



## RESEARCH PAPER

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## Phytosociological studies on alpine vegetation of Mastuj Valley, Hidukush Range, Pakistan

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### Abstract

Vegetation analysis in alpine areas of Mastuj Valley was conducted during 2008 to 2009. Phytosociological investigation of vegetation along altitudinal gradient indicated seven plant communities based on highest importance values. The communities included, *Acantholimon-Ephedra-Ribes*, *Cicer-Aristida-Tricholepsis*, *Betula-Juniperus-Acantholimon*, *Betula-Ribes-Rosa*, *Ephedra-Juniperus-Artemisia*, *Epilobium-Rheum-Matricaria* and *Betula-Salix-Rosa* community. Soil texture remained sandy loam to silt loam with less organic matter and nitrogen contents. Soil pH ranged between 6.3 to 7.5. Generally, tundra plant communities occupy their own microhabitats with peculiar environmental conditions that create the highly diverse vegetation mosaic in alpine belts.

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## Introduction

Mastuj Valley lies in between 36°-3' north latitude and 72°-5' east longitude towards the northeastern part of District Chitral bordering Northern areas and Afghanistan. It is surrounded on the north by Baroghil Pass, on the south by Shandur Pass, on the east by Chumarkhan Pass and on the west by Chitral subdivision. The area is drained by Laspur and Yarkhun rivers. Climatically the area falls within the arid temperate zone with hot summers and chilling winters with snowfall. The vegetation of the area has been classified into dry temperate open scrub, sub-alpine scrub, alpine herbaceous vegetation (Fig. 1) and cultivated plants (Ali, 2003). The area has remained under high biotic pressure. Farooq et al. (2010) conducted phytosociological studies in Push Ziarat, Waziristan and established 5 plant communities. The communities reflected the characters of dry temperate entities. Kegler et al. (2010) conducted phytosociological survey of the primary forests of different areas in Brazil. They proposed five associations, five sub-associations, three alliances, two orders and one phytosociological class. Noroozi et al. (2010) conducted phytosociological and ecological study on the high alpine vegetation of Tupal mountains, Iran. Hussain et al. (2011) conducted phytosociological study of some selected graveyards of Tehsil Peshawar and established six plant communities. Indreica and Keleman (2011) carried out phytosociological studies in southeastern Transylvania. The canopy cover of the stands ranged from 60-90 %. The shrub layer was always present covered 5-75 %, while herb layer was 5-80 % and was rich in species composition. Rana et al. (2011) described the alpine vegetation of a protected area of the northwestern Himalaya and identified 4 plant communities along with important environmental variables. Ullah et al. (2011) established five plant communities while conducting phytosociological survey of Tehsil Manki Sharif, District Nowshera. The hierarchies of alpine vegetation in North-east Asia were suggested in the series of publications of OHBA, (1968, 1969, 1974), who introduced a worldwide accepted class *Carici rupestris-Kobresietea bellardii* (OHBA 1974). Our

research on Alpine vegetation of Mastuj Valley, Hidukush Range since 2008-09 allowed us to extend considerably a moderator collection for this region. This paper aims to provide a general overview of phytosociological diversity of alpine vegetation communities, with special reference to their biogeographical distributional patterns.

## Materials and Methods

Seven stands were randomly selected based on physiognomic contrast and altitudinal gradient. Quadrat method was used to analyze the vegetation. Plant communities were established based on highest importance values. Plants were identified with the help of available literature (Nasir and Ali, 1971-1994, Ali and Qaiser, 1995-2011). Soil samples were collected from 0-15 cm depth at all investigated sites and analyzed for physico-chemical characteristics. Soil textures was determined by hydrometer method (Bonyoucos, 1936). Textural classes were determined with the help of textural triangle (Brady, 1990). Soil organic matter was determined by Walkley and Black method (Black, 1965). Calcium carbonate was determined by acid neutralization method (Rayan et al., 1996). Total Nitrogen was determined by the Kjeldahl method (Bremner and Mulvaney 1982). Phosphorus was determined after Chapman and Pratt (1961). Potassium was determined by flame emission spectroscopy (Roades, 1982). Soil pH and EC were determined after Richard (1954). TSS was determined by the recommended method of AOAC (1984).

## Results and discussion

Based on the highest importance values the following seven plant communities have been established.

### *Acantholimon-Ephedra-Ribes* community

This community consisted of 18 species along mid hill at Shandur Pass between altitude of 3640m-3910m (Table 1). *Acantholimon longiscapum* (IV. 49.53), *Ephedra gerardiana* (IV. 36.51) and *Ribes orientale* (IV. 33.77) were dominants, while *Artemisia brevifolia*, *Swertia speciosa*, *Arenaria* sp. *Cicer macranthum*, *Potentilla supina* and *Rosa webbiana* were co-dominants. The soil was composed of 1.44 %

organic matter, 5.00 % calcium carbonate, 0.072 ppm nitrogen, 24.00 ppm phosphorus, 100 ppm potassium, 6.6 pH, 0.16 % electrical conductivity and 0.051 % total soluble salts. The soil with 9.2 % clay, 24.0 % silt and 66.8 % sand represented sandy loam texture (Table 8). This community faced heavy grazing pressure and fuel wood collection.

#### *Cicer-Aristida-Tricholepsis* community

This community had 21 species at Ghuru near timber line between altitude of 3520m-3900m (Table 2). The dominants included *Cicer macranthum* (IV. 45.7), *Aristida cynantha* (IV. 42.76) and *Tricholepsis tibetica* (IV. 32.74). *Acantholimon longiscapum*, *Trachyspermum ammi*, *Nepeta paulsenii* and *Acantholimon* sp. were co-dominants. The soil had 0.72 % organic matter, 11.00 % calcium carbonate, 0.036 ppm nitrogen, 20.00 ppm phosphorus, 160 ppm potassium, 6.6 pH, 0.06 % electrical conductivity and 0.019 % total soluble salts. The soil was sandy loam with 0.8 % clay, 32.0 % silt and 67.2 % sand (Table 8). This community was under heavy grazing pressure.

#### *Betula-Juniperus-Acantholimon* community

This community was composed of 18 species at Chumarkhan Pass near timber line between altitude of 3100m-3500m (Table 3). *Betula utilis* (IV. 40.74), *Juniperus excelsa* (IV. 34.82) and *Acantholimon longiscapum* (IV. 33) were dominants, while *Artemisia brevifolia*, *Rosa webbiana*, *Ribes orientale*, *Cotoneaster nummularia* and *Ephedra gerardiana* were co-dominants.. The soil is composed of 1.10 % organic matter, 10.25 % calcium carbonate, 0.045 ppm nitrogen, 21.00 ppm phosphorus, 165 ppm potassium, 7.5 pH, 0.20 % electrical conductivity and 0.065 % total soluble salts. The soil was sandy loam with 2.7 % clay, 48.0 % silt and 52.4 % sand (Table 8). This community was under heavy grazing pressure and extensive fuel wood collection.

#### *Betula-Ribes-Rosa* community

This community had 22 species which occurred along timber line at Mastuj between altitude of 3010m-3300m (Table 4). *Betula utilis* (IV. 52.1), *Ribes*

*orientale* (IV. 33.77) and *Rosa webbiana* (IV. 23.56) were dominants. *Cicer macranthum*, *Rheum emodi*, *Aristida cynantha* and *Swertia speciosa* were co-dominants. The soil was sandy loam with 0.86 % organic matter, 10.25 % calcium carbonate, 0.043 ppm nitrogen, 21.00 ppm phosphorus, 160 ppm potassium, 7.5 pH, 0.22 % electrical conductivity, 0.070 % total soluble salts, 2.8 % clay, 46.0 % silt and 51.4 % sand. This community faces overgrazing and severe fuel wood collection.

#### *Ephedra-Juniperus-Artemisia* community

This community with 14 species was present at Baroghil Pass along foot hill between 3060m-3100m altitude (Table 5). The dominants of this community included *Ephedra gerardiana* (IV. 46.44), *Juniperus excelsa* (IV. 46.28) and *Artemisia brevifolia* (IV. 36.2). *Ribes orientale*, *Rosa webbiana*, *Atraphaxis pyrifolia* and *Hippophae rhamnoides* were co-dominants. The soil had 1.10 % organic matter, 10.00 calcium carbonate, 0.035 ppm nitrogen, 20.00 ppm phosphorus, 130 ppm potassium, 7.1 pH, 0.15 % electrical conductivity and 0.060 % total soluble salts. The soil represented sandy loam texture with 9.5 % clay, 45.0 % silt and 58.5 % sand (Table 8).

#### *Epilobium-Rheum-Matricaria* community

This community possessed 23 species at Miragram-1 near timber line between altitude of 2935m-3100m (Table 6). The dominants were *Epilobium angustifolium* (IV. 61.71), *Rheum emodi* (IV. 39.32) and *Matricaria disciformis* (IV. 26.9). Asteraceae sp. *Aristida cynantha* and *Oxyria digyna* were co-dominants. There were 1.65 % organic matter, 10.75 % calcium carbonate, 0.082 ppm nitrogen, 25.00 ppm phosphorus, 210 ppm potassium, 6.3 pH, 0.09 % electrical conductivity and 0.029 % total soluble salts. The soil was silt loam 0.8 % clay, 54.0 % silt and 45.2 % sand (Table 8).

#### *Betula-Salix-Rosa* community

This community consisted 15 species at Miragram-2 near timber line between altitude of 298m-3100m (Table 7). The dominants included *Betula utilis* (IV. 64.02), *Salix acmophylla* (IV. 44.93) and *Rosa*

*webbiana* (IV. 40.03). *Rumex longifolius*, *Epilobium hirsutum*, *Polygonum* sp. and *Juniperus excelsa* were co-dominants. The soil had 1.17 % organic matter, 10.75 % calcium carbonate, 0.058 ppm nitrogen, 18.00 ppm phosphorus, 200 ppm potassium, 7.0 pH,

0.12 % electrical conductivity and 0.038 % total soluble salts. The soil was sandy loam with 2.8 % clay, 38.0 % silt and 59.2 % sand (Table 8).

**Table 1.** Phytosociological Attributes of *Acantholimon-Ephedra-Ribes* community at Shandur Pass along Mid hill between altitude of 3640-3910m.

S.No	Plant species	Density	Cover	Frequency	RD	RC	RF	IV
1.	<i>Acantholimon longiscapum</i> Bokhari.	5.0	6.0	100	15.38	16.43	17.54	49.53*
2.	<i>Ephedra gerardiana</i> L.	4.0	5.0	60	12.30	13.69	10.52	36.51**
3.	<i>Ribes orientale</i> Desf.	4.0	4.0	60	12.30	10.95	10.52	33.77***
4.	<i>Artemisia brevifolia</i> Wall ex DC.	2.5	3.5	50	7.69	9.58	8.77	26.04
5.	<i>Swertia speciosa</i> D.Don.	2.5	2.5	50	7.69	6.84	8.77	23.3
6.	<i>Arenaria serphyllifolia</i> L.	2.0	2.0	40	6.15	5.47	7.01	18.63
7.	<i>Cicer macranthum</i> M. Popov.	2.0	2.0	40	6.15	5.47	7.01	18.63
8.	<i>Potentilla supina</i> L.	2.0	2.0	40	6.15	5.47	7.01	18.63
9.	<i>Rosa webbiana</i> Wall ex Royle.	2.0	3.0	20	6.15	8.21	3.50	17.86
10.	<i>Primula</i> sp.	1.5	1.5	10	4.61	4.10	1.75	10.46
11.	<i>Astragalus amberstianus</i> Royle ex Benth.	1.0	1.0	20	3.07	2.73	3.50	9.3
12.	<i>Cotoneaster microphylla</i> Wall ex Lind.	1.0	1.0	20	3.07	2.73	3.50	9.3
13.	<i>Taraxacum officinale</i> Weber.	0.5	0.5	10	1.53	1.36	1.75	4.64
14.	<i>Pteris</i> sp.	0.5	0.5	10	1.53	1.36	1.75	4.64
15.	<i>Primula denticulata</i> Sm.	0.5	0.5	10	1.53	1.36	1.75	4.64
16.	<i>Thalictrum alpinum</i> L.	0.5	0.5	10	1.53	1.36	1.75	4.64
17.	<i>Trachomitum Venetum</i> (L.) Woodson.	0.5	0.5	10	1.53	1.36	1.75	4.64
18.	<i>Ranunculus lobatus</i> Jacq ex Cam.	0.5	0.5	10	1.53	1.36	1.75	4.64
<b>Total</b>		<b>32.5</b>	<b>36.5</b>	<b>570</b>	<b>99.89</b>	<b>99.83</b>	<b>99.9</b>	<b>299.8</b>

**Table 2.** Phytosociological Attributes of *Cicer-Aristida-Tricholepis* community at Ghuru along Timberline between altitude of 3520 – 3900m.

S.No.	Plant species	Density	Cover	Frequency	RD	RC	RF	IV
1.	<i>Cicer macranthum</i> M. Popov.	9.5	9.5	90	16.37	16.10	13.23	45.7*
2.	<i>Aristida cynantha</i> Nees & Steud.	9.5	9.5	70	16.37	16.10	10.29	42.76**
3.	<i>Tricholepis tibetica</i> H & T.	7.0	7.0	60	12.06	11.86	8.82	32.74***
4.	<i>Acantholimon longiscapum</i> Bokhari.	4.5	4.5	70	7.75	7.62	10.29	25.66
5.	<i>Trachyspermum ammi</i> (L.) Spargue.	4.0	4.0	60	6.89	6.77	8.82	22.48
6.	<i>Nepeta paulsenii</i> Briq.	3.0	3.0	60	5.17	5.08	8.82	19.07
7.	<i>Acantholimon</i> Sp.1	4.0	3.0	40	6.89	5.08	5.88	17.85
8.	<i>Acantholimon</i> Sp.2	3.0	4.0	20	5.17	6.77	2.94	14.88
9.	<i>Rosa webbiana</i> Wall ex Royle.	3.0	4.0	20	5.17	6.77	2.94	14.88
10.	<i>Matricaria disciformis</i> (C.A.M.) DC.	2.0	2.0	40	3.44	3.38	5.88	12.7
11.	<i>Asperula oppositifolia</i> Ehrend.	1.5	1.5	10	2.58	2.54	1.47	6.59
12.	<i>Astragalus amberstianus</i> Royle ex Benth.	1.0	1.0	20	1.72	1.69	2.94	6.35
13.	<i>Euphorbia falcata</i> L.	1.0	1.0	20	1.72	1.69	2.94	6.35
14.	<i>Oxyria digyna</i> (L.) Hill.	1.0	1.0	20	1.72	1.69	2.94	6.35
15.	<i>Pteris</i> sp.	1.0	1.0	20	1.72	1.69	2.94	6.35
16.	<i>Berberis lycium</i> Royle.	0.5	0.5	10	0.86	0.84	1.47	3.17
17.	<i>Psilostachya suworowii</i> (Regd) Roshk.	0.5	0.5	10	0.86	0.84	1.47	3.17
18.	<i>Rheum emodi</i> Wall ex Meissn.	0.5	0.5	10	0.86	0.84	1.47	3.17
19.	<i>Scrophularia stewartii</i> Penn.	0.5	0.5	10	0.86	0.84	1.47	3.17
20.	<i>Taraxacum</i> Sp.	0.5	0.5	10	0.86	0.84	1.47	3.17
21.	<i>Thalictrum alpinum</i> L.	0.5	0.5	10	0.86	0.84	1.47	3.17
<b>Total</b>		<b>58</b>	<b>59</b>	<b>680</b>	<b>99.9</b>	<b>99.87</b>	<b>99.96</b>	<b>299.73</b>

**Table 3.** Phytosociological Attributes of *Betula-Juniperus-Acantholimon* community at Chumarkhan Pass along Timberline between altitude of 3100-3500m.

S.No	Plant species	Density	Cover	Frequency	RD	RC	RF	IV
1.	<i>Betula utilis</i> D.Don.	5.5	9.5	90	12.5	17.27	10.97	40.74*
2.	<i>Juniperus excelsa</i> M.Bieb.	4.5	7.5	90	10.22	13.63	10.97	34.82**
3.	<i>Acantholimon longiscapum</i> Bokhari.	4.5	6.5	90	10.22	11.81	10.97	33***
4.	<i>Artemisia brevifolia</i> Wall ex DC.	4.0	4.0	80	9.09	7.27	9.75	26.11
5.	<i>Rosa webbiana</i> Wall ex Royle.	4.0	4.0	80	9.09	7.27	9.75	26.11
6.	<i>Ribes orientalis</i> Desf.	3.0	3.0	60	6.81	5.45	7.31	19.57
7.	<i>Atraphaxis pyrifolia</i> Bunge.	2.5	2.5	50	5.68	4.54	6.09	16.31
8.	<i>Cotoneaster nummularia</i> Fisch & Mey.	2.5	2.5	50	5.68	4.54	6.09	16.31
9.	<i>Ephedra gerardiana</i> L.	2.5	2.5	50	5.68	4.54	6.09	16.31
10.	<i>Berberis lycium</i> Royle.	2.0	2.0	40	4.54	3.63	4.87	13.04
11.	<i>Asperula oppositifolia</i> Ehrend.	2.0	2.0	20	4.54	3.63	2.43	10.6
12.	<i>Potentilla supina</i> L.	2.0	2.0	20	4.54	3.63	2.43	10.6
13.	<i>Hippophae rhamnoides</i> L.	1.0	2.0	20	2.27	3.63	2.43	8.33
14.	<i>Salix acmophylla</i> Boiss.	1.0	2.0	20	2.27	3.63	2.43	8.33
15.	<i>Myricaria elegans</i> Royle.	1.0	1.0	20	2.27	1.81	2.43	6.51
16.	<i>Tricholepsis tibetica</i> H & T.	1.0	1.0	20	2.27	1.81	2.43	6.51
17.	<i>Pteris</i> sp.	0.5	0.5	10	1.13	0.90	1.21	3.24
18.	<i>Salix</i> sp.	0.5	0.5	10	1.13	0.90	1.21	3.24
<b>Total</b>		<b>44</b>	<b>55</b>	<b>820</b>	<b>99.93</b>	<b>99.89</b>	<b>99.86</b>	<b>299.68</b>

**Table 4.** Phytosociological Attributes of *Betula-Ribes-Rosa* (BRR) Community at Mastuj along Timberline between altitude of 3010 – 3300m.

S.No.	Plant species	Density	Cover	Frequency	RD	RC	RF	IV
1.	<i>Betula utilis</i> D.Don.	5.0	10.0	60	14.70	25.64	11.76	52.1*
2.	<i>Ribes orientale</i> Desf.	4.0	4.0	60	11.76	10.25	11.76	33.77**
3.	<i>Rosa webbiana</i> Wall ex Royle.	2.5	2.5	50	7.35	6.41	9.80	3.56***
4.	<i>Cicer macranthum</i> M. Popov.	2.5	2.5	30	7.35	6.41	5.88	19.64
5.	<i>Rheum emodi</i> Wall ex Meissn.	2.5	2.5	30	7.35	6.41	5.88	19.64
6.	<i>Aristida cynantha</i> Nees & Steud.	2.0	2.0	40	5.88	5.12	7.84	18.84
7.	<i>Nepeta paulsenii</i> Briq.	1.5	1.5	30	4.41	3.84	5.88	14.13

8.	<i>Swertia speciosa</i> D.Don.	1.5	1.5	30	4.41	3.84	5.88	14.13
9.	Asteraceae 1.	1.5	1.5	30	4.41	3.84	5.88	14.13
10.	<i>Hippophae rhamnoides</i> L.	2.0	2.0	10	5.88	5.12	1.96	12.96
11.	<i>Pteris</i> sp.	1.5	1.5	10	4.41	3.84	1.96	10.21
12.	<i>Sedum ewersii</i> Ledeb.	1.5	1.5	10	4.41	3.84	1.96	10.21
13.	<i>Codonopsis clematidia</i> (Schrenk.) Clarke.	1.0	1.0	20	2.94	2.56	3.92	9.42
14.	<i>Sonchus asper</i> (L.) Hill.	1.0	1.0	20	2.94	2.56	3.92	9.42
15.	<i>Astragalus amberstianus</i> Royle ex Benth.	0.5	0.5	10	1.47	1.28	1.96	4.71
16.	<i>Berberis lycium</i> Royle.	0.5	0.5	10	1.47	1.28	1.96	4.71
17.	<i>Mentha longifolia</i> (L.) Huds.	0.5	0.5	10	1.47	1.28	1.96	4.71
18.	<i>Parnassia nubicola</i> Planch ex Clarke.	0.5	0.5	10	1.47	1.28	1.96	4.71
19.	<i>Scrophularia stewartii</i> Penn.	0.5	0.5	10	1.47	1.28	1.96	4.71
20.	<i>Sonchus</i> Sp.	0.5	0.5	10	1.47	1.28	1.96	4.71
21.	<i>Nepeta</i> Sp.	0.5	0.5	10	1.47	1.28	1.96	4.71
22.	<i>Matricaria disciformis</i> (C.A.M.) DC.	0.5	0.5	10	1.47	1.28	1.96	4.71
<b>Total</b>		<b>34</b>	<b>39</b>	<b>510</b>	<b>99.96</b>	<b>99.92</b>	<b>99.96</b>	<b>299.84</b>

**Table 5.** Phytosociological Attributes of *Ephedra-Juniperus-Artemisia* Community at Baroghill Pass along Foothill between altitude of 3060-3100m.

S.No	Plant species	Density	Cover	Frequency	RD	RC	RF	IV
1.	<i>Ephedra gerardiana</i> L.	5.5	5.5	90	16.17	15.27	15	46.44*
2.	<i>Juniperus excelsa</i> M.Bieb.	4.5	6.5	90	13.23	18.05	15	46.28**
3.	<i>Artemisia brevifolia</i> Wall ex DC.	4.0	4.0	80	11.76	11.11	13.33	36.2***
4.	<i>Atraphaxis pyrifolia</i> Bunge.	3.5	3.5	50	10.29	9.72	8.33	28.34
5.	<i>Ribes orientale</i> Desf.	4.0	4.0	60	11.76	11.11	10	32.87
6.	<i>Rosa webbiana</i> Wall ex Royle.	4.0	4.0	60	11.76	11.11	10	32.87
7.	<i>Hippophae rhamnoides</i> L.	2.5	2.5	50	7.35	6.94	8.33	22.62
8.	<i>Berberis lycium</i> Royle.	1.5	1.5	30	4.41	4.16	5	13.57
9.	<i>Cicer macranthum</i> M. Popov.	1.0	1.0	20	2.94	2.77	3.33	9.04
10.	<i>Gnaphalum luteo-album</i> L.	1.0	1.0	20	2.94	2.77	3.33	9.04
11.	<i>Salix acmophylla</i> Boiss.	1.0	1.0	20	2.94	2.77	3.33	9.04
12.	<i>Artemisia scoparia</i> Waldst & Kit.	0.5	0.5	10	1.47	1.38	1.66	4.51

13.	<i>Clematis grata</i> Wall.	0.5	0.5	10	1.47	1.38	1.66	4.51
14.	<i>Calamogrostris pseudophragmites</i> Hall. f. Koeler.	0.5	0.5	10	1.47	1.38	1.66	4.51
<b>Total</b>		<b>34</b>	<b>36</b>	<b>600</b>	<b>99.96</b>	<b>99.92</b>	<b>99.96</b>	<b>299.84</b>

**Table 6.** Phytosociological Attributes of *Epilobium-Rheum-Matricaria* Community at Miragram-I along Timberline between altitude of 2935- 3100m.

S.No.	Plant species	Density	Cover	Frequency	RD	RC	RF	IV
1.	<i>Epilobium angustifolium</i> L.	8.5	8.5	90	23.28	22.07	16.36	61.71*
2.	<i>Rheum emodi</i> Wall ex Meissn.	4.5	5.5	70	12.32	14.28	12.72	39.32**
3.	<i>Matricaria disciformis</i> (C.A.M.) DC.	3.0	3.0	60	8.21	7.79	10.90	26.9***
4.	Sp. White Fls.	3.5	3.5	30	9.58	9.09	5.45	24.12
5.	<i>Eragrastris minor</i> Host.	2.5	2.5	50	6.84	6.49	9.09	22.42
6.	<i>Oxyria digyna</i> (L.) Hill.	2.0	2.0	40	5.47	5.19	7.27	17.93
7.	<i>Berberis lycium</i> Royle.	2.0	3.0	20	5.47	7.79	3.63	16.89
8.	<i>Chondrilla graminea</i> M.Bieb.	2.0	2.0	20	5.47	5.19	3.63	14.29
9.	<i>Pteris</i> sp.	1.0	1.0	20	2.73	2.59	3.63	8.95
10.	<i>Scrophularia stewartii</i> Penn.	1.0	1.0	20	2.73	2.59	3.63	8.95
11.	<i>Cicer macranthum</i> M. Popov.	0.5	0.5	10	1.36	1.29	1.81	4.46
12.	<i>Conyza canadensis</i> (L.) Conquist.	0.5	0.5	10	1.36	1.29	1.81	4.46
13.	<i>Epilobium hirsutum</i> L.	0.5	0.5	10	1.36	1.29	1.81	4.46
14.	<i>Eragrastris nigra</i> Nees ex Steud.	0.5	0.5	10	1.36	1.29	1.81	4.46
15.	<i>Nepeta paulsenii</i> Briq.	0.5	0.5	10	1.36	1.29	1.81	4.46
16.	<i>Ribes orientale</i> Desf.	0.5	0.5	10	1.36	1.29	1.81	4.46
17.	<i>Salix acmophylla</i> Boiss.	0.5	0.5	10	1.36	1.29	1.81	4.46
18.	<i>Sedum ewersii</i> Ledeb.	0.5	0.5	10	1.36	1.29	1.81	4.46
19.	<i>Pteris</i> Sp.	0.5	0.5	10	1.36	1.29	1.81	4.46
20.	<i>Cynoglossum</i> Sp..	0.5	0.5	10	1.36	1.29	1.81	4.46
21.	<i>Medicago lupulina</i> L.	0.5	0.5	10	1.36	1.29	1.81	4.46
22.	<i>Potentilla supina</i> L.	0.5	0.5	10	1.36	1.29	1.81	4.46
23.	Grass 1.	0.5	0.5	10	1.36	1.29	1.81	4.46
<b>Total</b>		<b>36.5</b>	<b>38.5</b>	<b>550</b>	<b>99.78</b>	<b>99.84</b>	<b>99.84</b>	<b>299.46</b>

**Table 7.** Phytosociological Attributes of *Betula-Salix-Rosa* community at Miragram- II along Timberline between altitude of 2980 – 3100m.

S.No.	Plant species	Density	Cover	Frequency	RD	RC	RF	IV
1.	<i>Betula utilis</i> D.Don.	7.5	8.5	90	22.38	23.28	18.36	64.02*
2.	<i>Salix acmophylla</i> Boiss.	5.0	5.0	80	14.92	13.69	16.32	44.93**
3.	<i>Rosa webbiana</i> Wall ex Royle.	4.5	4.5	70	13.43	12.32	14.28	40.03***
4.	<i>Rumex longifolius</i> DC.	3.0	4.0	20	8.95	10.95	4.08	23.98
5.	<i>Epilobium hirsutum</i> L.	2.5	2.5	30	7.46	6.84	6.12	20.42
6.	<i>Polygonum</i> Sp.	2.0	2.0	40	5.97	5.47	8.16	19.6
7.	<i>Juniperus excelsa</i> M.Bieb.	1.5	2.5	30	4.47	6.84	6.12	17.43
8.	<i>Eragrastris nigra</i> Nees ex Steud.	2.0	2.0	20	5.97	5.47	4.08	15.52
9.	<i>Aristida cynantha</i> Nees & Steud..	1.5	1.5	30	4.47	4.10	6.12	14.69
10.	<i>Swertia speciosa</i> D.Don.	1.5	1.5	30	4.47	4.10	6.12	14.69
11.	<i>Capparis spinosa</i> L.	0.5	0.5	10	1.49	1.36	2.04	4.89
12.	<i>Conyza canadensis</i> (L.) Conquist.	0.5	0.5	10	1.49	1.36	2.04	4.89
13.	<i>Hippophae rhamnoides</i> L.	0.5	0.5	10	1.49	1.36	2.04	4.89
14.	<i>Sedum ewersii</i> Ledeb.	0.5	0.5	10	1.49	1.36	2.04	4.89
15.	<i>Lactuca</i> Sp.	0.5	0.5	10	1.49	1.36	2.04	4.89
<b>Total</b>		<b>33.5</b>	<b>36.5</b>	<b>490</b>	<b>99.94</b>	<b>99.86</b>	<b>99.96</b>	<b>299.76</b>

**Table 8.** Physico-chemical Analysis of Soils of different Plant Communities found in Mastuj Valley, Hidukush Range, Pakistan.

S.No.	Plant communities	Textural class	CaCO <sub>3</sub> (%)	Organic N matter (%)	N %	P %	K %	pH	Ec <sub>x10<sup>3</sup></sub>	TSS %	Clay %	Silt %	Sand %
1.	AER	Sandy loam	5.00	1.44	0.072	24.00	100	6.6	0.16	0.051	9.2	24.0	66.8
2.	CAT	Sandy loam	11.00	0.72	0.036	20.00	160	6.6	0.06	0.019	0.8	32.0	67.2
3.	BJA	Sandy loam	10.25	1.10	0.045	21.00	165	7.5	0.20	0.065	2.7	48.0	52.4
4.	BRR	Sandy loam	10.25	0.86	0.043	21.00	160	7.5	0.22	0.070	2.8	46.0	51.4
5.	EJA	Sandy loam	10.00	1.10	0.035	20.00	130	7.1	0.15	0.060	9.5	45.0	58.5
6.	ERM	Silt loam	10.75	1.65	0.082	25.00	210	6.3	0.09	0.029	0.8	54.0	45.2
7.	BSR	Sandy loam	10.75	1.17	0.058	18.00	200	7.0	0.12	0.038	2.8	38.0	59.2

The arctic tundra zone and alpine vegetation belt are characterized by a complex of dwarf shrubs, graminoid and herbaceous tundra communities that occur in conditions of heat deficit and a very short growing season. The effects of these climatic factors in different habitats are strongly controlled by topography. Generally, tundra plant communities occupy their own microhabitats with peculiar environmental conditions that create the high diverse vegetation mosaic in alpine belts (Tokyo and Vladivostok, 2007). The alpine zone is commonly characterized by many species of hemicryptophytes and thorny cushions. Species number decline very strongly with increasing altitude (Noroozi et al., 2008). Vegetation structure depends upon the prevailing environmental condition. Habitat condition depends on a number of factors including biotic interaction in the form of overgrazing, deforestation and clearing of land for developing new settlements (Shah and Hussain, 2009). The present result also agree with that of Akbar et al. (2010) who reported that *Juniperus excelsa* and *Betula utilis* were dominant in some forests of Skardu district of Karakorum Range. Phytosociological studies can be an important tool to detect temporal vegetation changes in response to global climate change (Felde et al., 2012). The vegetation of alpine areas is interesting in its composition and structural characteristics since the region is diversified in terms of topography and plant species. From the present study it was noticed that the Northern vegetation of Pakistan changes from southern vegetation i.e. Khan et al., (2011a, b); Khan et al., (2012a, b); Khan and Hussain, (2012a, b); Khan et al., (2013). The alpine zone in Mastuj Valley lies between 3000-4000m. Deforestation, overgrazing and erosion are common threats to plant biodiversity in this area. The plants need conservation and protection management in these small, isolated and fragile ecosystem.

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