showed that maximum abundance was reported in *Cynodon dactylon* (72.36/m^2), followed by *Trifolium repens* (12.78/m^2), *Veronica persica* (12.16/m^2), *Medicago minima* (12.01/m^2), *Thymus linearis* (11.80/m^2) and lowest value was reported in *Artemisia absinthium* (3.62/m^2). Similarly, maximum abundance in middle altitude was reported in *Cynodon dactylon* (66.17/m^2) followed by *Conyza canadensis* (12.58/m^2), *Capsella bursa pastoris* (12.56/m^2), *Thymus linearis* (12.16/m^2), *Medicago minima* (10.98/m^2), whereas, minimum value was recorded in *Artemisia absinthium* (3.12/m^2). Similarly in upper altitude, maximum abundance was observed in *Cynodon dactylon* (63.33/m^2) followed by *Veronica persica* (11.03/m^2), *Sochus oleraceous* (9.59/m^2), *Trifolium pratense* (9.11/m^2), *Poa annua* (9.08/m^2) and lowest value was found in *Xanthium spinosum* (2.67/m^2).

Autumn season

It is evident from the analused data that highest abundance in lower altitude was reported in *Cynodon dactylon* (60.56/m^2) followed by *Conyza canadensis* (9.81m^2), *Trifolium ripens* (9.6/m^2), *Trifolium pretense* (9.52 /m^2) and *Medicago minima* (9.26/m^2) and lowest value was observed in *Utrica dioica* (1.06/m^2). The most abundant species at middle altitude was *Cynodon dactylon* (58.78/m^2), followed by *Conyza canadensis* (12.72/m^2), *Trifolium repens* (9.52/m^2), *Medicago minima* (9.01/m^2), *Thymus linearis* (8.96/m^2) and minimum value was recorded in *Artemisia maritima* (0.96/m^2)**.** However, in case of upper altitude, maximum value for abundance was found in *Cynodon dactylon* (57.76/m^2) followed by *Poa bulbosa* (7.33/m^2), *Poa annua* (6.47/m^2) *Lollium spp.* (6.12/m^2), *Oxalis corniculata* (5.48/m^2) and lowest value was reported in *Euphorbia helioscopia* (0.85/m^2).

Importance Value Index

Spring season

As indicated in Table 2, in spring season, the maximum IVI in case of lower altitude was recorded for *Cynodon dactylon* (38.84) followed by *Trifolium pratense* (7.43), *Stellaria media* (7.02), *Chaerophyllum villossum* (6.93), *Conyza canadensis* (6.71), *Medicago minima* (6.64), whereas minimum value for IVI was reported in *Asplenium spp.* (2.29). Similarly, among the species present in middle altitude, maximum IVI was shown by *Cynodon dactylon* (44.34), followed by *Medicago minima* (8.75), *Trifolium repens* (8.30), *Polygonum plebeium* (8.10), *Capsella bursa pastoris* (8) and *Utrica dioica* (2.29) was having the lowest value for IVI. At upper altitude, maximum IVI in was recorded in *Cynodon dactylon* (68.40), followed by *Poa bulbosa* (15.3), *Oxalis corniculata* (12.9), *Conyza canadensis* (11.3), *Poa annua* (10.9) and lowest value was shown by *Oenothera rosea* (3.65).

Summer season

The data tabulated in Table 2 revealed that in summer season, *Cynodon dactylon* (31.16) was having maximum IVI followed by *Conyza canadensis* (7.32), *Artemisia indica* (6.61), *Marubium vulgare* (6.09), *Medicago minima* (5.86), whereas minimum value was found in *Verbascum thapsus* (1.79) in lower altitude. In this season, maximum IVI in middle altitude was recorded for *Cynodon dactylon* (35.16), *Marubium vulgare* (7.86), *Trifolium repens* (7.72) *Lepidium rudrale*. (6.96), *Medicago minima* (6.87) and lowest value was recorded in *Utrica dioica* (1.88)**.** At upper altitude, maximum IVI was shown by *Cynodon dactylon* (56.14) followed by *Poa annua* (12.4), *Plantago lanceolata* (10.3), *Sonchus oleraceous* (10.3), *Veronica persica* (9.91) and minimum IVI value was shown by *Utrica dioica* (3.46).

Autumn season

From the data presented in Table 2, it was observed that in autumn season, *Cynodon dactylon* (44.71) had maximum IVI followed by *Conyza canadensis* (7.48), *Trifolium pratense* (7.37), *Trifolium repens* (7.11), *Plantago lanceolata* (7.07), with minimum value in *Veronica persica* (1.19) at lower altitude. Similarly, at middle altitude, *Cynodon dactylon* showed maximum IVI (52.15) followed by *Trifolium repens* (9.18), *Conyza canadensis* (8.85), *Capsella bursa pastoris* (8.74), *Plantago lanceolata* (8.16) and minimum value was recorded in *Artmesia maritima* (1.74). Maximum IVI at upper altitude was shown by *Cynodon dactylon* (74.06), followed by *Poa bulbosa* (13.75), *Conyza canadensis* (13.48), *Oxalis corniculata* (12.68), *Poa annua* (12.38) and minimum value was observed in *Oenothera rosea* (0.72).

Table 2: Seasonal variation in IVI (Importance Value Index) of herbaceous species along different elevations of Benhama, Kashmir

S. No.	Species	Lower (1720m-1761m amsl)			Middle (1761m-1802m amsl)			Upper (1802m-1843m amsl)		
		Spring	Summer	Autumn	Spring	Summer	Autumn	Spring	Summer	Autumn
1	*Achillea millefolium*	2.62	4.01	5.64	-	-	-	-	-	-
2	*Ajuga parviflora*	4.10	4.49	4.33	-	-	-	-	-	-
3	*Amaranthus viridis*	-	4.09	4.24	-	5.37	4.69	-	-	-
4	*Artemisia indica*	5.81	6.61	6.69	6.26	5.55	4.03	-	-	-
5	*Artemisia maritime*	-	-	-	-	3.74	1.74	-	-	-
6	*Artemisia abscinthium*	4.24	5.11	6.51	5.97	6.15	6.50	-	-	-
7	*Asplenium* spp	2.29	3.34	3.42	-	-	-	-	-	-
8	*Avena fatua*	4.39	4.27	5.81	6.33	4.83	6.04	7.45	5.18	7.81
9	*Bromus japonicas*	4.67	2.9	-	3.38	3.78	-	5.51	5.37	7.39
10	*Capsella bursa pastoris*	4.82	4.1	-	8.0	6.62	8.74	8.21	5.99	8.45
11	*Cirsium arvense*	5.17	4.91	5.49	6.29	4.62	6.75	8.66	8	8.86
12	*Centurea iberica*	5.14	5.04	5.60	6.03	5.62	6.37	7.42	6.96	8.93
13	*Chenopodium album*	5.61	5.42	4.59	4.65	6.15	7.00	-	-	-
14	*Clinopodium umbrossum*	3.71	4.05	5.59	-	-	-	-	-	-
15	*Convolvulus arvense*	5.72	5.13	3.71	4.84	4.10	4.60	7.24	8.55	12.13
16	*Conyza Canadensis*	6.71	7.25	7.48	7.30	6.27	8.85	11.3	8.14	13.48
17	*Crepis* spp	-	-	-	-	-	-	8.56	4.83	9.44
18	*Chaerophyllum villossum*	6.93	4.86	4.41	-	5.12	-	-	-	-
19	*Cynoglossum lanceolatum*	4.20	4.37	4.06	-	4.94	-	-	-	-
20	*Cynodon dactylon*	38.84	30.9	44.71	44.34	35.16	52.15	69.8	57.2	74.06
21	*Daccus carrota*	3.54	4.36	4.35	3.11	4.02	3.40	-	-	-
22	*Echinochola colunum*	-	4.53	2.23	-	5.03	-	-	-	-
23	*Erodium cicutarium*	4.48	4.82	4.26	5.66	5.79	5.46	-	-	-
24	*Euphorbia helioscopia*	4.61	4.6	5.48	7.30	5.71	6.15	3.79	7.94	2.24
25	*Gallium aparine*	4.17	4.37	6.03	6.64	4.87	7.14	-	-	-
26	*Geranium pretense*	4.38	4.29	4.52	5.49	4.80	4.47	-	-	-
27	*Hypericum perforatum*	6.00	5.1	3.50	-	-	-	-	-	-
28	*Lactuca dissecta*	-	-	-	6.12	4.88	6.04	9.74	7.43	7.37
29	*Lepidium rudrale*	5.83	5.41	5.22	7.31	6.96	7.23	4.13	6.3	-
30	*Lespediza capitata*	4.40	3.78	4.28	6.12	5.09	5.50	10.6	8.31	11.44
31	*Lollium* spp	4.13	4.53	5.21	6.34	5.49	6.38	9.57	8.31	12.0
32	*Marubium vulgare*	5.46	6.09	5.18	7.16	7.86	5.74	-	-	-
33	*Matricaria chamomilla*	2.80	2.98	2.93	3.60	3.09	4.05	4.6	3.78	5.35
34	*Medicago minima*	6.64	5.86	6.78	8.75	6.87	7.40	8.57	7.11	9.88
35	*Medicago polymorpha*	3.43	3.35	-	-	-	-	-	-	-
36	*Meliotus alba*	-	3.7	-	-	-	-	-	-	-
37	*Myosotis arvensis*	-	5.35	-	-	-	-	-	-	-
38	*Oenothera rosea*	5.79	4.55	4.48	6.68	6.65	6.86	3.65	7.55	0.72
39	*Oxalis corniculata*	5.63	3.55	5.41	7.26	5.92	7.90	12.9	7.92	12.68
40	*Papaver roseaus*	3.42	3.16	1.56	-	-	-	-	-	-
41	*Plantago lanceolata*	5.98	4.48	7.07	7.95	5.93	8.16	10.6	10.3	8.07
42	*Poa bulbusa*	5.68	4.62	5.73	6.89	5.57	6.06	15.3	9.66	13.75
43	*Poa annua*	5.74	4.58	5.93	7.10	5.46	6.89	10.9	12.44	12.38
44	*Polygonum plebeium*	6.10	5.18	5.95	8.10	6.28	6.57	9.77	8.74	10.53
45	*Prunella vulgaris*	4.87	5.04	5.62	6.20	5.97	5.47	-	-	-
46	*Ranunculus arvense*	3.60	5	-	-	4.88	-	-	-	-
47	*Rhumex histatus*	4.64	5.11	5.94	7.57	6.28	6.41	6.4	6.36	9.13
48	*Rubdosia rugosa*	-	3.9	3.57	-	-	-	-	-	-

49	*Rumex nepalensis*	4.78	3.73	5.82	5.58	4.36	6.37	-	-	-
50	*Salvia moorcraftiana*	4.75	5.09	5.70	5.62	5.96	7.12	-	5.07	-
51	*Scandix pectin veneris*	5.95	4.12	3.14	-	-	-	-	-	-
52	*Sochus oleraceous*	4.05	4.29	3.61	-	5.71	-	-	10.3	-
53	*Solanum nigrum*	3.29	2.95	3.81	3.72	3.09	3.74	-	-	-
54	*Sorghum halepensis*	4.22	3.82	5.07	4.96	4.13	5.33	-	6.67	-
55	*Stellaria media*	7.02	5.69	1.45	7.65	6.85	-	-	8.44	-
56	*Taraxicum officinale*	3.90	3.23	4.56	3.95	3.22	4.36	8.09	6.04	10.18
57	*Thymus linearis*	-	5.21	4.85	-	5.92	6.32	-	-	-
58	*Trifolium pretense*	7.43	4.81	7.37	5.76	5.33	3.26	8.53	8.12	-
59	*Trifolium repens*	5.98	5.3	7.11	8.30	7.72	9.18	9.06	8.33	-
60	*Utrica dioica*	2.79	1.79	1.77	2.29	1.88	2.84	4.11	3.46	8.33
61	*Verbascum Thapsus*	5.73	4.77	3.96	6.28	5.53	4.99	6.6	6.09	7.33
62	*Veronica persica*	6.10	4.55	1.19	5.51	4.88	-	-	9.91	-
63	*Vicia sepia*	2.94	2.99	-	-	-	-	-	-	-
64	*Xanthium spinosum*	4.52	4.53	4.33	5.08	4.15	5.56	5.06	5.15	7.96
Total		300	300	300	300	300	300	300	300	300

Where, amsl = above mean sea level

Discussion

Plant community at all the three altitudes was analysed in different seasons for various parameters necessary to describe a plant community. This spatial cum temporal analysis depicted a considerable change in the composition of plant species due to the grazing pressure, less protection and also loss of vegetation cover at the grazed site. Species composition is recorded to decrease with the increase in the altitude. Maximum number of species were found in lower altitude which begins to decline with the increase in altitude of the site. The highest species diversity in lower and middle altitudes might be due to moderate disturbance by grazing and invasion of new species. At upper altitude, the number of plant species declined overtime, mainly of palatable species due to the less nutrient content, selective grazing behavior of livestock animal, thereby decreasing the ratio of palatable to non-palatable species. This variation might also be due to the soil type and its composition, elevation of sites, moisture contents of soil, nature of disturbance like grazing pressure, human interference and isolation of study site populated regions. A highest diversity of species in intermediate disturbed ecosystem. Due to grazing and trampling by cattle in upper altitudes, there is the reduction in the soil moisture as the compactness of the soil is increased. The highly compacted soil in general shows a lower permeability and increased runoff Moreover denuded patches are created as a result of over-grazing by domestic livestock, the direct sunlight received by soil surface at upper altitude enhances the chances of evaporation and finally results in reduction in the soil organic matter [6, 8]. Branson *et al.* (1981) [4] in his study on rangeland hydrology also reported reduction in soil moisture content due to grazing. Similarly Faizul *et al.*, 1995[9] in his study also concluded that the grazing decreases the percentage of organic carbon at upper and middle altitude which reduces soil organic matter, compacts the soil surface layer and ultimately increases surface runoff. The present study indicates that the lower altitude has a good fertility potential which may be due to less biotic and abiotic interferences and addition of a higher amount of leaf litter. High nutrient levels at lower altitude are also due to nutrient regeneration from fallen leaves, twigs, buds, flowers, decaying roots among other decaying material. Variation in quantitative parameters like, species richness and species diversity is related to variations in edaphic factors, elevation, slope aspect and micro-climatic conditions between the three altitudes. Species diversity is one of the most important characteristics of a community. It is a mechanism which generates stability. The nature of plant community at a place is determined by other species that grow and develop in such environment [3]. The general structure of species at all three altitudes indicated increasing trend in their number mostly during spring and summer and during autumn, species number at all altitudes showed overall a declined trend. This may be attributed to the fact that during spring/ summer season, new species go on sprouting in the soil resulting from better conditions like relative humidity and soil moisture during this period. Further, enough soil moisture availability for optimum nutrient flow in soil plant system and congenial air temperature manifested itself into luxurious vegetative growth and thereby adding to species in total resulted more diversity. During autumn and winter season, the rate of sprouting is diminished and species number declined owing to adverse climatic conditions. Similar role of climatic variables on growth and development of herbage vegetation has been advocated by various other authors [1, 10, 11, 13].

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