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Phytosociological status of Daksum range grasslands in Kashmir valley

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Abstract
The present study was carried out at three altitudes *viz.,* Arishan, Harkani and Deesu, and migratory grazing status in Daksum range of Anantnag Forest Division, Kashmir in the year 2014-15. A total of 50 plant species belonging to 21 families were recorded from the study area out of which 12 were trees. Over storey (Tree species) dominant and co -dominant species differed from each other in each sample plot. Results revealed that total density of trees, shrubs and herbaceous species ranged between 66 to 688, 994 to 187 and 1 to 98 tillers/m^2 at all the three sites. Among the trees *Picea smithiana* and *Pinus wallichiana* were present at all the study sites. *Cedrus deodara* (IVI 98.98) and *Pinus wallichaina* (IVI 81.93) were the most dominant species on lower altitude site while *Abies pindrow* and *Picea smithiana* were the dominant species on middle and upper altitude ranges. Amongst the shrub species *Juniperus squammata* exhibited highest frequency value of 85% at higher altitude, *Rhododendron anthopogon* (70%) and *Vibernum* spps (78%) displayed maximum frequency value respectively at middle and lower sites. The IVI of herbaceous species indicated that *Poa annua* (63.72) was dominant at lower altitude while *Fragaria nubicula* (75.66) and *Poa pratense* (77.10) dominates the upper altitude site respectively.

Keywords: phytosociology, grassland, grazing, conservation, IVI and dominant

1. Introduction
Jammu and Kashmir is located in the northern part of the Indian subcontinent in the vicinity of the Karakorum and western mountain ranges. It falls in the great north western part of the Himalayan ranges with marked relief variation, snowcapped summits, antecedent drainage and complex geological structure. The total area of the state of Jammu and Kashmir is about 2, 22, 236 sq. km [1]. Kashmir comprises of three natural divisions namely Jammu, Kashmir and Ladakh. The pasture areas of Jammu and Kashmir State which lie in sub-tropical zone of Jammu, temperate, sub alpine and alpine areas of Kashmir and Ladakh are extensively used for grazing. Temperate areas are situated between 1000-4500 m altitude and this exhibits a remarkable diversity. Because of the geographical features of the state, 82 per cent land area falls under non crop land category, be it forests or rangelands and 18 per cent is cropland [1]. The resultant small holdings and vast grazing land allows evolving various crop-livestock or only livestock based livelihood systems. Because of the availability of these rangeland resources over 25 per cent population of J&K is of nomads and semi nomads namely Gujjars, Bakerwals, Chopans, Chongpas and Gaddies whose livelihoods are widely or partially dependent on rangeland based pastoral or agro pastoral systems. Grasslands including savanna, shrub steppe are among the largest ecosystem in the world and are the potential natural vegetation on 33 million sq. km on earths land surface, their area is estimated at 52.5 million sq. km which is about 40.5 per cent of the total terrestrial area excluding Greenland and Antarctica [15].

2. Materials and methods
2.1 Description of the study area
2.1.1 Site Location
Proposed study was carried out along three locations of the Daksum range spread over an area of 34418.73 ha. This forest range is situated between 33°36′ 43" N North Latitude and 75° 26′ 6" E East longitude. The tract lies within an elevation zonation of 1598 meters to 5425 meters. All the four seasons of the year are represented. Spring is cool and rather wet. Average minimum and maximum temperature varies from -11 to 33° C. Autumn is bright and pleasant while as winter is extremely cold and experiences heavy snow falls. The district receives an average annual precipitation of about 1103 mm in the form of rain and snow for about 70 days. Unlike the outer Himalayas there is no distinct rainy season in Kashmir Valley.

Anantnag district is hilly and mountainous towards the north east and south west with broad intermountain valley. The altitude of the hill ranges up to 3000 m amsl.

2.2 Selection of the sites

The Anantnag division forests are classified in the revised classification of forest types by Champion and Seth under the broad type groups 12,13,14 & 15 but do not strictly conform to on account of the diversity in structure and composition. The site selected was located in Kokernag Tehsil of District Anantnag. Sample plots selected were at following altutudes:

Site selected	Altitude
Arishan	12600ft above mean sea level
Harkani	9800ft above mean sea level
Deesu	7700ft above mean sea level.

2.3 Sampling design

On the basis of grazing intensity selected forest range was divided into three sites. Each site was then divided into three transects laid vertically and was of 100 m apart from each other to cover maximum area. Two blocks were selected per transect and are also laid out vertically. Finally at each sampling block three quadrates will be laid down per block by applying the North-West corner method. To record the sampling intensity structure, quadrates of 10m × 10m for trees, 5m × 5m for shrubs and 1m × 1m for grasses and herbs were laid down on each sampling plot at all three sites. Sampling was carried out by stratified random sampling in the month of June and there after vegetative analysis was carried out. To record phyto-sociological structure 3 quadrates for trees of size 10 x 10 m were drawn in each block followed by 6 quadrates of shrubs of size 5x 5 m and 9 quadrates of herbs were laid in all the three altitudes respectively. The total no. of quadrates for trees were 54, 108 for shrubs and 162 for herbs.

2.4 Phytosociology of grazing sites

The vegetation of selected forest range was recorded in all the quadrates laid at three sites. Vegetation data was quantatively analyzed for the frequency, density, Basal area and dominance according to procedures followed by Curtis and McIntosh (1950); Misra (1969) and Sorensen (1948).

$$\text{Density} = \frac{\text{Total No. of individuals of a species in all quadrates}}{\text{Total No. of quadrates studied}}$$

$$\text{Frequency (\%)} = \frac{\text{No. of quadrates in which the species occurred}}{\text{Total No. of quadrates studied}} \times 100$$

$$\text{Abundance} = \frac{\text{Total No. of individuals of a species in all quadrates}}{\text{Total No. of quadrates in which the species occur}}$$

2.4.1 Relative density, relative frequency and relative basal area

The vegetation of the selected grassland was recorded in all the quadrates laid at three altitude sites. The vegetation data were quantitatively analyzed for Relative density, Relative frequency and Relative basal area according to the procedure followed by Curtis and McIntosh (1950) and Misra (1969).

$$\text{Relative density} = \frac{\text{No. of individual of the species}}{\text{No. of individual of all the species}} \times 100$$

$$\text{Relative frequency} = \frac{\text{No. of occurrence of the species}}{\text{No. of occurrence of all the species}} \times 100$$

$$\text{Relative dominance} = \frac{\text{Total basal area of the species}}{\text{Total basal area of all the species}} \times 100$$

2.4.2 Importance Value Index

The IVI, which is an integrated measure of the relative frequency, relative density and relative dominance, was calculated for all species of trees, shrubs and herbaceous species separately for different elevation classes in the study area of the forest division according to procedure followed by Curtis and McIntosh (1950) and Misra (1969).

IVI = Relative Density + Relative Frequency + Relative Basal area

3. Results

3.1 Floristic composition of vegetation and phytosociological analysis

The floristic composition of Daksum range at three altitudes viz Arishan, Harkani and Deesu gives the detailed information regarding the 50 species belonging to 21 families. A close scrutiny of the data evinces that the total number of species at higher elevation (Arishan), Middle elevation (Harkani) and lower elevation (Deesu) were 19, 21 and 28 species respectively. In general total number of species decrease with increase in elevation.

Further twelve tree species viz., *Abies pindrow* (Royle ex D.Don), *Acer pictum* Wall., *Aesculus indica* Colebr., *Betula utilis* D.Don., *Cedrus deodara* Loud., *Fraxinus excelsia* Linn., *Juglans regia* L., *Picea smithiana* (Wall.) Boiss., *Pinus wallichiana* (A.B. Jacks)., *Padus cornuta* (Wall ex. Royale)., *Robinia pseudoacacia* Linn., *Taxus wallichiana* were recorded in the study area in which maximum no of tree species were present at Middle altitude (Harkani) 8 tree species followed by Lower altitude (7 tree species) and 6 trees species were recorded at upper altitude (Arishan). The tree species *Picea smithiana* and *Pinus wallichiana* were present at all the three altitude sites. While in case of shrubs, twelve shrub species were recorded *viz Berberis aristata Royle., Cotoneaster nummalaris* Fisch & C.A. Mey., *Elageanus rhamonoides* (L.)., *Indigofera heterentha* Brandis., *Juniperus squammatta* D. Don., *Prunus avium* (L) L., *Paenia emodi., Rhododendron campunulatum* D. Don., *Rhododendron anthopogon* D. Don., *Parrotiopsis jacquemontii., Skimmia laureala* and *Vibernum* spps out of which maximum number of five shrub species were present at both lower and upper elevation sites followed by three shrub species at Middle altitude. *Skimmia laureala* was common shrub species to middle and lower altitude sites. Further twenty six herb species were recorded at the study site, viz., *Aconitium heterophyllu*m Wall., *Agrostis canina*, *Arctium lappa* L., *Artemisia bienis* Wild., *Arisiama jacquemontii* Blume., *Asplenium ramosum* L., *Cynodon dactylon* Pers., *Dactylis glomerata* L., *Fragaria nubicula* (Hook. f)., *Gysophilla ceratiodes* D.Don., *Helianthus annus* L., *Heracleum candicans* Wall., *Ranunculus pamatifidus* H. Reidl., *Hypercium perforatum* L., *Impatiens glandulifera* Royle., *Medicago polymorpha* Wild., *Mentha longifolia* Huds., *Persicaria amplexicaulis* D.Don., *Poa annua* L., *Poa Pratense* L., *Poa balbusa* L., *Potentila neplensis* Hook.f., *Rumex neplensis* Spreng., *Rumex patentia* L., *Taraxicum officinale., Trifolium repens* out of which the maximum

number of herbage species i.e. 16 herb species were present at Lower altitude (Deesu) followed by middle altitude (Harkani) (10 herb species) and lowest species composition was recorded at upper altitude (8 herb species).

3.1.1 Phytosociology of trees

Results revealed that the upper altitude (Arishan) was dominated by *Abies pindrow* followed by *Picea smithiana* with their respective Important Value Index 92.90 and 65.84, respectively. The density, frequency and basal area for *Abies pindrow* were recorded as 327 trees/ha, 100 per cent and 84.20 m^2/ha respectively followed by *Picea smithiana* with density (261 tree/ha), frequency (95%) and basal area (45.95 m^2/ha). *Fraxinus excelsia* and *Betula utilis* were rarely distributed species with their IVI 28.20 and 18.31, respectively. The lowest density (72.16 trees/ha), frequency (35%) and basal area (07.21) were recorded for *Betula utilis.* Sample plots drawn from intermediate site (Harkani) dominated by *Picea smithiana* and *Abies pindrow* with their respective Important value index 86.03 and 68.13 respectively. The density (688 trees/ha), Frequency (100%) and basal area (98.96 m^2/ha) were recorded highest for *Picea smithiana* followed by *Abies pindrow* with density (449 trees/ha), frequency (100%) and basal area (78.59). The rare distribution were recorded in case *of Juglans regia, Cedrus deodara, Taxus wallichiana* and *Aesculus indica* with IVI 14.11, 16.84, 16.44 and 17.59 respectively (Fig. 1). At intermediate site the lowest density (74.66), frequency (27%) and Basal area (14.34 m^2/ha) were recorded in case of *Aesculus indica.* Further data evinces that the Lower altitude (Deesu) was dominated by *Cedrus deodara* and *Pinus wallichiana* tree species with their Important value index 98.98 and 81.93 respectively. The density, frequency and basal area for *Cedrus deodara* were recorded as 653 trees/ha, 98% and 75.95 m^2/ha, respectively followed by *Pinus wallichiana* with density (450 tree/ha), frequency (90%) and basal area 68.96 m^2/ha. The rarely distributed species at lower altitude (Deesu) were *Padus cornuta, Taxus wallichiana* and *Robinia pseudoacacia* with their importance value index 10.60, 10.99 and 22.27, respectively. The lowest density (66 trees/ha), frequency (20%) and basal area (02.53 m^2/ha) were recorded in case of *Padus cornuta.*

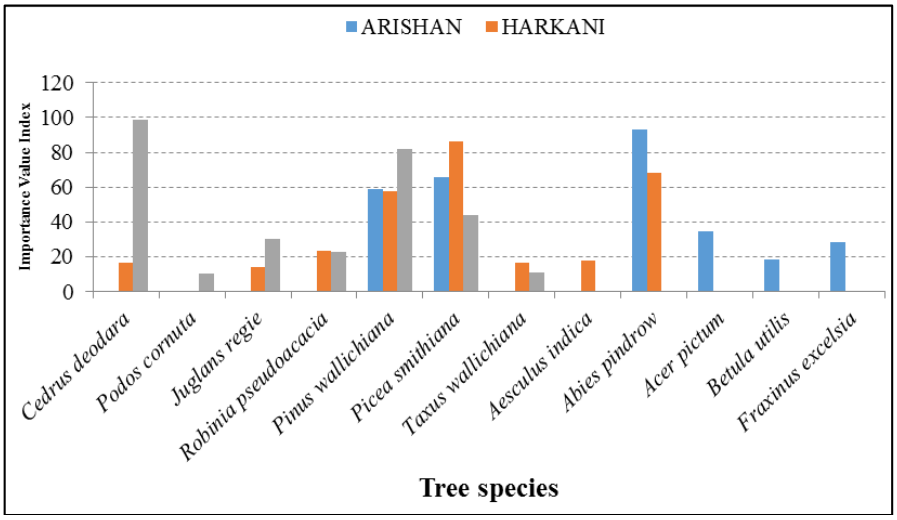

Fig 1: Important value index of tree species at three sites.

3.1.2 Phytosociology of shrubs

The data pertaining to shrubs revealed that upper altitude (Arishan) was dominated by *Juniperus squammata, Rhododendron campunnulatum* and *Prunus avium* shrub species with their Important Value Index of 83.21, 75.09 and 60.80 respectively. The density, frequency and basal area recorded for *Juniperus squammata* were 994 shrubs/ha, 85% and 37.03 m^2/ha respectively followed by *Rhododendron campunnulatum* with density (954 shrubs/ha), frequency (60%) and basal area (35.01 m^2/ha). The rarely distributed shrub species were *Cotoneaster nummalaris* and *Berberis aristata* with their important value index 31.27 and 48.78 respectively. The lowest density (294 shrubs/ha), frequency (50%) and basal area (09.01 m^2/ha) was recorded for *Cotoneaster nummalaris* at this site. At Middle altitude the dominant shrub species was *Skimmia laureola* (density 368 shrubs/ha), Frequency (55%), basal area (10.20 m^2/ha) with Importance value index 118.56 followed by *Rhododendron anthopogon* with density, frequency, basal area and importance value index 318 shrubs/ha, 70%, 9.01 m^2/ha and 116.91 respectively. The lowest density (157 shrubs/ha), frequency (40%), basal area (5.21 m^2/ha) and Importance value index (64.52) was recorded for *Elaegnus rhamonoide* at Middle altitude (Harkani). Further for lower altitude (Deesu) revealed that the dominant shrub species were *Vibernum* spps., *Skimmia laureola* and *Paenia emodi* with their importance value index 99.45, 73.85 and 52.25 respectively. The density, frequency and basal area recorded for *Vibernum* spps were 665 shrubs/ha, 78% and 19.87 m^2/ha, respectively followed by *Skimmia laureola* with density (461 shrubs/ha), frequency (47%) and basal area (17.53 m^2/ha). The rare distribution was shown by *Parrotiopsis jacquemontii* with density (187 shrubs/ha), frequency (63%), basal area (02.21 m^2/ha) and Importance value Index of 35.47 (Fig. 2).

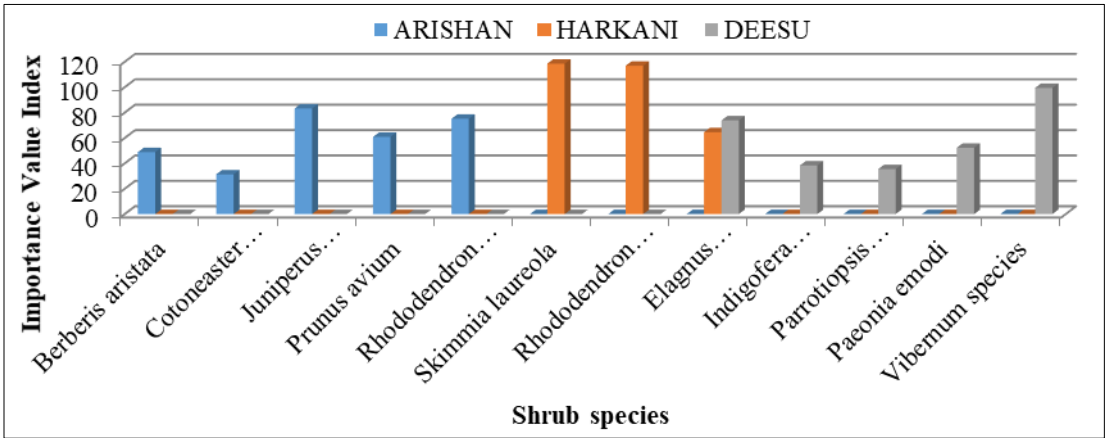

Fig 2: Important value index of shrub species at three sites.

3.1.3 Phytosociology of grasses and herbs

Regarding the grass species in upper altitude (Arishan) the dominant grass species were *Poa pretense*, *Hypercium perforatum* and *Cynodon dactylon* with their Importance value Index 77.10, 54.37 and 38.74 respectively. The highest density (39 tillers/m^2), frequency (62%) and basal area (3.89 cm^2/m^2) were recorded for *Poa pretense* followed by *Hypercium perforatum* with density (25 tiller/m^2), frequency (51%) and basal area (2.52 cm^2/m^2). The rarely distributed species were *Gysophilla cerastoides*, *Agrostis canina* and *Rumex neplensis* with their importance value index 16.40, 21.06 and 22.87 respectively. The lowest density (3.29 tillers/m^2). Frequency (60%) and basal area (0.11 cm^2/m^2) was recorded for *Gysophilla cerastoides.* Further the data shows that at Middle altitude (Harkani) the dominant plant species were *Fragaria nubicula*, *Poa annua*, *Cynodon dactylon* and *Heracleum candicans* with their importance value index 75.66, 63.75, 46.22 and 33.15 respectively. The density, frequency and basal area recorded for the *Fragaria nubicula* were 89 tillers/m^2, 100% and 7.31 cm^2/m^2, respectively followed by *Poa annua* with density (75 tillers/m^2), frequency (61%) and basal area (6.92 cm^2/m^2). The rarely distributed species were *Asplenium ramosum*, *Airsiama jacquemontii*, *Trifolium repens* and *Persicaria amplexicaulis* with their important value index 3.92, 7.63, 10.03 and 17.90 respectively. The lowest density (1.05 tillers/m^2), frequency (52%) and basal area 0.02 (cm^2/m^2) was recorded for *Arisiama jacquemontii*. The data for lower altitude (Deesu) shows that the site was dominated by *Poa annua*, *Poa balbusa*, *Dactylis glomerata* and *Poa pretense* with the importance value index 63.72, 56.39, 54.92 and 37.42 respectively. The highest density (98 tillers/m^2), frequency (100%) and basal area (10.98 cm^2/m^2) was recorded for *Poa annua* followed by *Poa balbusa* with density (82 tillers/m^2), frequency (100%) and Basal area (9.56 cm^2/m^2). The rarely distributed plant species were *Artimisia bienis*, *Rumex patentia*, *Acomastylis elata*, *Mentha longifolia* and *Arctium lappa* with their importance value index 0.58, 0.80, 1.12, 1.23 and 1.60 respectively (Fig. 3).

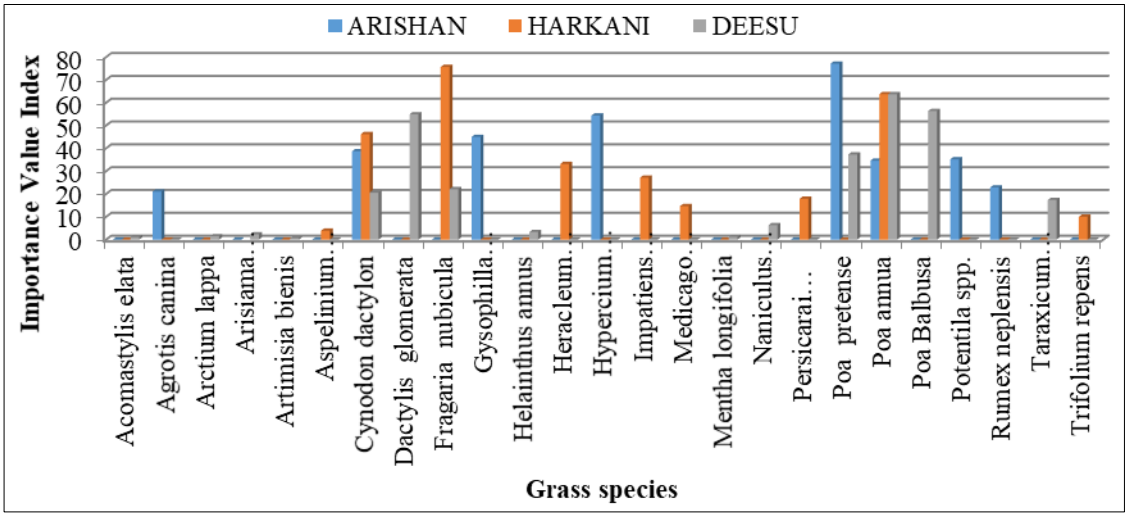

Fig 3: Important value index of grass species at three sites.

4. Discussion

In the present study large variations in floristic composition of trees, shrubs and grass species in three sites were recorded. It may be due to the fact that the sites were located far distant from one another and there was great variation in altitude. It may be also due to the micro climatic conditions of the grassland sites. There was a change in understory and ground vegetation with change in dominance and co-dominance of above storey tree species which may be due to well adaptability of these species under those dominant tree species. The plant community organizational analysis of the study area revealed a total of 50 plant species belonging to 21 families out of which 12 tree species, 12 shrub species and 26 herb species were recorded at all the three study sites. Out of 50 species. All together 50 plant species were recorded from three study stands belonging to 21 different families. The

result of the present study is much less than that of 113 species from temperate forest between 1800-2200m altitude of Subansiri district of Arunachal Pradesh and 122 species from temperate forest of Rhododendrons of western Arunachal Pradesh reported respectively [2,9]. The results were also in line with the reports of [10] who revealed that 59 species belonging to 54 genera and 34 families in the form of herbs, shrubs, understorey trees in Hytem reserve forest Malaysia. The species richness of the vegetation in the present study follow the trend as herb layer>shrub layer>tree layer i.e., 26 herb species, 12 shrub species and 12 tree species which is similar to that reported by [11] as 248 herb species, 39 shrub species and 37 tree species along the Sangla valley in North west Himalaya. The highest number of plant species recorded at all study sites belonged to Rosaecae (07), Poacaeae (06) followed by Pinaceae (04), Fabaceae (03), Polygonaecae (03), Asteraceae (03),Eriaceae (02), while Aceracea, Berbidacaeae, Betulaceae, Oleaceae, Araceae, Hippocastanaceae, Apiaceae, Balsaminaceae, Oleaceae, Caryophyllacaea, Cuppresaceae, Juglandaceae, Lamiaceae, Hammelidaceae, Elaganaceae, Gernaceae, Poeniaceae, Adoxaceae and Taxaceae were represented by one species each. Similar dominant families (Asteraceae, Eriaceae, Rosaceae and Poacaeae) from Sangla valley of North West Himalaya and temperate/subalpine forest of Arunachal Himalaya respectively [9, 11]. The density of trees ranged from minimum of 66 individuals/ha for *Padus cornuta* at lower elevation to a maximum of 688 individuals/ha for *Picea smithiana* at middle elevation. Among the trees species *Abies pindrow*, *Picea smithiana* and *Cedrus deodara* had the highest density of 327, 688 and 653 individuals ha^{-1} at higher, middle and lower elevations sites respectively. The tree density in the present study ranged between 66 to 688 individuals/ha which is lower than reported [12] i.e., 501 to 1250 trees/ha at Nanital Forest division of Uttarakhand. Among the trees *Cedrus deodara* recorded maximum basal area/ha on lower altitudinal range (75.95 m^2ha^{-1}), *Picea smithiana* recorded maximum basal area/ha on middle altitude (98.96 m^2ha^{-1}) while *Abies pindrow* shows maximum basal area/ha on upper altitude (84.02 m^2). The basal area is ranged between 02.53 to 98.97 m^2ha^{-1} which is within the range value of 33.98 (m^2/ha) to (105 m^2/ha) reported in pine dominated forest of Nanital Forest division [12]. The IVI of the tree species shows *Cedrus deodara* and *Pinus wallichiana* were dominant at lower elevation and *Picea simthiana* was dominant at middle elevation respectively, whereas at upper elevation site most dominant species was *Abies pindrow*. These results are supported by studies conducted in Langate Forest division of Kashmir [5]. The total shrub population varied considerably among the selected sites. Upper altitude showed the richest shrub population as compared to Middle and Lower altitude. The structural characteristics like density and basal area showed marked variation among different sites. Higher values of density were found for *Juniperus squammatta* at upper elevation site. *Juniperus squammatta* recorded the highest density of 994 individuals ha^{-1} at upper altitude while *Cotoneaster nummularis* exhibited lower density 294 individuals/ha^{-1} at upper elevation. The density of shrub is within the range of 510 to 1250 individuals/ha^{-1} from western Arunachal Pradesh [9]. Among the shrubs *Juniperus squammatta*, *Skimmmia laureola* and *Elaegnus rhamonoide* dominated the upper, middle and lower altitude with highest IVI of 83.21, 118.56 and 73.56, respectively. The lowest IVI of 31.27 was recorded for *Cotoneaster nummularis* at upper elevation site followed *Elaegnus rhamonoide* and *Parrotiopis jacquemontii* with IVI of 64.05 and 35.47 at middle and lower elevation respectively. The IVI values are in the range with the similar in Garhwal Himalaya [6]. Indices like dominance index, species diversity, IVI are in higher values in non-grazed sites as compared to the Grazed site (Arishan). So this study depicts that at herbaceous level the anthropogenic interference decreases species richness or species diversity or dominance index, similar observation was made [4, 8, 13].

5. Conclusion

A total of 50 plant species belonging to 21 families were recorded from the study area out of which 12 were trees. Over storey (tree species) dominant and co -dominant species differed from each other in each sample plot. The total density of trees, shrubs and herbaceous species ranged between 66 to 688, 994 to 187 and 1 to 98 tillers/m^2 at all the three sites. Among the trees *Picea smithiana* and *Pinus wallichiana* were present at all the study sites. *Cedrus deodara* (IVI 98.98) and *Pinus wallichaina* (IVI 81.93) were the most dominant species on lower altitude site while *Abies pindrow* and *Picea smithiana* were the dominant species on middle and upper altitude ranges. The basal area of trees varied on all the three altitudinal gradients. In case of basal area *Pinus wallichiana* and *Cedrus deodara* recorded maximum basal area 68.96 m^2/ha and 75.95 m^2/ha respectively on lower altitude while *Abies pindrow* and *Picea smithiana* recorded maximum basal area at middle (Harkani) and upper altitude (Arishan) sites respectively. The shrub species present at the study sites ranged from 03 to 05 at different elevation sites. Amongst the shrub species *Juniperus squammata* exhibited highest frequency value of 85% at higher altitude, *Rhododendron anthopogon* (70%) and *Vibernum* spps (78%) displayed maximum frequency value respectively at middle and lower sites. In case of basal area of shrub species *Juniperus squamatta* recorded the maximum basal area (37.04 m^2/ha) at higher altitude site, *Skimmia laureola* (10.20 m^2/ha) and *Vibernum* spps (19.87 m^2/ha) recorded maximum basal area at middle and lower altitude site respectively. The herbaceous species recorded ranged from 07 to 16 at three sites. The basal cover of herbaceous species depicted maximum basal cover of 3.98, 7.63 and 10.71 cm^2/m^2 for *Poa pretense*, *Fragaria nubicula* and *Poa balbusa at* Upper, Intermediate and Lower altitude sites respectively.

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