# PHYTOSOCIOLOGICAL STUDIES OF THE VASCULAR FLORA OF CHITRAL TOWN, DISTRICT CHITRAL LOWER, PAKISTAN

**Khushbu Zaman*, Zahir Muhammad*, Mujeeb ur Rahman*, Rehman Ullah*, Hazrat Ali* and Tahseen Ullah***

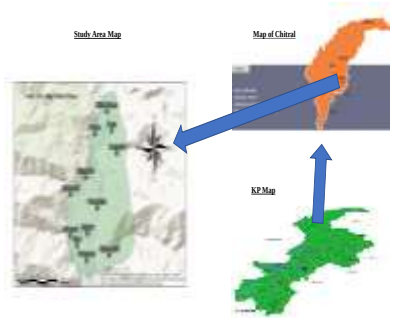
* Department of Botany, University of Peshawar, 25120, Pakistan

***Abstract-*** The present phytosociological study was carried out in Chitral town, Chitral lower Pakistan. The main objective of this research was to determine the vegetation structure and ecological parameters. Data was collected during 2020-2021 in spring and summer season. The quantitative data was collected from 4 monitoring sites by quadrate method. The size of quadrates was $5m^2$ for herbs, $10m^2$ for shrubs and $15m^2$ for trees. The communities *Scandix-Stellaria-Nepeta* (SSN), *Rosa-Rubus-Daphne* Community (RRD), *Ficus-Elaeagnus-Ailanthus* (FEA) and *Cannabis-Artemisia-Verbena* (CAV) were established in Deningol site. *Ranunculus-Mentha-Medicago* Community (RMM), *Rubus-Rosa-Tamarix* (RRT), *Robinia-Morus-Ficus* (RMF) and *Mentha-Cynodon-Conyza* (MCC) established in Guwali site, *Arenaria-Mentha-Cynodon* (AMC), *Rubus–Sophora-Tamarix* (RST), *Elaeagnus-Ailanthus-Morus* (EAM), *Mentha-Cynodon-Oxalis* (MCO) established in Jughhorgol site, *Veronica-Plantago-Ranunculus* (VPR), *Veronica-Plantago-Ranunculus* (VPR), *Salix-Populus-Elaeagnus (*SPE) and *Mentha-Plantago-Erigeron* (MPE) established in plain areas. Soil analysis was done to determine the physio-chemical properties of soil. The flora was found to be under biotic stress due to anthropogenic activities.

***Index Terms-*** Phytosociological, ecological parameters, quantitative data, physio-chemical properties, biotic stress

## I. INTRODUCTION

District Chitral is located in the northern part of North West Frontier Province of Pakistan, bordered with Afghanistan, China, Central Asian states and Gilgit-Baltistan. Chitral lies between 35˚ 10' 15" to 36˚ 55' 32" North and 71˚ 11' 32" to 73˚51' 34" East. Among all districts of Khyber Pakhtunkhwa (KP) Chitral is the largest one having an area of about 14850 $km^2$. The study area (Chitral town) is located in Chitral lower and is known as Chitral town. It is located 35˚50'42"N and 71˚47'6" E. It lies between two charming valleys Chumorkhon and Balach. It shows the elevation of about 4820 to 5880 feet from the sea level. The environmental conditions of Chitral shows there is a great variation in humidity and seasonal distribution of precipitation. The vegetation of the area shows the dominancy of rough resistant and cold tolerant vegetation because of long dry summer and considerable amount of snowfall in winter season (Khan *et al.*, 2011).




**a**

**b**

**Fig.1 (a) Geo referenced map of Chitral town, (b) Map of Research area (Chitral town) District Chitral lower, Pakistan**

### Phytosociology

Phytosociology deals with study of plant communities, composition, structure and their close relationship with one another. Phytosociology is helpful to explore the impact of different ecological factors on the whole structure and diversity of a plant community (Nazir *et al.*, 2012). It is also helpful in analyzing the important parameters of different communities of plants including quantitative, qualitative and synthetic attributes in any specific geographical region the wild and cultivated plants cover is known to be the vegetation which were classified into different communities of plants on the basis of floristic composition, habitat, and vegetation structure (Ali *et al.*, 2015). Species diversity reflects the health and productivity of any area, it also helpful in understanding the processes which are involved

in the developmental changes and community's organization (Amjad *et al.,* 2015). Environmental factors greatly affect the flora; area temperature decreases with elevation as a result the distribution of plant species also become less (Mehmood *et al*., 2015). Changes in weather conditions have a great impact on the composition and population level of species (Hussain and Parveen, 2009). Soil factor is also helpful in determining the different features of flora of any specific area (Khan *et al.,* 2010). Different phytosociological works have been done in different areas of Pakistan. Hussain and Parveen (2015) studied the phytosociological attributes of Kirthar range. Some of these are Khan *et al.* (2016) studied the pine communities of Kohistan, KPK, Pakistan. Ahmad and Yasmin (2011) observed the vegetation of Hanna Lake Balochistan. Ahmed *et al.* (2006) studied the phytosociological structure of Himalayan forests of Pakistan and recognized 24 plant communities. Ali *et al*. (2019) explored the wheat flora in Tehsil Charsadda, established five weed communities and recorded 33 species of weed. Khan *et al.* (2012) observed the relationship between vegetation and environment in the forest of Chitral. Naz *et al.* (2017) explored the areas around Karachi and recorded 83 plant species and showed that *Prosopis juliflora* was the dominant species. Farooq *et al.* (2010) surveyed the Phyto diversity of South Waziristan and established five communities. Hadi and Ibrar (2017) enlisted the grass flora of Kalash valley and recorded 36 species of grasses having 29 genera. Hameed *et al*. (2002) explored the flora of Lal Suhanra National Park, Bahawalpur. Hussain *et al.* (2010) analyzed the phytosociology of Central Karakoram National Park and showed the dominancy *of Picea smithiana*, *Pinus wallichiana* and *Juniperus excelsa* in all established stands. Ilyas *et al.* (2015) carried out the vegetative analysis of Kabal valley, Swat and established 9 plant communities. Zareen *et al.* (2018) determined the relation between the distribution of plants and ecological factors in Narowal, district Punjab. They recorded 59 plant species and classified the plant communities using TWINSPAN.

## II. MATERIALS AND METHODS

Regular surveys were carried out in Chitral town during summer and spring season of 2020-2022. Plants from different sites of Chitral town were collected, dried, preserved and identified by following the available literature (Ali and Qaiser, 1993-2018). The identified specimens were submitted to the Herbarium, Department of Botany, University of Peshawar. To find the vegetation structure of Chitral town four different sites were selected on the basis of topography and altitude. Vegetative sampling was analyzed using quadrate method. The size for herbs was (1×1m), for shrubs (5×5m) and for trees (10×10m). The vegetative analytical characters like density, frequency and cover were measured and changed into relative values for the calculation of IV (Importance value).The cover values were changed into mid values (Dubenmire, 1968).The communites of the plants were established on the basis of highest importance values (Ahmad and Shaukat 2012; Hussain 1989).The importance values of species were obtained by the summation of relative density, relative frequency and relative cover (Badshah *et al*., 2016)

IV=RD+ RC +RF (Eq. 1)

Sorenson's similarity index was obtained by using

$$SI=2\sum nc/\sum n1+\sum n2 \quad \text{(Eq. 2)}$$

Here,

nc= No. of same spp. between two communities

n1= Individual spp. of one site

n2= Individual spp. of another site

Simpson's diversity index (D) was obtained by using

$$D=\mathrm{N(N-1)}\Big/\sum \mathrm{n(n-1)} \quad \text{(Eq. 3)}$$

Here,

N= Total No. of all spp.

n= Total No. of individuals of a spp.

Shannon's diversity index (H) was calculated by using

$$H=-\sum_{i=1}^{s}\left[\left(\frac{ni}{n}\right)\times\left(\frac{In(ni)}{In(n)}\right)\right] \quad \text{(Eq. 4)}$$

Here,

ni= No. of individuals of all spp.

n= Total No. of individuals of all the spp.

Species richness (S.R) was calculated by following Menhinick (1964)

$$S.\ R=S/\sqrt{N} \quad \text{(Eq. 5)}$$

Here,

S= No. of spp. in a stand

N= Total number of individuals individuals in a stand

Maturity index (MI) was obtained by the methods followed by Pichi-Sermolli (1948)

MI

Frequancy % of all the spp. in a stand/Total No. of Spp. in a stand

Species evenness was calculated by

$$\text{Evenness: } E = \frac{H}{\ln(s)} \qquad \text{(Eq. 6)}$$

Here,

H= Shannon's index

s= Total number of Spp. in a community

***Soil analysis***

Soil samples of 4 kg collected from each of the four sites of Chitral town. The collected samples were packed in polythene bags. The physio-chemical properties of soil samples were analyzed in Agricultural Reaearch Institute Tarnab, Peshawar. To find the pH of soil, pH meter was used (Koehler *et al.*, 1984). Acid neutralization method was used to determine the lime (Thomas 1982). Organic matter in soil was determined with the help of $FeSO_4$ and $K_2Cr_2O_7$ solution (Nelson *et al*., 1996). The potassium and phosphorus content were determined by methods described by (Soltanpour., 1991). Electrical conductivity was estimated by following (Rhoades, 1996). For the determination of nitrogen Kjeldahl methodology was followed (Bemmer and Mulvaney 1982).

**Table No. 1.** Importance values of all the species of different sites

| | | Spring communities | | | | Summer communities | | | |
|---|---|---|---|---|---|---|---|---|---|
| S.No. | **Plant species** | DG | GW | JG | PA | DG | GW | JG | PA |
| 1 | *Acorus calamus* L. | 0 | 0 | 0 | 4.843 | 0 | 0 | 0 | 0 |
| 2 | *Adiantum capillus-veneris* L. | 0 | 0 | 0 | 0 | 1.142 | 13.776 | 0 | 0 |
| 3 | *Adiantum venustum* Don. | 0 | 0 | 3.396 | 0 | 0 | 0 | 0 | 0 |
| 4 | *Amaranthus spinosus* L. | 0 | 0 | 0 | 1.350 | 0 | 6.055 | 0 | 0 |
| 5 | *Amaranthus deflexus* L. | 0 | 0 | 0 | 0 | 6.094 | 0 | 0 | 0 |
| 6 | *Amaranthus viridis* L. | 0 | 0 | 0 | 0 | 4.767 | 3.924 | 0 | 1.320 |
| 7 | *Amaranthus* Spp. | 0 | 0 | 0 | 0 | 6.094 | 0 | 0 | 0 |
| 8 | *Ammi visnaga* L. | 0 | 0 | 0 | 4.832 | 0 | 3.863 | 0 | 3.051 |
| 9 | *Anthemis arvensis* L. | 0 | 0 | 0 | 0 | 5.492 | 0 | 1.871 | 0 |
| 10 | *Anthemis cotula* L. | 4.137 | 1.047 | 0 | 0 | 1.880 | 15.534 | 0 | 0 |
| 11 | Arabis spp | 0 | 0 | 0 | 0 | 5.894 | 0 | 0 | 0 |
| 12 | *Arenaria serpyllifolia* L. | 9.015 | 1.654 | 37.342 | 8.675 | 0 | 0 | 0 | 2.420 |
| 13 | *Artemisia absinthium* L. | 0 | 0 | 11.652 | 0 | 5.492 | 0 | 0 | 0 |
| 14 | *Artemisia brevifolia* Wall. | 0 | 0 | 0 | 0 | 3.424 | 0 | 0 | 0 |
| 15 | *Artemisia maritima* L. | 19.72 | 0 | 7.858 | 0 | 0 | 0 | 0 | 2.526 |
| 16 | *Artemisia scoparia* L. | 0 | 0 | 0 | 0 | 15.779 | 8.530 | 0 | 1.19 |
| 17 | *Artemisia vulgaris* L. | 0 | 0 | 2.319 | 4.165 | 0 | 0 | 0 | 0 |
| 18 | *Arum jacquemontii* Blume. | 0 | 0 | 2.481 | 0 | 0 | 0 | 0 | 0 |
| 19 | *Arundo donux* L. | 0 | 0 | 4.343 | 1.980 | 0 | 0 | 0 | 0 |
| 20 | *Asperugo procumbance* L. | 0 | 7.862 | 0 | 1.555 | 0 | 0 | 0 | 0 |
| 21 | *Astragalus psilocentros* L. | 0 | 0 | 0 | 0 | 0 | 0 | 9.523 | 0 |
| 22 | Asteraceae spp. | 0 | 0 | 0 | 2.804 | 0 | 0 | 0 | 0 |
| 23 | *Calendula arvensis* L. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3.008 |
| 24 | *Cannabis sativa* L. | 16.41 | 18.177 | 0 | 9.805 | 29.74 | 8.203 | 10.199 | 12.257 |
| 25 | *Cerastium glomerutum* Thuill. | 4.18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 26 | *Capsella bursa-pastoris* L. | 0 | 6.054 | 12.809 | 4.627 | 0 | 0 | 0 | 0 |
| 27 | *Carduus nutans* L. | 0 | 0 | 14.751 | 0 | 0 | 0 | 0 | 0 |
| 28 | *Carthamus lanatus* L. | 0 | 0 | 0 | 3.950 | 0 | 0 | 0 | 0 |
| 29 | *Cheilanthes pteridoides* (Reichard.) C.Chr. | 0 | 0 | 0 | 5.241 | 0 | 0 | 0 | 0 |
| 30 | *Chenopodium album* L. | 0 | 0 | 0 | 0 | 2.282 | 1.287 | 1.746 | 5.505 |
| 31 | *Chenopodium botrys* L. | 0 | 0 | 0 | 0 | 1.142 | 1.139 | 6.985 | 0 |
| 32 | *Chenopodium vulgare* L. | 0 | 1.654 | 0 | 0 | 0 | 0 | 0 | 0 |
| 33 | *Cichorium intybus* L. | 0 | 5.162 | 0 | 0 | 0 | 0 | 3.436 | 4.026 |
| 34 | *Cirsium vulgare* (Savi)Ten. | 0 | 0 | 2.050 | 2.168 | 1.142 | 1.139 | 1.746 | 0 |
| 35 | *Clematis arvensis* | 0 | 0 | 0 | 3.331 | 0 | 0 | 0 | 0 |
| 36 | *Clematis grata* Wall. | 0 | 9.088 | 0 | 0 | 0 | 0 | 0 | 0 |
| 37 | *Clematis orientalis* L. | 0 | 0 | 0 | 5.892 | 0 | 0 | 2.828 | 4.416 |
| 38 | *Clinopodium vulgare* L. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.997 |
| 39 | *Cnicus benedictus* L. | 0 | 0 | 0 | 0 | 0 | 0 | 3.787 | 1.997 |
| 40 | *Convolvulus arvensis* L. | 0 | 0 | 12.280 | 0 | 2.282 | 0 | 0 | 6.300 |
| 41 | *Coronopus didymus* L. | 9.633 | 0 | 14.124 | 1.657 | 2.081 | 4.532 | 0 | 0 |
| 42 | *Conyza Canadensis* L. | 0 | 0 | 0 | 0 | 7.978 | 0 | 0 | 8.089 |
| 43 | *Cynanchum acutum* L. | 0 | 0 | 0 | 0 | 0 | 16.644 | 6.202 | 0 |
| 44 | *Cynodon dactylon* L. | 7.080 | 0 | 20.709 | 0 | 14.195 | 18.573 | 32.770 | 13.767 |
| 45 | *Cynoglossum lanceolatum* Forssk. | 0 | 0 | 0 | 0 | 5.769 | 2.488 | 2.415 | 0 |
| 46 | *Datura stramonium* L. | 0 | 0 | 5.207 | 0 | 2.685 | 4.532 | 0 | 0 |
| 47 | *Descurainia sophia* L. | 9.475 | 2.142 | 0 | 3.309 | 0 | 0 | 0 | 0 |
| 48 | *Echinops echinatus* Roxb. | 0 | 0 | 0 | 0 | 0 | 0 | 2.290 | 0 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 49 | *Epilobium hirsutum* L. | 0 | 0 | 0 | 0 | 8.792 | 5.759 | 3.617 | 2.946 |
| 50 | *Epilobium parviflorum* Schreb. | 8.443 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 51 | *Epilobium spp.* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4.707 |
| 52 | *Erigeron bonariensis* L. | 2.861 | 7.149 | 0 | 0 | 1.14 | 0 | 0 | 1.320 |
| 53 | *Erigeron Canadensis* L. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.089 |
| 54 | *Erodium cicutarium* L. | 4.535 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 55 | *Equisetum ramosissium* Desf. | 0 | 1.2098 | 0 | 1.453 | 0 | 1.139 | 9.901 | 2.118 |
| 56 | *Erodium cicutarium* L. | 0 | 0 | 0 | 1.980 | 0 | 0 | 0 | 0 |
| 57 | *Euphorbia falcata* L. | 0 | 0 | 0 | 0 | 0 | 1.436 | 0 | 0 |
| 58 | *Euphorbia helioscopia* L. | 8.368 | 0 | 0 | 1.248 | 0 | 0 | 0 | 0 |
| 59 | *Euphorbia hirta* L. | 0 | 9.4224 | 0 | 0 | 0 | 0 | 0 | 0 |
| 60 | *Filago pyramidata* L. | 9.413 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 61 | *Fumaria indica* (Hausskn.) | 0 | 0 | 0 | 2.701 | 0 | 0 | 0 | 0 |
| 62 | *Gagea elegans* Wall. ex . | 0 | 0 | 5.425 | 0 | 0 | 0 | 0 | 0 |
| 63 | *Galinsoga parviflora* Cav. | 0 | 0 | 0 | 0 | 8.792 | 1.290 | 1.996 | 0 |
| 64 | *Galium aparine* L. | 0 | 2.094 | 0 | 5.904 | 0 | 0 | 0 | 0 |
| 65 | *Geranium rotundifolium* L. | 2.487 | 0 | 0 | 1.555 | 4.214 | 0 | 0 | 0 |
| 66 | *Geranium wallichianum* D. Don. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3.775 |
| 67 | *Gnaphalium thomsonii* Hook.f. | 0 | 0 | 0 | 0 | 0 | 0 | 7.654 | 0 |
| 68 | *Hordeum murinum* L. | 0 | 3.466 | 15.475 | 0 | 0 | 0 | 0 | 0 |
| 69 | *Impatiens balfourii* Hook. | 0 | 0 | 0 | 0 | 0 | 0 | 2.165 | 0 |
| 70 | *Lactuca dissecta* L. | 4.752 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 71 | *Lactuca serriola* L. | 1.29 | 1.047 | 5.249 | 1.350 | 11.478 | 3.464 | 12.107 | 11.209 |
| 72 | *Lolium temulentum* L. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.359 |
| 73 | *Lotus corniculatus* L. | 0 | 0 | 0 | 0 | 0 | 0 | 10.841 | 0 |
| 74 | *Lepyrodiclis holosteoides* (C.A.Mey) | 0 | 0 | 2.499 | 0 | 0 | 0 | 0 | 0 |
| 75 | *Malcolmia africana* L. | 0 | 0 | 0 | 5.445 | 3.426 | 0 | 0 | 0 |
| 76 | *Malva neglecta* Wallr. | 0 | 3.553 | 0 | 0 | 0 | 0 | 3.436 | 2.480 |
| 77 | *Marrubium vulgare* L. | 0 | 0 | 0 | 0 | 2.081 | 0 | 1.996 | 0 |
| 78 | *Matricaria chamomilla* L. | 0 | 7.892 | 0 | 0 | 0 | 13.289 | 0 | 0 |
| 79 | *Medicago lupilina* L. | 7.828 | 1.736 | 0 | 0 | 0 | 0 | 0 | 0 |
| 80 | *Medicago polymopha* L. | 0 | 24.041 | 0 | 5.597 | 0 | 2.340 | 0 | 2.238 |
| 81 | *Medicago sativa* Lin. | 0 | 0 | 0 | 6.603 | 0 | 0 | 0 | 10.005 |
| 82 | *Melica persica* Kunch, Rev. | 0 | 0 | 4.191 | 0 | 0 | 0 | 0 | 0 |
| 83 | *Mentha arvensis* L. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.238 |
| 84 | *Mentha longifolia* L. | 2.225 | 27.067 | 23.77 | 11.823 | 11.465 | 34.893 | 61.456 | 32.151 |
| 85 | *Myriactis wallichi* Less. | 0 | 0 | 0 | 0 | 0 | 3.6282 | 0 | 0 |
| 86 | *Tamarix aphylla* L. | 0 | 0 | 0 | 0 | 0 | 0 | 7.014 | 0 |
| 87 | *Nasturtium officinale* R. Br. | 0 | 0 | 7.090 | 6.059 | 0 | 0 | 13.239 | 7.387 |
| 88 | *Nepeta cataria* L. | 19.79 | 0 | 0 | 0 | 0 | 0 | 0 | 1.455 |
| 89 | *Neslia apiculata* Fisch. | 0 | 0 | 0 | 1.980 | 0 | 0 | 0 | 0 |
| 90 | *Onopordum acanthium* L. | 1.86 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 91 | *Onosma hispida* Wall ex G. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4.381 |
| 92 | *Oxalis corniculata* L. | 9.981 | 20.661 | 0 | 3.514 | 11.437 | 11.018 | 16.803 | 9.654 |
| 93 | *Persicaria hydropiper* L. | 0 | 14.655 | 6.911 | 0 | 2.282 | 2.723 | 0 | 5.804 |
| 94 | *Persicaria maculosa* S. F. Gay | 0 | 0 | 0 | 0 | 2.282 | 4.414 | 0 | 0 |
| 95 | *Persicaria nepalensis* (Meisn.)H. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3.302 |
| 96 | *Phagnalon niveum* Edgew. | 0 | 0 | 0 | 0 | 0 | 4.916 | 0 | 0 |
| 97 | *Plantago lanceolata* L. | 4.816 | 10.534 | 19.729 | 3.707 | 5.167 | 8.308 | 12.103 | 31.148 |
| 98 | *Plantago major* L. | 0 | 1.817 | 0 | 0 | 9.999 | 2.192 | 10.195 | 3.228 |
| 99 | *Plantago ovata* L. | 9.008 | 8.405 | 0 | 18.717 | 4.629 | 0 | 0 | 0 |
| 100 | *Poa annua* L. | 14.25 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 101 | *Polygonium aviculare* L. | 0 | 0 | 0 | 0 | 6.447 | 0 | 0 | 7.042 |
| 102 | *Polygonum plebejum* R. Br. | 0 | 0 | 0 | 0 | 0 | 2.192 | 0 | 0 |
| 103 | *potentilla bifurca* L. | 0 | 0 | 0 | 10.068 | 0 | 0 | 0 | 0 |
| 104 | *Potentilla supina* L. | 0 | 10.282 | 0 | 8.572 | 0 | 7.356 | 0 | 0 |
| 105 | *Prunella vulgaris* L. | 1.38 | 14.735 | 6.325 | 14.148 | 0 | 14.631 | 3.936 | 1.320 |
| 106 | *Ranunculus arvensis* L. | 6.574 | 0 | 0 | 1.350 | 9.256 | 8.886 | 0 | 17.254 |
| 107 | *Ranunculus balbosus* L. | 0 | 0 | 0 | 0 | 0 | 0 | 3.565 | 0 |
| 108 | *Ranunculus repens* L. | 0 | 27.673 | 9.919 | 16.688 | 0 | 0 | 0 | 0 |
| 109 | Ranunculus spp. | 0 | 0 | 0 | 6.608 | 0 | 0 | 0 | 7.042 |
| 110 | *Rumex angulatus* Lin. | 0 | 0.966 | 3.425 | 3.502 | 1.142 | 0 | 0 | 1.802 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 111 | *Rumex dentatus* Lin. | 0 | 0 | 0 | 0 | 0 | 0 | 1.020 | 0 |
| 112 | *Rumex hastatus* D.Don | 7.261 | 4.364 | 0 | 1.98 07 | 8.702 | 5.820 | 13.698 | 2.480 |
| 113 | *Saccharum spontaneum* L. | 0 | 0 | 0 | 0 | 0 | 0 | 6.307 | 4.522 |
| 114 | *Saxifraga hirulus* L. | 0 | 0 | 0 | 1.350 | 0 | 0 | 0 | 0 |
| 115 | *Salvia plebia* R. BR. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.524 |
| 116 | *Scandix pecten-veneris* L. | 24.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 117 | *Scrophularia striata* L. | 0 | 0 | 0 | 0 | 4.767 | 0 | 0 | 0 |
| 118 | *Sisymbrium irio* Lin. | 5.471 | 0 | 0 | 0 | 0 | 0 | 0 | 1.877 |
| 119 | *Sisymbrium officinale* Lin. | 0 | 0 | 0 | 0 | 3.424 | 0 | 0 | 0 |
| 120 | *Sonchus arvensis* L. | 0 | 0 | 0 | 0 | 2.485 | 0 | 0 | 0 |
| 121 | *Sonchus asper* L. | 0 | 0 | 0 | 4.370 | 3.625 | 1.287 | 0 | 1.440 |
| 122 | *Sonchus oleraceus* L. | 0 | 2.620 | 0 | 7.619 | 0 | 0 | 0 | 0 |
| 124 | *Stellaria media* L. | 21.41 | 0 | 7.676 | 16.612 | 0 | 0 | 0 | 0 |
| 123 | *Stellaria uliginosa* Murr. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.746 |
| 124 | *Tagetes erecta* L. | 0 | 13.086 | 0 | 0 | 5.568 | 10.410 | 0 | 0 |
| 125 | *Tagetes minuta* L. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.238 |
| 126 | *Taraxacum officinale* Weber. | 14.31 | 0 | 9.362 | 3.638 | 0 | 8.015 | 0 | 0 |
| 127 | *Taraxicum erythrospermum* Andrz. ex. | 0 | 1.047 | 0 | 0 | 0 | 0 | 0 | 0 |
| 128 | *Taraxicum officinale* (G.H. Weber. Ex.) | 0 | 5.185 | 0 | 0 | 0 | 0 | 0 | 0 |
| 129 | *Thesium himalense* Royle ex Engew. | 10.89 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 130 | *Torilis arvensis* (Huds.) | 0 | 0 | 0 | 0 | 0 | 4.886 | 0 | 0 |
| 131 | *Torilis leptophylla* L. | 0 | 0 | 0 | 0 | 0 | 0 | 2.540 | 2.721 |
| 132 | *Tribulus terrestris* Lin. | 0 | 0 | 1.195 | 2.082 | 0 | 0 | 0 | 0 |
| 133 | *Trifolium repens* L. | 0 | 0 | 0 | 2.185 | 0 | 0 | 0 | 4.434 |
| 134 | *Trifolium resupinatum* L. | 0 | 0 | 0 | 4.7299 | 0 | 0 | 0 | 0 |
| 135 | *Urtica dioca* L. | 0 | 0 | 5.240 | 0 | 5.972 | 0 | 0 | 0 |
| 136 | *Verbascum Thapsus* Lin. | 0 | 1.047 | 5.386 | 6.409 | 10.072 | 0 | 0 | 0 |
| 137 | *Verbena officinalis* L. | 0 | 9.174 | 0 | 0 | 15.630 | 8.457 | 0 | 5.877 |
| 138 | *Veronica beccabunga* L. | 2.609 | 0 | 0 | 0 | 3.087 | 0 | 0 | 0 |
| 139 | *Veronica persica* Pior. | 11.43 | 2.7109 | 9.793 | 23.130 | 0 | 0 | 0 | 0 |
| 140 | *Vicia hirsuta* L. | 0 | 9.5036 | 0 | 0 | 0 | 0 | 0 | 0 |
| 141 | *Vicia sativa* L. | 2.394 | 0 | 0 | 6.334 | 0 | 0 | 0 | 0 |
| 142 | *Viola canescens* Wall. Ex. Roxb. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 143 | *Viola odarata* L. | 0 | 0 | 0 | 5.138 | 0 | 0 | 3.141 | 0 |
| 144 | *Xanthium strumarium* L. | 0 | 0 | 0 | 3.638 | 0 | 0 | 0 | 0 |

**Table No. 2.** Importance values of all the shrubs species of different sites

| S.No. | Plant species | DG | GW | JG | PA |
|---|---|---|---|---|---|
| 1. | *Cotoneaster microphylla* | 7.199 | 0 | 18.921 | 0 |
| 2. | *Daphne mucronata* Royle | 62.54 | 51.18 | 0 | 30.53 |
| 3. | *Euonymus japonicus* Thunb. | 7.199 | 7.813 | 0 | 0 |
| 4. | *Hippophae rhamnoides* | 0 | 0 | 0 | 18.55 |
| 5. | *Rosa ecea* Aitch. | 0 | 0 | 7.040 | 0 |
| 6. | *Rosa webbiana* Wall. ex Royle | 92.04 | 80.73 | 18.55 | 53.99 |
| 7. | *Rubus fruticosus* | 89.51 | 84.73 | 178.44 | 151.28 |
| 8. | *Sophora mollis* Royle. | 30.08 | 22.57 | 44.52 | 26.18 |
| 9. | *Tamarix dioica* Royle ex.Roch | 18.61 | 52.95 | 32.50 | 19.44 |

**Table No. 3.** Importance values of all the tree species of different sites

| S.No. | Plant species | DG | GW | JG | PA |
|---|---|---|---|---|---|
| 1. | *Ailanthus altissimus* Mill. | 43.16 | 34.25 | 61.11 | 26.33 |
| 2. | *Crataegus songarica* K. Koch | 0 | 2.74 | 0 | 26.78 |
| 3. | *Elaeagnus angustifolia* L. | 46.94 | 27.29 | 83.25 | 36.39 |
| 4. | *Ficus carica* L. | 55.42 | 34.98 | 12.44 | 23.72 |
| 5. | *Juglans regia* L. | 6.876 | 0 | 0 | 3.691 |
| 6. | *Malus domestica* (Suckow) | 0 | 0 | 5.083 | 4.910 |
| 7. | *Morus alba* L. | 17.18 | 53.25 | 58.85 | 18.79 |
| 8. | *Pinus wallichiana* A.B Jackson | 0 | 0 | 4.076 | 0 |
| 9. | *Pistacia integerrima* J. L. Stewart. | 0 | 0 | 0 | 9.137 |
| 10. | *Platanus orientalis* L. | 21.18 | 0 | 0 | 0 |
| 11. | *Populus nigra* L. | 3.197 | 0 | 0 | 39.93 |
| 12. | *Prunus armenicana* Marshall | 14.48 | 9.137 | 0 | 23.69 |
| 13. | *Prunus domestica* L. | 0 | 0 | 0 | 5.790 |
| 14. | *Prunus avium* L. | 0 | 11.54 | 0 | 0 |
| 15. | *Prunus dulcis* L. | 0 | 0 | 4.586 | 0 |
| 16. | *Pyrus communis* L. | 0 | 0 | 0 | 4.602 |
| 17. | *Punica granatum* L. | 4.542 | 19.37 | 0 | 0 |
| 18. | *Robinia pseudoacacia* L. | 0 | 57.50 | 6.565 | 19.92 |
| 19. | *Salix babylonica* L. | 23.82 | 32.63 | 56.294 | 52.31 |
| 20. | *Tamarix aphylla* L. | 0 | 17.27 | 7.725 | 0 |

## III. Results

### Spring communities

### Deningol (Site -1)

#### a. *Scandix - Stellaria - Nepeta* community (SSN)

This community was established at Deningol at an elevation of about 1511-1666 m. A total of 35 herb species were recorded. The dominnat species were *Scandix pectin-veneris* (IV. 24.65) and *Stellaria media* (IV. 21.41) followed by *Nepeta cataria* (IV. 19.79), *Artemisia maritima* (IV. 19.72), *Cannabis sativa* (16.41)

while *Taraxicum officinale* (IV 14.31), *Poa annnua* (IV. 14.25), *Veronica persica* (IV. 11.43) and *Thesium himalense* (IV. 10.89) were codominated species respectively (Tab No. 1). The rest of the species had IV less than 10. The lowest IV was measured in *Onopordum acanthium* (1.86), *Prunella vulgaris* (1.38) and *Lactuca serriola* (1.29). The TIV of first three dominant species was (TIV. 65.862) while the TIV of other than these species were (TIV.183.675) (Table No. 1). In life form therophytes were dominant (26 spp.) followed by hemicryptophytes (4 spp.), chamaephytes (2 spp.) and geophytes (3 spp.) (Table No.5). Community was dominated by nanophylls having (20 spp.) followed by leptophylls (4 spp.), microphylls (5 spp.), mesophylls (5 spp.) and macrophylls (1 spp.) (Table No. 6).

Soil properties showed that the soil at site was Sandy loam with 6% clay, 34% silt and 60% sand. The pH of the soil was 8 $dsm^{-1}$. The electrical conductivity was 1.95 mS/m and organic matter 1.04% and calcium carbonate content 3% was recorded. The composition of Nitrogen 0.051%, Phosphorus 64.9 mg/kg, potassium 220mg/kg was recorded. The total soluble salt content was recorded 0.624% respectively (Table No.4).

**b. *Rosa - Rubus -Daphne* Community (RRD)**

This community was dominated by *Rosa webbiana* having IV (92.04), *Rubus fruticosus* (89.51) and *Daphne mucronata* (62.54) followed by *Sophora mollis* (30.08) and *Tamarix dioica* (18.61). The lowest IV was calculated in *Cotoneaster microphylla* (7.19). The TIV of the first three dominating species were (244.104) while the others were (55.895). (Table No.2). The life form was dominated by nanophanerophytes having (3 spp.) followed by microphanerophytes (2 spp.) and therophytes (1 spp.) (Table No.5). The leaf size spectrum showed the dominancy nanophylls (2 spp.) followed by microphylls (1 spp.) leptophylls (2 spp.) and aphyllous (1 spp.) (Table No.6).

**c. *Ficus - Elaeagnus – Ailanthus* Community (FEA)**

A total of 10 tree species recorded during sampling. The dominant species were *Ficus carica* (IV. 55.42), *Elaeagnus angustifolia* (IV. 46.94) and *Ailanthus atissima* (IV. 43.16) by making association with *Robinia pseudoacacia* (IV. 36.69), *Punica granatum* (26.47), *Salix babylonica* (23.82), and *Platanus orientalis* (21.18). While the rest of the species had less IV i-e *Morus alba* (17.18), *Prunus armenicana* (14.48), *Juglans regia* (6.87), *Prunus avium* (4.54) and *Populus nigra* (3.19). The TIV of first three dominant species were (145.527) while the remaining were (113.23158). (Table No.3). Community was dominated by megaphanarophytes having (10 spp.) followed by nanophanarophytes (1spp.). (Table No. 5). This community dominated by macrophylls (5spp.) followed by mesophylls (5 spp.) and microphylls (1 spp.). (Table No. 6).

**Guwali site (Site-2)**

**a. *Ranunculus- Mentha - Medicago Community* (RMM)**

During quadrate sampling total of 38 herb species recorded. This community was established at Guwali. Total 38 species recorded at an elevation of about 1429-1499m. The dominant species were *Ranunculus repens* (IV .27.67), *Mentha longifolia* (IV. 27.06) and *Medicago polymorpha* (IV. 24.04) followed by *Oxalis corniculata* (IV. 20.66) and *Cannabis sativa* (IV.18.17). The rest of the species had IV less than 14. *Anthemis cotula* had least (IV. 1.04). The TIV of first three dominant species were (78.783) while the remaining were (221.261) (Table No.1). Community was dominated by therophytes (29 spp.) followed by geophytes (5 spp.), chamaephytes (3 spp.) and hemicryptophytes (1 spp.) (Table No.5). Leaf size spectrum showed the dominancy of nanophylls (18 spp.) followed by microphylls (6 spp), mesophylls (9 spp.), macrophylls (3 spp.), leptophylls (1 spp.) and aphyllous (1 spp.) (Table No.6)

At this site the soil was Sandy loam with 4% clay, 18% silt and 78% sand. The pH was recorded 8.1 $dsm^{-1}$. The electrical conductivity was determined 0.56 mS/m. Total soluble salt 0.179%, organic matter 3.1 % and calcium carbonate content 9.25% was recorded. The composition of nitrogen 0.155%, phosphorus 12.7 mg/kg and potassium 84 mg/kg were recorded respectively (Table No.4).

**b. *Rubus-Rosa-Tamarix Community* (RRT)**

This shrubby community showed the dominance of *Rubus fruticosus* having IV (84.73), *Rosa webbiana* (80.73) making association with *Tamarix dioica* (52.95), *Daphne mucronata* (51.18) and *sophora mollis* (22.57). The lowest IV had *Euonymus japonicus* (7.81). The TIV of first three dominant species were (218.427) while the remaining were (81.572). (Table No. 2). Community was dominated by nanophanarophytes (3 spp.) followed by microphanarophytes (2 spp.) and therophytes (1 spp.) (Table No. 5). This community dominated by leptophylls (2 spp.) followed by nanophylls (2 spp.) and microphylls (2 spp.) (Table No. 6).

**c. *Robinia-Morus -Ficus carica* Community (RMF)**

A total of 11 tree species recorded from Guwali. *Robinia pseudoacacia* (IV. 57.50) *and Morus alba* (IV. 53.25) were dominant species. *Ficus carica* (IV. 34.98), *Ailanthus altissima* (IV. 34.25) and *Salix babylonica* (IV. 32.63) showed co dominance, while the rest of species had IV less than 28, i-e *Elaeagnus angustifolia* (27.29), *Punica granatum* (19.37), *Tamarix aphylla* (17.27), *Prunus avium* (11.54) and *Prunus armenicana* (9.13). The lowest IV had that of *Crataegus songarica* (2.74). The TIV of first three dominant species were (145.743) while the remaining were (154.256) (Table No.3). This community was dominated by mesophanarophytes (8 spp.) followed by microphanarophytes (1 spp.), nanophanarophytes (1 spp.) and megaphanarophytes (1 spp.) (Table No.5). This community was dominated by mesophylls having (6 spp.) followed by macrophylls (3 spp.), microphylls (1 spp.) and leptophylls (1 spp.) (Table No.6).

**Jughoorgol site (Site-3)**

**a. *Arenaria - Mentha - Cynodon community* (AMC)**

*Arenaria - Mentha - Cynodon* community was comprised of total 33 spp. at an elevation of about 1523-1450m. The dominant

species on the basis of IV were *Arenaria serpyllifolia* (IV. 37.34), followed by *Mentha longifolia* (IV. 23.77) and *Cynodon dactylon* (IV. 20.70). While other six species *Plantago lanceolata* (IV. 19.72), *Hordeum murinum* (IV. 15.47), *Carduus nutans* (IV. 14.75), *Coronopus didymus* (IV. 14.12), *Capsella bursa-pastoris* (12.80) and *Convolvulus arvensis* (IV.12.28) were co dominated species. The lowest IV was recorded in *Tribulus terrestris* (IV.1.19). The TIV of first three dominant species were (TIV. 81.826) while the remaining was (TIV. 218.173) (Table No1.)

Community was dominated by therophytes with (20 spp.) followed by geophytes (6 spp.), Chamophytes (4 spp.) and hemicryptophytes (2 spp.) (Table No. 5). Microphylls showed dominancy (11 spp.) followed by nanophylls (9 spp.), mesophylls (6 spp.), leptophylls (3 spp.) and macrophylls (3 spp.) (Table No. 6).

Soil at this site was was sandy loam with 2% clay, 24% silt and 74% sand. The pH was recorded 8.3 $dsm^{-1}$. The electrical conductivity was 0.51 mS/m. Total soluble salt 0.163 %, organic matter 1.04 % and calcium carbonate content 9.25% was recorded. The composition of nitrogen 0.051%, phosphorus 20.2 mg/kg and potassium 58 mg/kg were recorded respectively (Table No.4)

**b. *Rubus – Sophora- Tamarix community* (RST)**

This community dominated by *Rubus fruticosus* having (IV=178.44), followed by *Sophora mollis* (44.52) and *Tamarix dioica* (32.50). While the other 3 species *Cotoneaster microphylla* (18.92), *Rosa webbiana* (18.55) and *Rosa ecae* (7.040) had less than 18 IV values. The TIV of first three dominant species were (255.48) while the remaining were (44.51) (Table No.2). Community was dominated by nanophanerophytes (4 spp.) and microphanerophytes (2 spp.) (Table No.5). This community dominated by microphylls (1 sp.) followed by followed by nanophylls (4 spp.) and leptophylls (1spp.) (Table No.6).

**c. *Elaeagnus -Ailanthus -Morus* (EAM)**

Tree community of Jughoorgol site consisted of total of 10 species. *Elaeagnus angustifolia* having (IV. 83.25), *Ailanthus atissima* (IV. 61.11) and *Morus alba* (IV. 58.85) were dominant species. *Salix babylonica* having (IV. 56.29) is co dominant species followed by *Ficus carica* (IV. 12.44). While the rest of the species had IV values less than 8.i-e *Tamarix aphylla* (IV. 7.72), *Robinia pseudoacacia* (IV. 6.56), *Malus domestica* (IV. 5.08), *Prunus dulcis* (IV. 4.58) and *Pinus wallichiana* (IV. 4.07). The TIV of first three dominant species were (203.22) while the remaining were (96.774) (Table No.3). The community was dominated by megaphanarophytes (7 spp.) followed by nanophanerophytes (1 spp.), microphanerophytes (1 spp.) and mesophanerophytes (1 spp.) (Table No.5). This community is dominated by mesophylls (4 spp.) followed by microphylls (2 spp.), macrophylls (2 spp.), nanophylls and leptophylls having 1 species each (Table No.6).

**Plain areas (Site-4)**

**a. *Veronica - Plantago - Ranunculus Community* (VPR)**

At this site total of 54 species were recorded at an elevation of about 1423-1626m. Species like *Veronica persica*, *Plantago ovata* and *Ranunculus repens* with IV 23.13, 1871, 16.68 were dominant followed by *Stellaria media* (IV. 16.61), *Prunella vulgaris* (IV. 14.14), *Mentha longifolia* (IV. 11.82) and *Potentilla nepalensis* (IV. 10.06). While the rest of species IV had less than 9. The lowest IV *had Euphorbia helioscopia* (1.24). The TIV of first three dominant species were (TIV. 58.536) while the remaining was (TIV. 241.46) (Table No.1). Community was dominated by therophytes having (38 Spp.) followed by geophytes (8 spp.), chamophytes (5 spp.), hemicryptophytes (2 spp.) and nanophanarophytes (1 spp.) (Table No.5). This community was dominated by nanophylls (18 spp.) followed by microphylls (14 spp.), mesophylls (12 spp.), leptophylls (8 spp.) and macrophylls (2 spp.) (Table No.6)

Soil was silty loam at this site with 8% clay, 62% silt and 30% sand. The pH of the soil was 8 $dsm^{-1}$. The electrical conductivity was recorded 0.59 mS/m. Total soluble salt 0.188 %, organic matter 3.18 % and calcium carbonate content 5.25 % was recorded. Nitrogen content 0.069 %, Phosphorus74.9 mg/kg and potassium 114 mg/kg were recorded respectively (Table No.4).

**b. *Rubus -Rosa- Daphne Community* (RRD)**

At this site the dominant species were *Rubus fruticosus* having IV (151.28) and *Rosa webbiana* (53.99) followed by *Daphne mucronata* (30.53), *sophora mollis* (26.18), *Tamarix dioica* (19.44) and *Hippophae rhamnoides* (18.55). The TIV of first three dominant species were (235.809) while the remaining were (64.190). (Table No. 2). This community was dominated by nanophanarophytes (3 spp.) followed by microphanarophytes (2 spp.) and therophytes (1 spp.) (Table No. 5). Leaf size showed the dominancy of mesophylls (1 spp.) followed by nanophylls (3 spp.) and leptophylls (2 spp.) (Table No. 6).

**c. *Salix - Populus - Elaeagnus Community* (SPE)**

A total of 14 tree species were recorded. *Salix babylonica*, *Populus nigra* and *Elaeagnus angustifolia* were dominant species (IV. 52.31), (IV. 39.93) and (IV. 36.39) respectively followed by *Crataegus songarica* (IV. 26.78), *Ailanthus altissima* (IV. 26.33), *Ficus carica* (IV. 23.72), *Prunus armenicana* (IV. 23.69). While the rest of the species having IV less than 20. The least IV was that of *Juglans regia* (3.69). The TIV of first three dominant species were (IV. 128.647) while the remaining was (IV.167.896) (Table No.3). This community was dominated by megaphanarophytes (12 spp.) followed by microphanarophytes (1 spp.) and nanophanerophytes (1 spp.) (Table No. 5). The leaf size showed the dominancy of mesophylls (6 spp.) followed by macrophylls (6 spp.) and microphylls (2 spp.) (Table No. 6).

**Summer communities**

**Deningol (Site -1)**

***Cannabis- Artemisia - Verbena* Community (CAV)**

During summer quadrate sampling total of 49 herb species were recorded *Cannabis sativa* (IV. 29.74), *Artemisia scoparia* (IV. 15.77) and *Verbena officinalis* (IV.15.63) showed the dominancy followed *by Cynodon dactylon* (IV. 14.19), *Lactuca serriola* (IV. 11.47), *Mentha longifolia* (IV. 11.46) and (IV. 11.43). The lowest IV had seen in total five species having equal IV *Chenopodium botrys*, *Adiantum capillus-veneris* ,*Cirsium vulgare* , *Erigeron bonariensis* ,and *Rumex angulatus* (1.14). The TIV of first three dominant species were (TIV. 61.151) while the remaining was (TIV. 238.848). (Table No.1). This community was dominated by therophytes (33 spp.) followed by

hemicryptophytes (9spp.), geophytes (4 spp.) and chamophytes (3 spp.) (Table No.7). The leaf size shows the dominancy of microphylls (14 spp.) followed by nanophylls (16 spp.), macrophylls (5 spp.), mesophylls (7 spp.), leptophylls (5 spp.) and aphyllous (2 spp.) (Table No.8).

**Guwali (Site-2)**

***a. Mentha- Cynodon- Conyza* Community (MCC)**

A total of 44 herb species were recorded. The community was dominated by *Mentha longifolia* (IV. 34.89), *Cynodon dactylon* (IV. 18.57) and *Conyza canadensis* (IV. 16.64) related with *Anthemis cotula* (IV. 15.53), *Prunellla vulgaris* (IV. 14.63) *Adiantum capillus-veneris* (IV. 13.77) and *Matricaria Chamomilla* (IV.13.28) while other than these species the IV less than 11. The lowest IV is seen in 3 species i-e *Cirsium vulgare*, *Equisetum ramosissium* and *Chenopodium botrys* (1.13). The TIV of first three dominant species were (TIV. 70.112) while the remaining was (TIV. 229.88). (Table No. 1). The life form showed the dominancy of therophytes (30 spp.) followed by geophytes (4 spp.), hemicryptophytes (7 spp.) and chamaephytes (3 spp.) (Table No. 7). Community was dominated by nanophylls (18 spp.) followed by microphylls (9 spp.), mesophylls (8 spp.), leptophylls (4 spp.), macrophylls (3 spp.) and aphyllous (1spp.) (Table No. 8).

**Jughoorgol site (Site-3)**

***a. Mentha- Cynodon- Oxalis* Community (MCO)**

At this site the dominant species were 35 species recorded. *Mentha longifolia* (IV. 61.45), *Cynodon dactylon* (IV. 32.77) and *Oxalis corniculata* (IV. 16.80). *Rumex hastatus* (IV. 13.69), *Nasturtium officinale* (IV. 13.23), *Lactuca serriola* (IV. 12.10), *Plantago lanceolata* (IV. 12.10), *Lotus corniculatus* (10.84), *Cannabis sativa* (IV. 10.19), *Plantago major* (IV. 10.19) were co-dominant members respectievely. The lowest IV was that of *Rumex dentatus* (IV. 1.02). The TIV contribution of first three dominant species was (TIV. 111.030) while the remaining was (TIV.189.344). (Table No. 1). The community was dominated by therophytes (21spp.) followed by geophytes (3 spp.), hemicryptophytes (4 spp.), chamaephytes (5 spp.) and nanophytes (2 spp.) (Table No.7). Nanophylls (16 spp.) showed the dominancy followed by microphylls (9 spp.), leptophylls (z4 spp.), mesophylls (4 spp.) and macrophylls (2 spp.) (Table No. 8).

**Plain areas (Site -4)**

***a. Mentha- Plantago - Erigeron* Community (MPE)**

The site included of total of 51 herb species. Among these herbs *Mentha longifolia*, *Plantago lanceolata*, *Erigeron canadensis* and *Ranunculus arvensis* showed dominancy having IV of 32.15, 31.14, 17.29 and 17.25 respectively followed by *Cynodon dactylon* (IV. 13.76), *Cannabis sativa* (IV. 12.25), *Lactuca serriola* (IV. 11.20) and *Medicago sativa* (IV. 10.00). The lowest IV was recorded in *Artemisia scoparia* (IV. 1.19). The TIV contribution of first three dominant species was 80.594 while the remaining were 19.525 (Table No.1). This community was dominated by therophytes (33 spp.) followed by chaemophytes (7 spp.), hemicryptophytes (7 spp.), geophytes (3 spp.) and nanophanarophytes (1 spp.) (Table No. 7). The leaf size showed the dominancy of nanophylls (22 spp.) followed by microphylls (17 spp.), leptophylls (4 spp.), mesophylls (7spp.) and macrophylls (1 spp.) (Table No.8).

**Table No.4.** Physio-chemical properties of soil samples of different sites

| Site Name | Soil texture | Clay | Silt | Sand | pH | EC | TSS | CaCo3 | OM | N | P | K |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DG | Sandy loam | 6 | 34 | 60 | 8 | 1.95 | 0.624 | 3 | 1.04 | 0.051 | 64.9 | 220 |
| GW | Sandy loam | 4 | 18 | 78 | 8.1 | 0.56 | 0.179 | 9.25 | 3.1 | 0.155 | 12.7 | 84 |
| JG | Sandy loam | 2 | 24 | 74 | 8.3 | 0.51 | 0.163 | 9.25 | 1.04 | 0.051 | 20.2 | 58 |
| PA | Silty Loam | 8 | 62 | 30 | 8 | 0.59 | 0.188 | 5.25 | 3.18 | 0.069 | 74.9 | 114 |

**Keys:**
**DG**=Deningol, **GW**= Guwali**, JG**= Jughoorgol, **PA**= Plain areas, **EC**=Electrical conductivity, **$CaCO_3$**= Calcium carbonate, **OM**= Organic matter, **N**= Nitrogen, **P**= Phosphorus, **K**=Potassium

**Table No. 5.** Life form representation of spring communities

| | Deningol | | | Guwali | | | Jughoorgol | | | Plain areas | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Life form** | **SSN** | **RSD** | **FEA** | **RMM** | **RRT** | **RMF** | **AMC** | **RST** | **EAM** | **VPR** | **RRD** | **SPE** |
| Therophytes | 26 | 1 | 0 | 29 | 1 | 0 | 20 | 0 | 0 | 38 | 1 | 0 |
| Geophytes | 3 | 0 | 0 | 5 | 0 | 0 | 6 | 0 | 0 | 8 | 0 | 0 |
| Hemicryptophytes | 4 | 0 | 0 | 1 | 0 | 0 | 2 | 0 | 0 | 2 | 0 | 0 |
| Chamaephytes | 2 | 0 | 0 | 3 | 0 | 0 | 4 | 0 | 0 | 5 | 3 | 0 |
| Nanophanerophytes | 0 | 3 | 1 | 0 | 3 | 1 | 0 | 4 | 1 | 1 | 0 | 1 |
| Microphanerophytes | 0 | 2 | 0 | 0 | 2 | 1 | 0 | 2 | 1 | 0 | 2 | 1 |
| Mesophanerophytes | 0 | 0 | 0 | 0 | 0 | 8 | 0 | 0 | 1 | 0 | 0 | 0 |
| Megaphanerophytes | 0 | 0 | 10 | 0 | 0 | 1 | 0 | 0 | 7 | 0 | 0 | 13 |
| Climbers | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table No. 6.** Leaf size representation of spring communities

| | Spring communities | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Deningol | | | Guwali | | | Jughoorgol | | | Plain areas | | |
| Leaf size | SSN | RSD | FEA | RMM | RRT | RMF | AMC | RST | EAM | VPR | RRD | SPE |
| Aphyllous | 0 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Leptophylls | 4 | 2 | 0 | 1 | 2 | 1 | 3 | 1 | 1 | 8 | 2 | 0 |
| Nanophylls | 20 | 2 | 0 | 18 | 2 | 0 | 9 | 4 | 1 | 18 | 3 | 0 |
| Microphylls | 5 | 1 | 1 | 6 | 2 | 1 | 11 | 1 | 2 | 14 | 0 | 3 |
| Mesophylls | 5 | 0 | 5 | 9 | 0 | 6 | 6 | 0 | 4 | 12 | 1 | 6 |
| Macrophylls | 1 | 0 | 5 | 3 | 0 | 3 | 12 | 0 | 2 | 2 | 0 | 6 |

**Table No. 7.** Life form representation of summer communities

| | Deningol | Guwali | Jughoorgol | Plain areas |
|---|---|---|---|---|
| **Life form** | **CAV** | **MCC** | **MCO** | **MPE** |
| Therophytes | 33 | 30 | 21 | 33 |
| Geophytes | 4 | 4 | 3 | 3 |
| Hemicryptophytes | 9 | 7 | 4 | 7 |
| Chamaephytes | 3 | 3 | 5 | 7 |
| Nanophanerophytes | 0 | 0 | 2 | 1 |

**Table No. 8.** Life form representation of summer communities

| | Deningol | Guwali | Jughoorgol | Plain areas |
|---|---|---|---|---|
| **Leaf size** | **CAV** | **MCC** | **MCO** | **MPE** |
| Aphyllous | 2 | 1 | 0 | 0 |
| Leptophylls | 5 | 4 | 4 | 4 |
| Nanophylls | 16 | 18 | 16 | 22 |
| Microphylls | 14 | 9 | 9 | 17 |
| Mesophylls | 7 | 8 | 4 | 7 |
| Macrophylls | 5 | 3 | 2 | 1 |

**Simpson diversity index**

Simpson diversity index is the most important value for study of a community. The results represent that the Simpson's diversity index value (0.072 D) is lower in AMC established in Jughoorgol while higher Simpson's diversity index value (0.048 D) was recorded in SSN established in Deningol (Table No.9). The results of summer herbaceous communities show that the Simpson's diversity index value 0.144 was lower in MCO established in Jughoorgol while high value 0.051 D was seen in CAV established in Deningol. The high diversity of Deningol is due to high moisture content because of North facing slopes as compare to South facing slopes, while the summer herbaceous communities showed that the Simpson's diversity index value 0.144 was lower in MCO established in Jughoorgol while higher value (0.051) was seen in CAV established in Deningol. This is because of the physio-chemical properties of soil. The potassium content of soil (220 mg/kg) was greater in Deningol as compare to other sites. Grazing pressure greatly affect the species distribution. The lowest diversity in Jughoorgol was due to high grazing pressure and more water runoff due to which plant survival can be affected. The shrub communities showed that RRT established in Guwali was the more diverse community having 0.2171D. The less diverse community was RST established in Jughoorgol having 0.4465 D. The more diversity of shrubs in Guwali was due to high protected areas. Simpson diversity index for trees showed that the more diverse community was SPE established in Plain areas having 0.1006 D while the less diverse community was EAM having 0.2185D established in Jughoorgol. Higher Simpson diversity in SPE was due availability of more space as compare to other sites.

**Shannon diversity index (H")**

Diversity is randomly selection of different species in a community. Shannon's diversity index (H) represented the difference between communities. Community VPR was the most diverse having (3.35 H) followed by SSN (3.22 H), RMM (3.07H) while AMC was less diverse community having index value of 2.99 H established in Jughoorgol (Table No.9). The smaller number of species in Jughoorgol as compare to Plain areas was due to higher altitude (1560m) as compared to other sites. Among the summer communities Shannon's diversity index (H) showed that the CAV was the most diverse having (3.37 H) index value established in Deningol, followed by MCC (3.26 H), and MPE (3.22 H). MCO in Jughoorgol was less diverse having value (2.64 H). The less diversity was also due greater pH value (8.3 $dsm^{-1}$) of soil as compare to other sites. Shannon diversity index was shrub communities showed that the most diverse was community was RRT established in Guwali having (1.55) index value. The less diverse community was RST having (1.10 H) established in Jughoorgol. Shannon diversity index for trees showed that the most diverse was SPE established in Plain areas having 2. 38H.While the less diverse community was EAM having 1.67 H established in Jughoorgol.

**Species richness (SR)**

According to Menhinick index formula the high species richness was found in VPR having 1.72 at Plain Areas Site followed by RMM having (1.08) and SSN (1.07). The high species richness at Plain areas was due to high phosphorus content (74.9 mg/kg) in soil as compare to other sites. The lowest species richness value was found in AMC (0.95) at Jughoorgol site. Among summer communities CAV have high richness having value of (2.19). The lowest species richness was recorded at Jughoorgol site MCO having value of (1.27). (Table No. 9). Species richness values for shrub shows that RRT established in Guwali have high richness having value of (0.84) while the low species richness value is recorded in RRD having value of 0.68 established in Plain areas. Highest species richness for trees was found in *Salix- Populus - Elaeagnus Community* (SPE) having value of 1.30 while less species richness was seen in community EAM having value of 0.96 established in Jughoorgol. The high species richness in these communities was due to variation in altitude, species richness is high at lower altitude while low at higher altitude.

**Simpson diversity index**

Simpson diversity index is the most important value for study of a community. The results represent that the Simpson's diversity index value (0.072 D) is lower in AMC established in Jughoorgol while higher Simpson's diversity index value (0.048 D) was recorded in SSN established in Deningol (Table No.9). The results of summer herbaceous communities show that the Simpson's diversity index value 0.144 was lower in MCO established in Jughoorgol while high value 0.051 D was seen in CAV established in Deningol. The high diversity of Deningol is due to high moisture content because of North facing slopes as compare to South facing slopes, while the summer herbaceous communities showed that the Simpson's diversity index value 0.144 was lower in MCO established in Jughoorgol while higher value (0.051) was seen in CAV established in Deningol. This is because of the physio-chemical properties of soil. The potassium content of soil (220 mg/kg) was greater in Deningol as compare to other sites. Grazing pressure greatly affect the species distribution. The lowest diversity in Jughoorgol was due to high grazing pressure and more water runoff due to which plant survival can be affected. The shrub communities showed that RRT established in Guwali was the more diverse community having 0.2171D. The less diverse community was RST established in Jughoorgol having 0.4465 D. The more diversity of shrubs in Guwali was due to high protected areas. Simpson diversity index for trees showed that the more diverse community was SPE established in Plain areas having 0.1006 D while the less diverse community was EAM having 0.2185D established in Jughoorgol. Higher Simpson diversity in SPE was due availability of more space as compare to other sites.

**Shannon diversity index (H")**

Diversity is randomly selection of different species in a community. Shannon's diversity index (H) represented the difference between communities. Community VPR was the most diverse having (3.35 H) followed by SSN (3.22 H), RMM (3.07H) while AMC was less diverse community having index value of 2.99 H established in Jughoorgol (Table No.9). The smaller number of species in Jughoorgol as compare to Plain areas was due to higher altitude (1560m) as compared to other sites. Among the summer communities Shannon's diversity index (H) showed that the CAV was the most diverse having (3.37 H) index value established in Deningol, followed by MCC (3.26 H), and MPE

(3.22 H). MCO in Jughoorgol was less diverse having value (2.64 H). The less diversity was also due greater pH value (8.3 $dsm^{-1}$) of soil as compare to other sites. Shannon diversity index was shrub communities showed that the most diverse was community was RRT established in Guwali having (1.55) index value. The less diverse community was RST having (1.10 H) established in Jughoorgol. Shannon diversity index for trees showed that the most diverse was SPE established in Plain areas having 2. 38H.While the less diverse community was EAM having 1.67 H established in Jughoorgol.

**Species richness (SR)**

According to Menhinick index formula the high species richness was found in VPR having 1.72 at Plain Areas Site followed by RMM having (1.08) and SSN (1.07). The high species richness at Plain areas was due to high phosphorus content (74.9 mg/kg) in soil as compare to other sites. The lowest species richness value was found in AMC (0.95) at Jughoorgol site. Among summer communities CAV have high richness having value of (2.19). The lowest species richness was recorded at Jughoorgol site MCO having value of (1.27). (Table No. 9). Species richness values for shrub shows that RRT established in Guwali have high richness having value of (0.84) while the low species richness value is recorded in RRD having value of 0.68 established in Plain areas. Highest species richness for trees was found in *Salix- Populus - Elaeagnus Community* (SPE) having value of 1.30 while less species richness was seen in community EAM having value of 0.96 established in Jughoorgol. The high species richness in these communities was due to variation in altitude, species richness is high at lower altitude while low at higher altitude.

**Species evenness (E)**

In spring season, the evenness value (0.093 E) was higher at Jughoorgol site AMC followed by SSN (0.092 E), RMM (0.082 E). VPR community established in Plain areas (0.062 E) was recorded as less evenness community. Among summer herb communities the high evenness value (0.074) was seen in MCC community of Deningol while low evenness value (0.063) was recorded in MPE community of Plain areas. (Table No.9). In spring the evenness distribution of species is greater as compared to summer communities. This is due to high densities of any one or two species of summer communities. The less evenness in Plain areas of spring community VPR (0.062 E) was due to invasion of *Veronica persica*. The low evenness value (0.063 E) in Plain areas of summer community MPE was due to invasion of *Mentha longifolia*. The evenness values of other communities were intermediate due to uniform distribution of species. High evenness value (0.26 E) for shrub was recorded in RRT established in Guwali while the lowest evenness value 0.06 E was recorded in RSD in Deningol. High evenness value (0.20) for trees was recorded in RMF in Guwali site while lowest value 0.158 E was recorded in SPE in Plain areas.

**Maturity index (MI)**

The maturity index values of spring communities showed that the most mature community was RMM having value of (3.44MI) followed by SSN (3.25 MI) and AMC (3.21MI). Among the summer communities most mature community was community MCO with having 3.58MI while the less mature community was MPE with the low MI value of 2.07 (Table No.9). The maturity index values of summer communities represent that the most mature community was community MCO having the MI value of 3.58 while the less mature community was MPE with the low MI value of 2.07. Shrubs showed that the most mature community was RRT community having (6.33MI). The lowest maturity value (3.66) was seen in RST community established at Jughoorgol site. Maturity index values for trees showed that the most mature community was EAM community having MI value of 7.20. The lowest value (3.60 MI) was seen in SPE community. The immaturity of species was due to the effect of different ecological conditions like deforestation and soil erosion. The high pressure of anthropogenic activities badly affects the species to reach into the climax level.

**Sorenson's similarity index**

The highest similarity was recorded between SSN and RMM plant communities; the similarity index value was (0.41) which showed that SSN and RMM show the highest similarity, followed by AMC and VPR (0.39), SSN and VPR (0.38), RMM and AMC (0.37) and RMM and VPR (0.35). The highest similarity between these two communities is due to same moisture content. The lowest value of similarity index was recorded between SSN and AMC having the similarity index of (0.30). The lowest similarity index is due to different moisture content and different phytosociological habitats (Table No.10). The greatest similarity index is recorded between two communities CAV and MCC with the similarity value of (0.58). These results were same as the spring herb communities. The highest similarity between these communities was due to water content and wet condition of the area. The lowest similarity index is seen between MCC and MPE having similarity value (0.04) established in Guwali and Plain areas (Table No. 11). The dissimilarity between these two communities was due to different phytosociological habitats and altitude (1499-1626m). Four shrub communities were established from four different sites. The four communities showed the highest similarity index which included RSD and RMM, RSD and RST, RSD and RRD and RMM and RRD. Each of them had same highest similarity having value of (0.83) (Table No. 12). The high similarity between these communities was due to effect of edaphic characteristics like soil texture, pH, electrical conductivity, calcium carbonate, nitrogen, potassium and phosphorus content. The communities, RMM and RST, RST and RRD showed less similarity having value of (0.66). The highest similarity index was seen between the communities RRT and RMF established in Deningol and Guwali having similarity value (0.78) (Table No. 13). The highest similarity between these two communities was due to same water content. The lowest similarity index (0.53) was recorded in RMF and SPE tree communities established in Guwali and plain areas. The less similarity is due differences in edaphic values (Table No. 4) and different altitude (1499-1626).

**Table No.9. Diversity indices of all the four sites**

| Spring communities | | | | | | | |
|---|---|---|---|---|---|---|---|
| Sites | Abrr. | TSN | D | H | SR | E | MI |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Deningol | SSN | 35 | 0.048 | 3.22 | 1.07 | 0.092 | 3.25 |
| | RSD | 6 | 0.217 | 1.55 | 0.76 | 0.06 | 4.33 |
| | FEA | 12 | 0.121 | 2.19 | 1.11 | 0.200 | 3.75 |
| Guwali | RMM | 38 | 0.059 | 3.07 | 1.08 | 0.082 | 3.44 |
| | RRT | 6 | 0.217 | 1.56 | 0.78 | 0.26 | 6.33 |
| | RMF | 11 | 0.113 | 2.21 | 1.03 | 0.183 | 5.54 |
| Jughoorgol | AMC | 32 | 0.072 | 2.99 | 0.95 | 0.093 | 3.21 |
| | RST | 6 | 0.446 | 1.1 | 0.84 | 0.18 | 3.66 |
| | EAM | 10 | 0.218 | 1.67 | 0.96 | 0.167 | 7.20 |
| Plain areas | VPR | 54 | 0.052 | 3.35 | 1.72 | 0.062 | 1.85 |
| | RRD | 6 | 0.348 | 1.36 | 0.68 | 0.22 | 4.50 |
| | SPE | 15 | 0.100 | 2.38 | 1.30 | 0.158 | 3.60 |
| **Summer communities** | | | | | | | |
| Deningol | CAV | 49 | 0.051 | 3.37 | 2.19 | 0.068 | 2.57 |
| Guwali | MCC | 44 | 0.056 | 3.26 | 1.69 | 0.074 | 2.7 |
| Jughoorgol | MCO | 36 | 0.144 | 2.64 | 1.27 | 0.073 | 3.58 |
| Plain areas | MPE | 51 | 0.060 | 3.22 | 1.77 | 0.063 | 2.07 |

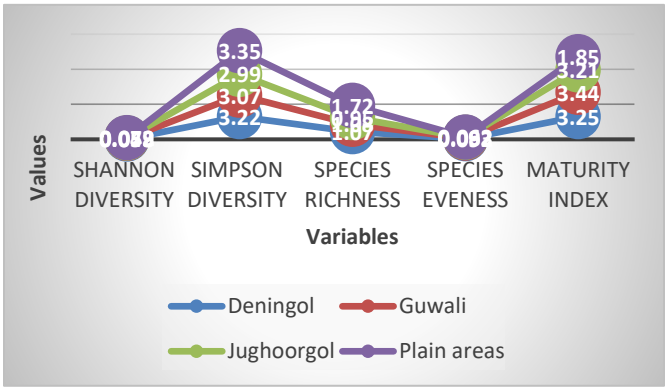



**Fig No. 2**. Graphical representation indices of spring herbs

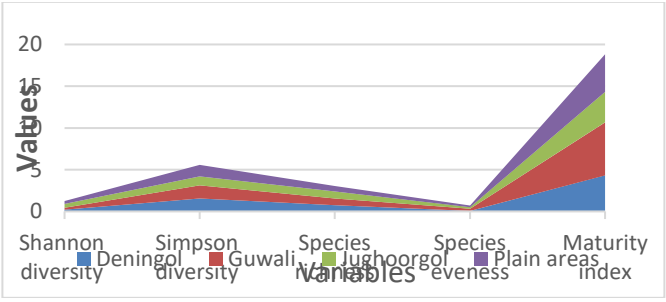



**Fig No.3.** Graphical representation indices of shrub communities

**Table No. 10.** Sorenson's similarity index of spring herb communities

| Sites | Communities | | | |
|---|---|---|---|---|
| Deningol | SSN | X | | |
| Guwali | RMM | 0.41 | X | |
| Jughoorgol | AMC | 0.30 | 0.37 | X |
| Plain areas | VPR | 0.38 | 0.35 | 0.39 |

**Table No. 11.** Sorenson's similarity index of summer herb communities

| Sites | Communities | | | |
|---|---|---|---|---|
| Deningol | CAV | X | | |
| Guwali | MCC | 0.58 | X | |
| Jughoorgol | MCO | 0.4 | 0.37 | X |
| Plain | MPE | 0.42 | 0.07 | 0.43 |

**Table No. 12.** Sorenson's similarity index of shrub communities

| Sites | Communities | | | |
|---|---|---|---|---|
| Deningol | RSD | X | | |
| Guwali | RRT | 0.83 | X | |
| Jughoorgol | RST | 0.83 | 0.66 | X |
| Plain | RRD | 0.83 | 0.83 | 0.66 |

**Table No. 13.**Sorenson's similarity index of tree communities

| Sites | Communities | | | |
|---|---|---|---|---|
| Deningol | RRT | X | | |
| Guwali | RMF | 0.78 | X | |
| Jughoorgol | EAM | 0.55 | 0.66 | X |
| Plain | SPE | 0.74 | 0.53 | 0.64 |

Keys: **D**= Simpson's index, **H**=Shannon's index, **SR**= Species richness, **E**= Evenness, **Mi**= Miturity index, **SSN**= *Scandix-Stellaria-Nepeta* community, **RMM**= *Ranunculus-Mentha-Medicago* Community, **AMC**= *Arenaria-Mentha-Cynodon* community, **VPR**= *Veronica-Plantago-Ranunculus* Community, **CAV**= *Cannabis-Artemisia-Verbena* Community, **MCC**= *Mentha-Cynodon-Conyza* Community, **MCO**= *Mentha-Cynodon-Oxalis* Community, **MPE**= *Mentha-Plantago-Erigeron* Community, **RSD**= *Rosa-Rubus-Daphne* Community, **RRT**= *Rubus-Rosa-Tamarix* Community, **RST**= *Rubus–Sophora-Tamarix* community, **RRD**= *Veronica-Plantago-Ranunculus* Community, **FEA**= *Ficus-Elaeagnus-Ailanthus* Community, **RMF**= *Robinia-Morus-Ficus* Community, **EAM**= *Elaeagnus-Ailanthus-Morus* Community, **SPE**= *Salix-Populus-Elaeagnus* Community.

## IV. Discussion

Vegetation of an area is the result of interaction between biotic and abiotic factors which leads to definite structure and composition. The whole vegetation of Chitral town was classified into herbs, shrubs and trees which in line with the works of

Hussain *et al*. (2010); Saeed *et al.* (2018); Hayat *et al.* (2019) and Ali *et al.* (2016). During phytosociological studies of Chitral town 4 sites were selected on the basis of topography and altitude, there was a great variation in the structure of all communities due to different aspect, condition and position. Total of 16 plant communities were established in both the spring and summer season of 2020 and 2021. Among these 12 communities were established in the spring season in while 4 communities were established in the summer season at 4 different sites (Deningol, Guwali, Jughoorgol, Plain areas). Total of 8 communities were herbaceous, 4 were spring herbaceous communities which were *Scandix-Stellaria-Nepeta* (SNN), *Ranunculus-Mentha-Medicago* (RMM), *Arenaria-Mentha-Cynodon* (AMC) and *Veronica-Plantago-Ranunculus* (VPR), while 4 were summer herbaceous communities were *Cannabis-Artemisia-Verbena* (CAV), *Mentha-Cynodon-Conyza* (MCC), *Mentha-Cynodon-Oxalis* (MCO) and *Mentha-Plantago-Erigeron* (MPE) and 4 shrubs communities were *Rosa-Rubus-Daphne* (RRD), *Rubus-Rosa-Tamarix* (RRT), *Rubus–Sophora-Tamarix* (RST) and *Rubus -Rosa- Daphne* (RRD) and 4 tree communities were *Ficus-Elaeagnus-Ailanthus* (FEA), *Robinia-Morus-Ficus* (RMC), *Elaeagnus-Ailanthus-Morus* (EAM) *and Salix-Populus-Elaeagnus* (SPE) Community. All these communities were established separately on the basis of importance values of species. The distribution of shrubs and trees were very rare in Chital town due to anthropogenic pressure. The expanding population and residential units greatly disturbed the habitat of plant species. Similar communities were documented by Ilyas *et al.* (2015); Haq *et al*. (2015); Ahmad *et al.* (2011); Akhlaq *et al.* (2018). The species *Mentha longifolia* and *cynodon dacytlon* were the common species in all the three communities, *Arenaria-Mentha-Cynodon* (AMC), *Mentha-Cynodon-Conyza* (MCC) and *Mentha-Cynodon-Oxalis* (MCO). The presence same species in these communities was due same water content and wet conditions of the area. Khan *et al.* (2012) also reported the effect of water content and moisture in the distribution of species. Zareen *et al.* (2015); Ali *et al.* (2018); Khan *et al.* (2012) also established communities having similar species. The dissimilarity between the species of all other communities was due to different altitude and difference in physio-chemical properties of soil. The flora of Chitral town showed poor floristic composition in some sites due to human activities like overgrazing, cutting, fragmentation, and over exploitation, which need to be conserved and protected. These findings were supported by Sharma *et al*. (2014); Khan *et al.* (2016) and Ali *et al.* (2015).

## V. CONCLUSION

This work reveals the vegetation structure of Chitral town based on 174 sampling units at 4 different monitoring sites. Soil analysis results cover about 12 parameters. Vegetation of area greatly affected due to anthropogenic pressure, due to which conservation of species is needed. The high species richness was found in VPR (1.72) and CAV have high richness having value of (2.19). The most mature community was RMM having MI (3.44). The evenness (E) value (0.093) is higher in AMC and RRT having evenness value of 0.26.

## References


[1] Ahmad, M., S. S. Shaukat. (2012): A Text book of vegetation ecology. – Abrar sons Karachi, Pakistan, pp. 302-305.

[2] Ahmad, S. S. and T. Yasmin. 2011. Vegetation classification along Hanna Lake, Baluchistan using ordination techniques. *Pak. J. Bot.*, 43(2): 863-872.

[3] Ahmed, M., T. Hussain, A.H. Sheikh, S. Hussain and M. F. Siddiqui.2006. Phytosociology and structure of Himalayan Forests from different climatic zones of Pakistan. *Pak. J. Bot*., 38(2): 361-383.

[4] Akhlaq, R., M. S. Amjad, M. F. Qaseem, S. Fatima, S. K. Chaudhari, and A. M. Khan.2018. Species diversity and vegetation structure from different climatic zones of Tehsil Harighel, Bagh, Azad Kasmir, Pakistan analysed through multivariate techniques. *Appl Ecol Environ Res.*, 16(4), 5193- 5211.

[5] Ali F., G. N. Hassan, Akhtar, M. J. Babar and J. Ataullah.2019. Phytosociology and some ecological attributes of weed flora of wheat in Tehsil Charsadda Khyber Pakhtunkhwa Pakistan. *Pak. J. Weed Sci. Res*., 25 (2): 121-136.

[6] Ali, A., L. Badshah and F. Hussain. 2018. Vegetation structure and threats to montane temperate ecosystems in Hindukush range, Swat, Pakistan. *Applied ecology and environmental research*, 16(4), 4789-4811.

[7] Ali, A., L. Badshah, F. Hussain and Z. K. Shinwari. 2016. Floristic composition and ecological characteristics of plants of Chail Valley, District Swat, Pakistan. *Pak. J. Bot.*, 48(3): 1013- 1026.

[8] Ali, H and M. Qaiser. 1993-2018. Flora of Pakistan Department of Botany.

[9] Ali, S., A. Perveen, and M. Qaiser. 2015. Vegetation structure, edaphalogy and ethnobotany of Mahaban and Malka (District Buner) KPK, Pakistan. *Pak. J. Bot.*, 47(SI) :15-22.

[10] Amjad, S. M., M. Arshad, H. M. Sadaf, Durr-e-Shahwar, F. Akrim and A. Arshad. 2015. Floristic composition, biological spectrum and conservation status of the vegetation in Nikyal valley, A.J. Kashmir. *Asian, Pac. J. Trop. Dis.*, 6(1): 63-69.

[11] Badshah, L., F. Hussain and Z. Sher. 2016. Floristic inventory, ecological characteristics and biological spectrum of plants of Parachinar, Kurram Agency, Pakistan. *Pak. J. Bot.*, 48(4): 1547-1558.

[12] Bremner, J., and M. Mulvaney .1982. Methods of Soil Analysis. Agronomy Monograph 9, Part 2, 2nd ed. *A.S.A.* 595-624.

[13] Daubenmire, R. F. 1968. *Plant communities: A textbook of plant synecology*. Harper and Row. New York, N. Y. United States of America.

[14] Farooq, S., A. Z. Khan. M. Yousaf and H. Fazal. 2010. Phytosociological study of Push Ziarat area (Shawal) in the South Waziristan, Pakistan. *Pak. J. Weed Sci.,* 16(1): 47-55.

[15] Hadi, F., and M. Ibrar. 2017. Diversity in the Historical Kalash Valley, District Chitral, Hindukush Range, Pakistan. *Biol. sci.,* 60(2) :59-64.

[16] Hameed, M., A. A. Chaudhry, M. A. Maan and A.H. Gill. 2002. Diversity of plant species in Lal Suhanra National Park, Bahawalpur, Pakistan. *Online J. Biol. Sci.,* 2(4): 267-274.

[17] Haq, F., H. Ahmad and Z. Iqbal. 2015. Vegetation description and phytoclimatic gradients of subtropical forests of Nandiar Khuwar catchment District Battagram. *Pak. J. Bot.,* 47(4), 1399- 1405.

[18] Hayat, S. A., F. Hussain, H. Zhu, and F. Asad. 2019. Floristic composition and ecological characteristics of plants of Tehsil Razar, Swabi District, Pakistan. *Silva Bal.,* 20(2): 95-108.

[19] Hussain, A., M. A. Farooq, M. Ahmad, M. Akbar and M. U. Zafar. 2010. Phytosociology and Structure of Central Karakoram National Park (CKNP) of Northern Areas of Pakistan.*World, Appl. Sci. J.*,9 (12): 1443- 1449.

[20] Hussain, F. 1989. Field and Laboratory Manual of Plant Ecology; UGC: Islamabad.

[21] Hussain, M. I. and A. Perveen. 2015. Phytosociological attributes of the plant biodiversity of the fort Ranikot and adjoining area (Kirthar range). *Pak. J. Bot*., 47(3): 927-935.

[23] Hussain, M.I. and A. Perveen. 2009. Plant biodiversity and phytosociological attributes of Tiko Baran (Khirthar Range). *Pak. J. Bot*., 41(2): 581-586. 180.

[24] Ilyas, M., R. Qureshi, N. Akhtar and Z. Haq. 2015. Vegetation analysis of Kabal valley, District Swat, Pakistan using multivariate approach. *Pak. J. Bot.*, 47: 77-86.

[25] Khan, A., M. Ahmed, M.F. Siddiqui, J. Iqbal and M. Wahab. 2016. Phytosociological analysis of pine forest at Indus Kohistan, KPK, *Pakistan. Pak. J. Bot*., 48(2): 575-580.

[26] Khan, N., M. Ahmad, M. Wahab, K. Nazim and M. Ajaib. 2010. Phytosociology, structure and physiochemical analysis of soil in Quercus Baloot Griff, forest District Chitral, Pakistan. *Pak. J. Bot.,* 42(4): 2429-2441.

[27] Khan, N., M. Ahmed, M. F. Siddiqui, S. Bibi and I. Ahmed. 2012. A phytosociological study of forest and non-forest vegetation of district Chitral, Hindukush Range of Pakistan. *FUUAST Journal of Biology*, *2*(1 june), 91-101.

[28] Khan, N., M., Ahmed, A. Ahmed, S. S. Shaukat, M. Wahab, M. Ajaib, and M. Nasir .2011. Important medicinal plants of chitral gol National park (cgnp) Pakistan. *Pak. J. Bot*, *43*(2):797- 809.

[29] Koehler, F. E., C. D. Moodie and B. L. McNeal. 1984. Laboratory manual for soil fertility, washington state uni. *Pullman Washington*.

[30] Mahmood, A., S. M. Khan, A. H. Shah and H. Ahmad. 2015. First floristic exploration of the District Torghar, Khyber Pakhtunkhwa, Pakistan. *Pak. J. Bot.,* 47(SI): 57-70.

[31] Naz, F., M. Ahmed and M. F. Siddiqui. 2017. Quantitative description of rapidly changing vegetation around Karachi. *Fuuast J. Biol*., 7(1): 89-104.

[32] Nazir, A., R. F. Malik and M. Ajaib. 2012. Phytosociological Studies of the vegetation of Sarsawa Hills District Kotli, Azad Jammu & Kashmir. *Biologia (Pakistan*), 58 (1): 123- 133.

[33] Nelson, D. W and L. E. Sommers. 1996. Total carbon, organic carbon, and organic matter. *Methods of soil analysis Part 3-chemical methods,* 5: 961–1010.

[34] Saeed, S. H., M. Hussain and G. M. Shah. 2018. Florestic checklist of Datta, District Mansehra Khyber Pakhtunkhwa, Pakistan. *Sci.Int.,* 30(4): 517-522.

[35] Sharma, P., J. C. Rana, U. Devi, S. S. Randhawa, and R. Kumar. 2014. Floristic diversity and distribution pattern of plant communities along altitudinal gradient in Sangla Valley, Northwest Himalaya. *Sci. World, J.*, Article ID 264878, 11 pages.

[36] Soltanpour, P. 1991. Determination of nutrient availability and elemental toxicity by ABDTPA soil test and ICPS. Advances in Soil Science, Springer, 165-190.

[37] Thomas, G.W. Exchangeable cations. Methods of soil analysis Part 2 Chemical and microbiological properties 1982: 159-165.

[38] Zereen, A., S. S. Ahmad, Z. Khan and A. Jahan. 2018. Determination of correlation between plant distribution and ecological factors in Narowal district Punjab, Pakistan. *Bangladesh, J. Botany*, 47(3): 451-458.

## Authors

**First Author** –
Khushbu Zaman, Department of Botany, University of Peshawar, 25120, Pakistan,
**Second Author** – Zahir muhammad, Department of Botany, University of Peshawar, 25120, Pakistan,
**Correspondence Author** – Khushbu Zaman, Department of Botany, University of Peshawar.