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PHYTOSOCIOLOGY OF MAI DHANI HILL NEAR MUZAFFARABAD, AZAD KASHMIR II. WINTER VEGETATION

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Six plant communities viz., *Themeda-Dodonaea-Maytenus, Dodonaea-Maytenus, Phoenix-Cynodon-Micromeria, Dodonaea-Otostegia-Themeda, Dodonaea-Themeda-Mallotus, Pinus-Hypodematium-Dodonaea* were established on the basis of phytosociological attributes on sunside at Mai Dhani Hill, Muzaffarabad in December, 1995. The highest species diversity is shown by *Phoenix-Cynodon-Micromeria* community at 970 m elevation while the lowest species diversity is shown by *Dodonaea-Otostegia-Themeda* community at 980 m elevation. With the increase of an altitude the species diversity decreased. The study area has sandy loam to loam type soil. The pH of the soil in the study area was slightly alkaline in nature. Organic matter varies from 2.0 to 2.65%. The $CaCO_3$ content varies from 15.7 to 23.2% while total soluble salts vary from 0.022 to 0.58%. There was a decrease in soil temperature from lower to higher altitudes.

Key words: Plant communities, Mai Dhani Hill, Species diversity.

Introduction

Vegetation is the outcome of habitat, environmental conditions and existing biotic influences. Some studies in the subtropical belt of Pakistan and Azad Kashmir have been carried out (Beg and Khan 1984; Chaghtai and Ghawas 1976; Hussain and Shah 1989; Malik and Hussain 1987, 1988, 1990). No quantitative data on the phytosociology Mai Dhani Hill available. The present study describes the existing vegetation structure, species diversity and soil plant relationship. The findings will help ecologists and ethonobotanists to work in other site of the same area.

Mai Dhani Hill near Muzaffarabad is bound on the North by district Gilgit, on the West by the district Mansehra, on the South by the district Poonch and on the East by occupied Kashmir. The spring and autumn seasons are pleasant with severe winter while June is the hottest month. December and January are the coldest months. The average maximum temperature varies in between 15°C in January to 35°C in June while the mean minimum temperature lies between 3-4°C in december to 22.5°C in August. The soils vary from clay loam to loam. Geographically, the rocks are of Cambrian dolomite, Murree sandstone, Murree mudstone and limestone (Malik and Hussain 1987).

Materials and Methods

Mai Dhani Hill near Muzaffarabad, Azad Kashmir was chosen for phytosociological study. The hill has two sides viz., sunside and shadeside. The sunside altitude varied from 800 to 1100 m. The phytosociological study was conducted during December, 1995 at six randomly selected sites based on physiognomic contrast.

The vegetation was analysed using 10x 2 m for trees, 5x 2 m for shrubs and 0.5x0.5m for herbs. Circumference of wood species was recorded at breast height and converted to coverage (basal area) using standard tables (Hussain 1989). A species was recorded in different state due to its age and habit. Frequency, density and canopy coverage of each species was converted to relative values and they were added together to give importance value for that species (Hussain 1989). Plant community was named after the three leading dominants with highest importance values.

Index of diversity was calculated after Simpson (1949). Degree of maturity index was determined after (Pichi-sermolli's 1948). The soil samples of the each sites were obtained up to a depth of 20 cm and mixed to make a composite sample. Five kg soil was collected from each site, it was stored in a polyethylene bag and labelled. The soils were analysed from Soil Testing Laboratory, Agriculture Research Institute (ARI) Tarnab, Peshawar. Soils were analysed for physical and chemical characteristies. The percentage of organic matter, phosphorus, potassium, nitrogen, in the soil was determined. pH, total soluble salts percentage, electrical conductivity, texture, calcium carbonate content and soil temperature were also determined (Richards 1954) Table 1.

Results and Discussion

The results have been summarised in the form of importance value (IV). Following six plant communities were established on sunside of Mai Dhani Hill in December 1995.

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Table 1
Physico-chemical analysis of soils at different altitudes of Mai Dhani Hill, Muzaffarabad (sunside)

Alt.m	Clay (%)	Silt (%)	Sand %	Textural class	pH	Electrical conductivity (EC mm hos/cm	Soil temp. (°C)	$CaCO_3$ %	Organic matter (%)	Total solube salts (%)	N (%)	P (ppm)	K (ppm)
800	7.4	23.2	69.4	Sandy loam	7.9	0.18	15	23.2	2.65	0.058	0.132	16.6	252
900	15.4	45.2	34.4	Loam	7.9	0.15	15	20.2	2.27	0.048	0.113	8.0	360
970	25.4	35.2	39.4	Loam	8.0	0.09	30	16.7	2.17	0.029	0.108	7.04	270
980	23.4	39.2	37.1	Loam	8.0	0.07	29	17.5	2.00	0.022	0.1	7.36	279
1050	23.4	37.2	39.2	Loam	7.6	0.08	29	20.5	2.13	0.026	0.106	7.36	297
1100	21.4	39.2	39.2	Loam	7.7	0.09	20	15.7	2.38	0.029	0.119	8.64	378

Community structure. (1). *Themeda-Dodonaea* Maytenus (TDM) community. This community was present at 800 m elevation. It was dominated by *Themeda anathera*, (IV=57.25) *Dodonaea viscosa* (IV=44.99) and *Maytenus royleanus* (IV=40.08). The codominants *Micromeria biflora, Adiantum capillus-veneris, Adhatoda zylonica, Dodonaea viscosa, Taraxacum officinale. Olea ferruginea, Pinus roxburghii, Adhatoda zylonica, and Quercus incana* were the associated members of this community Table 2. Two rare species were found and total number of species was 15. The soil was sandy loam in texture with the highest values of $CaCO_3$ organic matter, N, total soluble salts and P. The electrical conductivity was the highest and the K was the lowest of all the communities. The soil was slightly alkaline Table 1. With increasing altitude the *T. anathera* remained dominant but it also showed slightly lower importance values (IV=38.77; 39.24) which were recorded at 980 and 1050 m elevation, respectively. It is a fine fodder (Chaghtai and Ghawas 1976). Chaghtai and Ghawas (1976) reported that *T. anathera* got dominance due to less disturbance on north facing lower slopes than upper slopes in Malakand Pass, NWFP. The importance value of *D. viscosa* dominant member of the shrub layer is much greater than the importance value of *D. viscosa* co-dominant member of the herb layer. The importance value of *D. viscosa* from shrub layer is nearly equal to *M. royleanus* which is a third dominant. *M. royleanus* is non palatable and less preferred as firewood and therefore it grows gregariously in the area. Chaghtai *et al* (1988) reported that O. *ferruginea* being the leading dominant of *Olea-Acacia-Dodonaea* community had a tough competition from *Acacia modesta* on south facing slopes of an upland forest near Nowshera and due to its palatability, it has become the target of grazing and browsing.

(2). Dodonaea-Maytenus (DM) community. This community was harboured at a height of 900 m elevation *D. viscosa* (IV=66.1), and *M. royleanus* (IV=53.19) were the dominant

Table 2
Phytosociological attributes of *Themeda anathera, Dodonaea viscosa* and *Maytenus royleanus* community on "Mai Dhani Hill" at elevation of 800 meters in December, 1995. (Sunside)

Tree layer	Total	D	F	CC	RD	RF	RCC	IV
Shrubs								
Adhatoda zylonica	7	0.6	60	1.5	8.4	8.29	2.94	19.63
Berberis lycium	1	0.1	10	1.5	1.4	1.38	2.94	5.72
Dodonaea viscosa	57	1	100	8.75	14	13.83	17.16	44.99
Maytenus royleanus	18	1	100	6.25	14	13.83	12.25	40.08
Mallotus philippensis	1	0.1	10	0.25	1.4	1.38	0.49	3.27
Olea ferruginea	3	0.3	30	2.0	1.2	4.14	3.92	12.26
Pinus roxburghii	2	0.2	20	1.75	2.8	2.76	3.43	8.99
Quercus incana	2	0.2	20	0.5	2.8	2.76	8.98	6.54
Herbs								
Adhatoda zylonica	5	0.26	26.6	0.66	3.64	3.67	1.29	8.6
Adiantum capillus-veneris	20	0.6	66.6	4.83	8.4	9.21	9.47	27.08
Dodonaea viscosa	15	0.46	46.6	1.16	6.44	6.44	2.27	15.15
Micromeria biflora	25	0.66	66.5	5.33	9.24	9.21	10.45	28.9
Olea ferruginea	2	0.2	20	0.5	2.8	2.76	0.98	6.54
Themeda anathera	68	1	100	15	14	13.83	29.42	57.25
Taraxacum officinale	9	0.46	46.6	1	6.44	6.44	1.96	14.84

Key : D, Density; F, Frequency; CC, Canopy cover; RD, Relative density; RF, Relative frequency; RCC, Relative canopy cover; IV, Importance value.

while the co-dominants were *T. anathera, Quercus incana, M. biflora, M. philippensis, Adhatoda zylonica*. The associated members were *Sonchus asper, Oxalis corniculata, Heteropogon contortus* and *A. modesta* (Table 3). One rare species was found. Total number of species was 14. The soil was loam with pH of 7.9. The loam soil was rich in P and K while the organic matter was moderate. Electrical conductivity, soil temperature and $CaCO_3$ contents were low (Table 1).

(3). Phoenix-Cynodon-Micromeria (PCM) community. This community was found at an altitude of 970 m. It was dominated by *Phoenix sylvestris* (IV=34.12), *Cynodon dactylon* (IV=29.38) and *Micromeria biflora* (23.51) (Table 4). The co-dominants were *Mentha longifolia, Pteris cretica, Dodonaea viscosa, Rabdosia rugosa* and *Taraxacum officinale*. *Rabdosia rugosa* and *Taraxacum officinale* have the same importance value. The associated members were *Adiantum capillus-veneris, Fragaria* spp., *Themeda anathera, Viola odorata* and *Cannabis sativa*. Five species were rare. Total number of species were 18. The soil was loam and had the highest pH of all sites studied (pH=8), with moderate organic matter. The area had the lowest P while the soil temperature was the highest of all the communities studied (Table 1). The high (IV) of *P. sylvestris* is chiefly contributed by highest relative values of canopy coverage. It was absent at the higher altitudes. *Cynodon dactylon* dominant member from herbaceous layer showed higher relative density and frequency as compared to *P. sylvestric*. The (IV) of *Mentha longifolia* was equal to that of the *M. biflora*. *M. longifolia* was absent at the higher altitudes and was found around water courses of Mai Dhani Hill, Muzaffarabad. It occurred in a few patches and flourished only at 970 m elevation. *M. longifolia* is fond of growing in or around water courses in abundance (Stewart 1972) and spreads rapidly in moist sandy soils.

(4). Dodonaea-Otostegia-Themeda (DOT) community. This community was recorded at an altitude of 980 m

Table 3
Phytosociological attributes of *Dodonaea viscosa-Maytenus royleanus* community on "Mai Dhani Hill" at elevation of 900 meters in December, 1995

Tree Layer	Total	D	F	CC	RD	RF	RCC	IV
Acacia modesta	1	0.2	20	0.62	3.67	3.67	1.72	9.06
Shrubs								
Adhatoda zylonica	4	0.3	30	0.15	5.51	5.5	2.08	13.09
Dodonaea viscosa	22	1.0	100	10.57	18.38	18.36	29.36	66.1
Dalbergia sissoo	1	0.1	10	0.25	1.83	1.83	0.6	4.35
Maytenus royleanus	18	0.9	90	7.25	16.54	16.52	20.13	53.19
Mallotus philippensis	3	0.3	30	2.0	5.51	5.5	5.55	16.56
Quxercus incana	6	0.5	50	2.5	9.19	9.18	6.94	25.31
Herbs								
Dodonaea viscosa	16	0.8	80	2.0	14.7	14.08	5.55	34.93
Heteropogon contortus	1	0.06	6.66	1.0	1.1	1.22	2.77	5.09
Micromeria biflora	16	0.46	46	1.16	8.45	8.44	3.22	20.11
Oxalis corniculata	4	0.13	13	0.33	2.38	2.38	3.22	7.98
Sonchus asper	2	0.13	13	1.16	2.38	2.38	3.22	7.98
Themeda anathera	17	0.46	46	6.16	8.45	8.44	17.11	34

Table 4
Phytosociological attributes of *Phoenix sylvestris-Cynodon dactylon-Micromeria biflora* community on "Mai Dhani Hill" at elevation of 970 meters in December, 1995.

Tree layer	Total	D	F	CC	RD	RF	RCC	IV
Phoenix sylvestris	1	0.2	20	9.98	2.19	2.19	29.74	34.12
Shrubs								
Dodonaea viscosa	11	0.7	70	1.75	7.68	7.67	5.21	20.56
Maytenus royleanus	2	0.2	20	0.5	2.19	2.19	1.49	5.87
Olea ferruginea	4	0.3	30	0.75	3.29	3.28	2.23	8.8
Rabdosia rugosa	11	0.6	60	1.5	6.58	6.57	4.47	17.62
Herbs								
Adiantum capillusvenris	19	0.6	60	1.5	6.58	6.57	4.47	17.62
Berberis lycium	4	0.2	20	0.5	2.19	2.19	1.49	5.87
Cynodon dactylon	43	1.0	100	2.5	10.97	10.96	7.45	29.38
Canabis sativa	18	0.53	53	1.33	5.81	5.81	3.96	15.58
Dodonaea viscosa	4	0.2	20	0.5	2.19	2.19	1.49	5.87
Fragaria spp.	21	0.6	60	1.33	6.58	6.57	3.96	17.11
Mentha longifolia	23	0.8	80	2.0	8.78	8.77	5.96	23.51
Micromeria biflora	24	0.8	80	2.0	8.78	8.77	5.96	23.51
Oxalis corniculata	6	0.2	20	0.5	2.19	2.19	1.49	5.87
Pteris cratica	16	0.66	66.6	2.5	7.24	7.3	7.45	21.99
Taraxacum afficinale	15	0.6	60.0	1.5	6.58	6.57	4.47	17.62
Themeda	12	0.46	46.6	1.75	5.04	5.1	5.21	15.35
Viola odorata	12	0.46	46.6	1.16	5.04	5.04	3.45	13.53

elevaton. It was dominated by *Dodonaea viscosa* (IV=52.09), *Otostegia limbata* (IV=43.21) and *Themeda anathera* (IV=38.77) (Table 5). The co-dominants were *Acacia modesta, Maytenus royleanus, Micromeria biflora, Adiantum capillusveneris, Mallotus philippensis*. The associated members were *Sonchus asper, Dodonaea viscosa, Punica granatum, and Otostegia limbata* (Table 5). No rare species was present in this community. Total number of species were 12. The soil was loam, rich in K with the highest (pH=8), the soil showed the lowest percentage of organic matter, nitrogen, and total soluble salts. The $CaCO_3$ was also low while electrical conductivity was the lowest (EC=0.07 mmhos/cm, Table 1) of all the sites studied. *D. viscosa* is a very common plant of dry hills in the sub-Himalayan tracts and grows on denuded soils where little else can grow (Stewart 1958 & 1972). The density and frequ-ency of *D. viscosa* were much more higher than *Otostegia limbata* and this made the *D. viscosa* to remain dominant. The importance value of *D. viscosa* from the shrub layer was found to be much higher than from the herb layer. *D. viscosa* as a co-dominant from shrub layer was found only at 970 m elevation. Chaghatai *et al* (1988) reported *D. viscosa* as a co-dominant from shrub layer and was found in all habitats but was more frequent on south than on north facing slopes of an upland forest near Nowshera, NWFP. *Acacia modesta* was an associated member at 900 m elevation with IV=9.06 and was a co-dominant member in this community with IV=31.46. It did not get the status of a dominant member in any community. The exaltation of *A. modesta* the co-dominant member, is largely because of its fondness of relatively dry and exposed conditions (Sheikh & Hafeez 1977). *Acacia modesta* has low relative density with high relative canopy coverage suggests that number of plants is low but they are all of big size. No other species in this community showed the same trend as did the *A. modesta*.

(5). Dodonaea-Themeda-Mallotus (DTM) community. This community was established at an altitude of 1050 m elevation. The dominant members were *Dodonaea viscosa* (IV=42.39), *Themeda anathera* (IV=39.24) and *Mallotus philippensis* (IV=30.62) (Table 6). The co-dominants were

Table 5
Phytosociological attributes of *Dodonaea viscosa-Otostegia limbata-Themeda anathera* community on "Mai Dhani Hill" at elevation of 980 meters in December, 1995

Tree layer	Total	D	F	CC	RD	RF	RCC	IV
Acacia modesta	1	0.2	20	7.18	2.99	2.98	25.49	31.46
Shrubs								
Dodobaea viscosa	30	1.0	100	6.25	14.97	14.93	22.19	52.09
Maytenus royleanus	13	0.8	80	2.0	11.97	11.97	7.1	3.01
Mallotus Philippensis	6	0.5	50	1.25	7.48	7.46	4.43	19.37
Otostegia limbata	2	1.0	100	3.75	14.97	14.93	13.31	43.21
Punica granatum	1	0.2	20	0.25	2.99	2.98	0.88	6.85
Herbs								
Adiantum *capillus veneris*	30	0.53	53	1.33	7.93	7.91	4.72	20.56
D.viscosa	9	0.33	33.3	0.83	4.94	4.97	2.94	12.85
Micromeria biflora	22	0.66	66.6	1.66	9.88	9.94	5.89	25.71
Otostegia limbata	1	0.06	6.66	0.16	0.891	0.99	0.56	2.44
Sonchus asper	8	0.4	40	1.0	5.98	5.97	3.55	15.5
Themeda anathera	52	1.0	100	2.5	14.97	14.93	8.87	38.77

Table 6
Phytosociological attributes of *Dodonaea viscosa Themeda anathera,* and *Mallotus philippensis* community on "Mai Dhani Hill" at elevation of 1050 meters in December, 1995

Tree layer	Total	D	F	CC	RD	RF	RCC	IV
Shrubs								
Dodonaea viscosa	17	0.8	80	4.5	11.31	11.28	19.8	42.39
Maytenus royleanus	11	0.6	60	1.5	8.48	8.46	6.6	23.54
Mallotus philippensis	11	0.5	50	3.75	7.07	7.07	16.5	30.62
Punica granatum	5	0.2	20	0.3	2.82	2.82	2.2	7.84
Herbs								
Adiantum capillus veneris	11	0.6	60	1.5	8.48	8.46	6.6	23.54
Dodonaea viscosa	13	0.4	40	1	5.65	5.64	4.4	15.69
Heteropogon contortus	6	0.26	26.6	0.66	3.67	3.75	2.9	10.32
Micromeria biflora	19	0.73	73	1.83	10.32	10.29	8.05	28.66
Maytenus royleanus	10	0.46	46.6	1.16	6.5	6.57	5.1	18.17
Otostegia limbata	8	0.26	26.6	0.66	3.67	3.75	2.9	10.32
Oxalis corniculata	7	0.4	40	1.0	5.55	5.64	4.4	15.69
Rabdosia rugosa	12	0.4	40	1.0	5.65	5.65	4.4	15.69
Sonchus asper	10	0.46	46	1.16	6.5	6.48	5.1	18.08
Themeda anathera	40	1.0	100	2.5	14.14	14.10	11	39.24

Table 7
Phytosociological attributes of *Pinus roxburghii-Hypodematium crenatum-Dodonaea viscosa* community on "Mai Dhahi Hill" at elevation of 1100 meters in December, 1995

Tree layer	Total	D	F	CC	RD	RF	RCC	IV
Pinus roxburghii	3	0.6	60	31.62	10.48	10.29	40.13	60.9
Shrubs								
Dodonaea viscosa	15	0.8	80	8.25	13.98	13.73	10.51	38.22
Maytenus royleanus	15	0.7	80	4.24	12.23	13.73	5.41	31.37
Mallotus philippensis	6	0.3	30	2.0	5.24	5.14	2.54	12.92
Otostegia limbata	6	0.4	40	1.0	6.99	6.86	1.27	15.12
Quercus incana	5	0.3	30	0.15	5.24	5.14	0.95	11.33
Robdosia rugosa	12	0.7	70	1.75	12.23	12.01	2.23	26.47
Herbs								
Eriophorum comosum	18	0.46	46	6.16	8.04	7.89	7.85	23.78
Hypodematium crenatum	41	0.8	80	12.0	13.98	13.13	15.28	43.0
Themeda anathera	22	0.66	66.6	10.66	11.52	11.43	13.59	36.55

Micromeria biflora, Adiantum capillus veneris, Maytenus royleanus (from shrub and herb layer) and *Sonchus asper*. The associated members were *Dodonaea viscosa, Oxalis corniculata, Rabdosia rugosa, Otostegia limbata* and *Heteropogon contortus* (Table 6). One rare species was found. No tree was found in this community. Total number of species was 14. The loam soil showed the low percentage of $CaCO_3$, organic matter and N. The pH=7.6 was the lowest than of all the other sites studied. The electrical conductivity was low while the soil temperature was 29°C (Table 1). *Dodonaea viscosa* gained dominance from the shrub layer because of its highest values of relative density and canopy coverage. *Themeda anathera* was a second dominant from the herbaceous layer although its relative canopy coverage was less than *Mallotus philippensis*. The relative density and frequency of *T. anathera* was twice than that of *M. Philippensis*.

(6). Pinus-Hypodematium-Dononaea (PHD) community. This community was found at 1100 m elevation. The dominants were *Pinus roxburghii* (IV=60.09), *Hypodematium crenatum* (IV=43) and *Dodonaea viscosa* (IV=38.22) (Table 7). The co-dominants were *Themeda anathera, Maytenus royleanus, Rabdosia rugosa, Eriophorum comosum* and *Otostegia limbata. Mallotus philippensis* and *Quercus incana* were the associated members of this community. No rare species was found. Total number of species were 10. The soil was loam, rich in K with pH=7.7. The organic matter was moderate while the percentage of $CaCO_3$ content was the lowest than all the sites studied. The electrical conductivity was low and similar to found at 980 m elevation. The soil temperature decreased to 20°C (Table 1). *Pinus roxburghii* took the lead as a first dominant in this community due to its high values of canopy coverage as compared to other two dominants, *H. crenatum* and *D. viscosa*, respectively. *Mallotus philippensis* relative frequency and canopy coverage were quite low and this decreased its importance value. *Dodonaea viscosa* dominated the shrub layer and was absent in the herb layer. *Dodonaea viscosa* is a common undergrowth species of *P. roxburghii* (Shah *et al* 1994).

Plant species with dominant position in stands and with low importance values (IV). In the study, area studied in December, 1995 (sunside). Phoenix sylvestris was reported as a first dominant in the third stand and in this stand the IV of *D.viscosa, C.dactylon* and *M. biflora* were low. *Pinus roxburghii* was also the first dominant in the sixth stand and in the stand *D.viscosa, M.philippensis, O. limbata* and *H.crenatum* showed low IV. *Dodonaea viscosa* was dominant in six stands as a first, second, and third dominant, respectively and in these stands *M. philippensis, T. anathera, M.biflora* and *O.limbata* had low IV. *Maytenus royleanus* was dominant in two stands as a second and third dominant *Mallotus philippensis* was dominant is one stand as a third dominant and in this stand *M. biflora* showed low IV. *Otostegia limbata* was dominant in one stand as a second dominant and in this stand *T. anathera* and *M.biflora* showed low IV. *Themeda anathera* was dominant in three stands as a first, second and third dominant and in these stands *D.viscosa, M.philippensis* and *M.biflora* showed low IV (Table 3,5). Dastagir *et al* (1999) observed that *Themeda anathera* was a second dominant in one stand and third dominant in five stands in April, 1995 at Mai Dhani Hill, Muzaffarabad. *Cynodon dactylon* was dominant in one stand as a second dominant, and in this stand *M. biflora* had low IV. *Hypodematium crenatum* was also dominant in one stand as a second dominant and in this stand *M.philippensis, O. limbata* and *T. anathera* showed low IV. *Micromeria biflora* was dominant in one stand as a third dominant and in this stand *D.viscosa* and *T.anathera* showed low IV (Table 3-5).

Dodonaea viscosa attained the stature of a small tree at 900, 980 and 1050 m elevations. It extends up to higher altitudes and reaching up to 1100 m elevation. The highest import ance value (IV=66.1) of *D viscosa* was found at 900m elevation where it was the leading dominant and plant seemed to

flourish but with increasing altitude the important value decreased (Table 3). Vegetation in general and *D.viscosa* in particular decreases and becomes scanty with increasing altitude mainly for the steepness and exposure of slopes (Champion *et al* 1965).

Pinus roxurghii has low relative density with comparatively higher relative canopy coverage at 1100 m elevation suggests that trees population is extremely low with larger size. At the highest altitude of Mai Dhani Hill, Muzaffarabad the rate of survival of *P.roxburghii* is extremely low and only few trees were found. The conditions are unfavourable for their establishment and biotic pressure has tremendously contributed for its degradation. Presence of a few trees indicate that for many years the conditions were suitable for their existence. Chaghtai and Ghawas (1976) reported that comparatively high temperature, shallow soil, greater run off, low moisture contents of the soil and high winds of Malakand Pass are equally responsible for the absence of the *Pinus roxburghii* from south facing slopes. It was confined to north facing slopes alone.

The area once used probably to be a sub-tropical chir pine forest as indicated by the presence of *P.roxburghii* (Hussain and Ilahi 1991). *Dodonaea, Olea, Maytenus* and *Eriophorum* from the shrub layer are the indicators of sub-tropical vegetation. *Dodonaea viscosa* and *Berberis lycium* were present in herb layer alone in some of the communities recognised at *Mai Dhani Hill, Muzaffarabad, in April, 1995 (Dastagir et al.1999)*, while *D. viscosa* and *B. lycium* were found both from the shrub and herb layers (Table 3). Malik and Hussain (1990) reported similar findings in some parts of Kotli Hills, Azad Kashmir. *Acacia modesta* and *Olea ferruginea* were found very rarely at Mai Dhani Hill, Muzaffarabad. Hussain and Baz (1996) reported that *Acacia modesta* is common throughout the country up to 1000 m elevation to from *Olea-Acacia* or *Acacia-Monotheca* forests. *Olea ferruginea*, an associated member of *Themeda-Dodonaea-Maytenus* community was found to have IV=12.26 from shrub layer and IV=6.54 from herb layer, respectively. *Olea ferruginea* was absent at the higher altitudes of Mai Dhahi HIll, Muzaffarabad. Deforestation and overgrazing might have suppressed it. It is preferred for burning. *Themeda anathera* was dominant in six communities recognised at various altitudes of Mai Dhani Hill, Muzaffarabad, in April, 1995 (Dastagir *et al* 1999) while it was dominant in three communities recognised at 800, 980 and 1050 m elevations in December, 1995. *Cynodon dactylon* was not dominant but was found as an associated member of some of the communities recognised at various altitudes of Mai Dhani Hill, Muzaffarabad, in April, 1995 (Dastagir *et al* 1999). It was a leading dominant only at 970 m elevation with maximum IV=29.38 in December, 1995 (Table 4).

Chaghtai *et al* (1978) reported that grazing and particularly the soil deficiency of K and No_3 may be held responsible for low importance value of *C.dactylon.*

The highest species diversity is shown by *Phoenix-Cynodon-Micromeria* community at 970 m elevation while the lowest species diversity is shown by *Dodonaea Otostegia-Themeda* community (Table 4). With the increase of an altitude the species diversity decreases which is contrary to the species diversity observed in April, 1995 (Dastagir *et al* 1999). There are a few trees found at Mai Dhani Hill, Muzaffarabad and their importance value is not very high as *Acacia modesta* (IV=9.06 at 900 m elevation) and (IV=31.46). *Phoenix sylvestris* and *Pinus roxburghii* were dominant at 970 and 1100 m elevation, respectively.

Edaphology of plant communities. The soil texture varied from sandy loam to loam at the sunside of Mai Dhani Hill, Muzaffarabad. One community *Celtis-Dichanthium-Themeda* was found on loamy soil at 800 m elevation while other five communities were found on loamy soils. pH varied from 7.6 to 8.0 (Table 1). No community was found on the soil having moderate EC (1.0-2.0). The soils of all the communities has low (< 1.0) EC. The lowest EC was found in the soils of Celtis-*Dichanthium-Themeda* community at 1050 m elevation. The $CaCO_3$ varied from 15.7 to 23.2%. No community was found to show high (>30%) $CaCO_3$.

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