

VEGETATION DESCRIPTION AND CURRENT STATUS OF MOIST TEMPERATE CONIFEROUS FORESTS OF HIMALAYAN AND HINDUKUSH REGION OF PAKISTAN

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Abstract

The present study is based on the examination of vegetation description, disturbance factors and distribution of tree and understorey species of moist temperate conifer forests of southern Himalayan and Hindukush regions of Pakistan. Forty one stands at five different locations were selected for the study. Five conifer species and seven angiospermic species were sampled by point centered quarter method. Among conifers *Pinus wallichiana* occupied highest frequency found in 35 stands while *Abies pindrow* occurred in 27 stands with high importance value and density. *Cedrus deodara* is well tolerant in different climatic conditions, recorded from 22 sampling sites. *Taxus fuana* and *Picea smithiana* attained low frequency, recorded from 6 and 5 stands respectively. Angiospermic species that were associated with conifers attained very low frequency. *Quercus incana*, *Quercus ilex*, *Pyrus pashia*, *Albizia chinensis*, *Juglans regia* and *Populus pamirica*, *Populus alba* occurred in few sampled forests. Ground vegetation was also assessed to find the associated vegetation of the forests. The most common understorey species found in study area were: *Pteris cretica* (in 22 stands), *Acer caesium* (in 19 stands), *Rosa brunoni* (10 stands), *Berberis lyceum*, *Hedera nepalensis*, *Rubus biflorus*, *Thymus serpyllum* (9 stands), *Rosa webbiana*, *Rubus ellipticus* (8 stands), *Adiantum venustum*, *Echinophs niveus* (6 stands), *Adiantum capillus veneris*, *Aristida adscensionis*, *Cymbopogon jwarancusa*, *Duchesnea indica* (5 stands), *Dicanthium annulatum*, *Indigofera hebeptela*, *Podophyllum emodi*, *Quercus incana* (4 stands), *Andropogon lancifolius*, *Asplenium filix*, *Cotoneaster microphylla*, *Gloriosa superba*, *Plantago asiatica*, *Ranunculus muricatus*, *Sinapis arvensis* found in 3 stands. Seedlings of *Pinus wallichiana*, *Abies pindrow*, *Cedrus deodara*, *Picea smithiana* and *Taxus fuana* recorded from 22, 17, 15, 4 & 3 stands respectively indicated the future trend of the moist temperate forests of Pakistan.

Introduction

Phytosociology of the vegetation of moist temperate area of Himalayan and Hindukush region of Pakistan is presented in the present study. Sampling was carried out at five main different locations viz. Malakand division, Azad Kashmir, Murree hills, Hazara division and Kaghan valley. Conifer dominating forests were selected for the study but understorey species present in the forest were also analyzed. The present study dealt with species composition, distribution pattern and dominance concentration of the forests. Various workers like Champion *et al.*, 1965; Ahmed and Qadir (1976); Ahmed (1986, 1988); Ahmed *et al.*, (1989, 1990a, 1990b, 1991, 2006 and 2009); Khan *et al.*, (2008), Siddiqui *et al.*, (2009) have investigated the phytosociology of different mountainous areas of Pakistan, but no comprehensive study of the entire area of moist temperate region has been undertaken. This study attempts to cover a greater part of the moist temperate areas of Himalayan and Hindukush region of Pakistan to carry out quantitative phytosociological investigation. According to Champion *et al.*, (1965) this formation extends along the whole length of the outer ranges of the Himalaya between the subtropical pine forests and the sub-alpine formation with a rainfall from about 25" (64cm) or 30" (76cm) to about 60" (152cm) and the altitudinal range is from about 1372 m up to 3047 m, the limits varying markedly with aspect and configuration. The elevations of present study area were between 1600 to 3100 m. According to Amjad *et al.*, (1996) Pakistan has insufficient forest resources. The country due to its sharp climatic variations and arid conditions lacks reasonable tree cover. There is hardly 4.28 million hectares or 4.9 percent of total area under forest / tree cover. Out of it, the productive forests are less than 2%.

In Pakistan, the earlier ecological studies were generally observational. However, with the passage of time gradually quantitative principles were introduced and the vegetation description evolved to quantitative studies. The earlier studies generally appeared in 1950's. These were confined to visual description of the vegetation. No attempts were made to recognize community types and to correlate them with the relevant environmental factors. Among the earliest studies in the moist temperate area are those of Chaudhri (1957) conducted a phytosociological survey to Azad Kashmir, Muree hills, some part of Hazara district, Swat and Dir. He observed *Viburnum nervosum*, *Podophyllum* sp. *Viola serplenis*, *Adiantum venustum*, *Geranium wallichianum*, *Valerians*

wallichii, *Fragaria vesca*, *Gallum asperifolium*, *Dryopteris* sp. and *Impatiens* sp. Champion *et al.*, (1965) in their book described the vegetation of humid forests in detail. According to these authors, the major characteristic of the humid forests is the development of coniferous forests which begin in the northern area in the form of subtropical pine forests. These forests also extend into the dry temperate region, and to a relatively small degree into the sub-alpine forests. In many ways the structure and physiognomy of these forests is similar to those of North-temperate zones of Europe and North America. The prevalence of species is largely a function of altitude and the aspect. The forests are dominated by coniferous species, which constitute the major portion of the canopy (80%), while the evergreen underwood contributes to about 20% cover. *Taxus fuana* is the underwood in such forests in scattered form. Malik *et al.*, (2007) described phytosociological attributes of different plant communities of Pir Chinasi hills (moist temperate area) of Azad Jammu and Kashmir. The hills are protected from biotic interference such as grazing and cutting, therefore they represent natural vegetation. Thirteen plant communities were recognized based on species dominance. Some of the communities were dominated by tree species such as *Ficus palmata*, *Pinus wallichiana* and codominants *Picea smithiana* and *Pinus roxburghii*.

Materials and Methods

Sampling was carried out in conifer dominating forests, throughout their natural limits in moist temperate areas of Himalayan and Hindukush region of Pakistan. Though some forests are disturbed but mature and least disturbed forests were selected for quantitative sampling. The criteria for the selection of a stand were:

- 1- That it should be dominated by conifer trees
- 2- There should be no recent sign of disturbance
- 3- Stand should cover at least five hectare area

Forty one stands were sampled by Point Centered Quarter Method (Cottam and Curtis, 1956) for quantitative study. At each stands twenty points were taken at every twenty meter intervals. The p.c.q. method has been recommended by Mueller-Dombois and Ellenberg (1974) and Kent and Coker (1992) for systematic and random sampling, particularly for tree vegetation. This method gives reliable overall density and relative density estimates (Greig-Smith, 1983). It is fast, reliable and requires little labour with relative ease of calculation and is readily applied in thick dense forest with uneven topography. Phytosociological attributes (relative density, relative frequency & relative basal area) were calculated, according to the method described by Mueller-Dombois and Ellenberg (1974). Importance Value Index (Brown & Curtis, 1952) was used to rank each species and the plant species with the highest importance value in the stand was considered the dominant species. Plants specimens were collected from the studied area and identified with the help of flora of Pakistan (Stewart, 1972). Climatic factors (elevation, slope angle, aspects, longitude and latitude) of each stand were recorded, using GPS. Soil compactions of each stand measured by soil compact meter during sampling.

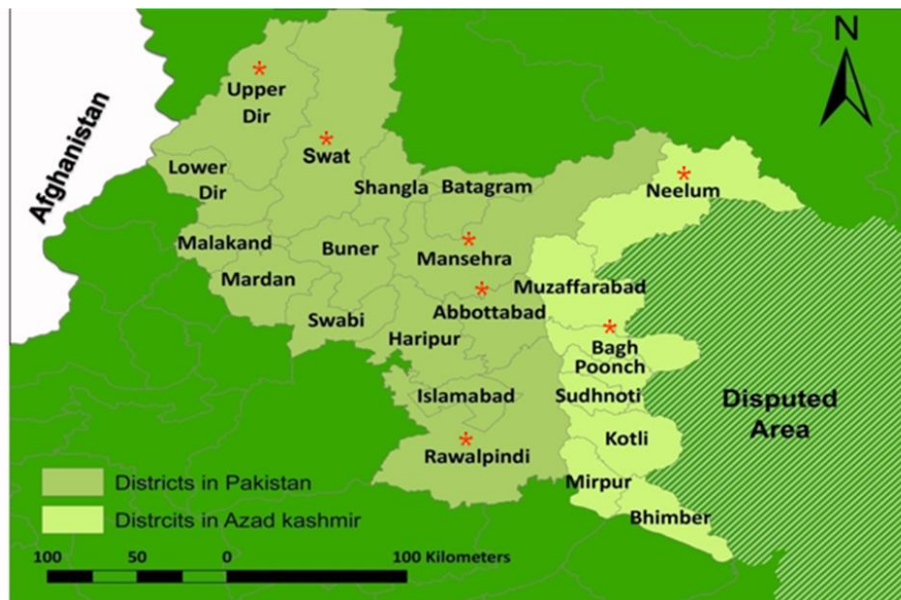


Fig.1. Study area map. *showing the district where sampling was conducted (Siddiqui *et al.*, 2012).

Table 1. Summary of sampling sites and site characteristics of studied moist temperate area of Himalayan region of Pakistan (Siddiqui *et al.*, 2011)

S. No.	Location and sites	Lati (N)	Longi (E)	Elev (m)	Slope (°)	Aspect	Canopy	Soil Comp. (TIP)
1- Dir Upper (district), Malakand Division								
1	Kumrat	35° 54'	72° 14'	2400	R. Top	R. Top	Closed	165
2	Pana Kot	35° 16'	71° 50'	2200	40	W	Closed	150
2- Swat (district), Malakand Division								
3	Malam Jabba 1	35° 12'	72° 81'	2600	34	W	Moderate	175
4	Malam Jabba 2	35° 20'	72° 40'	2350	30	N W	Open	200
5	Miandam	35° 09'	72° 30'	2600	49	N	Moderate	150
3- Neelam (district), Azad Kashmir								
6	Keran	34° 56'	73° 12'	1960	30	N E	Open	250
4- Bagh (district), Azad Kashmir								
7	Chikar, District Baagh	34° 54'	73° 10'	1930	28	N W	Moderate	150
8	Sudhan Gali 1,	34° 20'	73° 22'	2450	22	E	Moderate	200
9	Sudhan Gali 2	34° 22'	73° 28'	2500	32	N	Partly closed	130
10	Sudhan Gali 3	34° 19'	73° 25'	2420	38	West	Moderate	110
5- Murree (district), Rawalpindi Division								
11	Ghora Gali	33° 52'	73° 20'	2100	29	N	Moderate	150
12	Patreata Top 1	33° 50'	69° 56'	2300	40	S E	Closed	210
13	Patreata Top 2	33° 50'	69° 56'	2300	25	S W	Moderate	110
14	Nia, Near Patriata	33° 52'	69° 57'	2000	39	S	Moderate	150
15	Kashmir Point	34° 54'	73° 24'	2500	39	S	Closed	150
6- Abbot Abad (district), Hazara Division								
16	Ghora Dhaka 1	34° 02'	73° 26'	2500	36	N E	Closed	130
17	Ghora Dhaka 2	34° 04'	73° 24'	2500	32	S E	Closed	170
18	Ghora Dhaka 3	34° 07'	73° 25'	2800	40	S W	Moderate	180
19	Ghora Dhaka 4	34° 09'	73° 27'	2800	40	W	Closed	220
20	Ghora Dhaka 5	34° 11'	73° 28'	2600	37	S W	Closed	170
21	Khaira Gali	33° 57'	73° 23'	2730	42	S E	Closed	120
22	Changla Gali 1	33° 59'	73° 23'	2650	47	W	Open	180
23	Changla Gali 2	33° 59'	73° 23'	2670	35	S	Closed	150
24	Kuzah Gali 1	34° 02'	73° 24'	2560	R. Top	R. Top	Moderate	210
25	Kuzah Gali 2	34° 02'	73° 24'	2560	28	S E	Closed	210
26	NathiaGali, Lalazar 1	34° 54'	73° 46'	2640	35	S	Moderate	160
27	NathiaGali, Lalazar 2	34° 54'	73° 46'	2630	33	N W	Open	190
28	Thandyani 1	34° 14'	73° 22'	2320	31	S	Moderate	140
29	Thandyani 2	34° 14'	73° 22'	2300	38	S	Moderate	140
7- Mansehra (district), Kaghan Valley								
30	Paye	34° 47'	73° 30'	3100	38	S	Closed	250
31	Sri	34° 47'	73° 30'	2900	39	N	Closed	90
32	Shogran 1	34° 37'	73° 28'	2400	27	S W	Closed	170
33	Shogran 2	34° 37'	73° 28'	2400	23	S	Closed	190
34	Shogran 3	34° 37'	73° 28'	2500	33	S	Closed	150
35	Paras, Malkandi Pine Park	34° 41'	73° 35'	1600	20	N E	Closed	160
36	Khanian	34° 47'	73° 32'	2000	35	E	Closed	195
37	Shinu 1, Near Jurait Park	34° 38'	73° 26'	1900	39	N W	Moderate	180
38	Shinu 2, Near Jurait Park	34° 38'	73° 26'	1650	43	W	Closed	120
39	Naran, River Belt 1	34° 53'	73° 39'	2500	R. Top	N W	Moderate	190
40	Naran, River Belt 2	34° 53'	73° 39'	2500	R. Top	N W	Moderate	170
41	Lalazar (Naran)	34° 53'	73° 39'	3000	45	N W	Closed	150

Key to abbreviations: Lati. = Latitude, Longi. = Longitude, Elev.= Elevation, Soil comp.= Soil compaction. R. Top = Ridge top, E = East, W = West, N = North, S = South

Table 2. Phytosociological Attributes and absolute values of tree species in forty one stands of moist temperate areas of Himalayan range of Pakistan.

Main Location, Sites and Stand No.	Species Name	Phytosociological Attributes			
		Relative Frequency	Relative Basal Area	Relative Density	Importance Value
1- Dir upper (district), Malakand Division					
1 Kumrat	<i>Pinus wallichiana</i>	71	43	61	58
	<i>Cedrus deodara</i>	16	40	28	28
	<i>Populus pamirica</i>	12	10	10	11
	<i>Abies pindrow</i>	1	7	1	3
2 Panahkot	<i>Pinus wallichiana</i>	57	61	60	59
	<i>Cedrus deodara</i>	43	39	40	41
2- Swat (District), Malakand Division					
3 Malam Jabba 1	<i>Abies pindrow</i>	83	91	95	90
	<i>Picea smithiana</i>	17	9	5	10
4 Malam Jabba 2	<i>Pinus wallichiana</i>	91	99	97	96
	<i>Abies pindrow</i>	9	1	3	4
5 Miandam	<i>Abies pindrow</i>	56	84	55	65
	<i>Pinus wallichiana</i>	44	16	45	35
3- Nellam (district), Azad Kashmir					
6 Keran	<i>Cedrus deodara</i>	60	61	60	60
	<i>Pinus wallichiana</i>	40	39	40	40
4- Bagh (district), Azad Kashmir					
7 Chikar	<i>Pinus wallichiana</i>	100	100	100	100
8 Suddhan Gali	<i>Abies pindrow</i>	41	49	42	44
	<i>Pinus wallichiana</i>	38	37	45	40
	<i>Cedrus deodara</i>	21	14	13	16
9 Suddhan Gali 2	<i>Abies pindrow</i>	63	93	83	79
	<i>Pinus wallichiana</i>	31	4	15	17
	<i>Cedrus deodara</i>	6	3	3	4
10 Suddhan Gali 3	<i>Pinus wallichiana</i>	83	70	95	83
	<i>Abies pindrow</i>	17	30	5	17
5- Murree (district), Rawalpindi Division					
11 Ghora Gali	<i>Pinus wallichiana</i>	85	94	87	89
	<i>Pyrus pashia</i>	5	2	7	5
	<i>Taxus wallichiana</i>	5	2	3	3
	<i>Quercus incana</i>	5	2	3	3
12 Patriata Top 1	<i>Cedrus deodara</i>	83	91	83	78
	<i>Pinus wallichiana</i>	17	9	17	22
13 Patriata Top 2	<i>Pinus wallichiana</i>	100	100	100	100
14 Patriata Top 3	<i>Pinus wallichiana</i>	88	97	87	91
	<i>Albizia chinensis</i>	12	3	13	9
15 Kashmir Point	<i>Abies pindrow</i>	60	49	60	56
	<i>Pinus wallichiana</i>	27	25	27	26
	<i>Juglans regia</i>	8	21	8	13
	<i>Cedrus deodara</i>	5	5	5	5
6- Abbot Abad (district), Hazara division					
16 Ghora Dhaka 1	<i>Abies pindrow</i>	89	89	89	89
	<i>Taxus wallichiana</i>	5	9	5	7
	<i>Pinus wallichiana</i>	3	1	3	2
	<i>Cedrus deodara</i>	3	1	3	2
17 Ghora Dhaka 2	<i>Abies pindrow</i>	60	51	60	57
	<i>Pinus wallichiana</i>	35	47	35	39
	<i>Taxus wallichiana</i>	5	2	5	4
18 Ghora Dhaka 3	<i>Pinus wallichiana</i>	87	86	87	87
	<i>Abies pindrow</i>	13	14	13	13
19 Ghora Dhaka 4	<i>Abies pindrow</i>	60	60	60	60
	<i>Pinus wallichiana</i>	35	35	35	35
	<i>Taxus wallichiana</i>	5	5	5	5
20 Ghora Dhaka 5	<i>Abies pindrow</i>	62	42	62	55
	<i>Pinus wallichiana</i>	17	16	17	17
	<i>Cedrus deodara</i>	13	18	13	15
	<i>Juglans regia</i>	8	24	8	13
21 Khera Gali	<i>Cedrus deodara</i>	42	67	63	57
	<i>Pinus wallichiana</i>	33	31	26	30

Main Location, Sites and Stand No.	Species Name	Phytosociological Attributes			
		Relative Frequency	Relative Basal Area	Relative Density	Importance Value
22 Changla Gali 1	<i>Abies pindrow</i>	25	2	11	13
	<i>Abies pindrow</i>	57	78	57	64
	<i>Pinus wallichiana</i>	25	10	25	20
	<i>Taxus wallichiana</i>	15	11	15	14
23 Changla Gali 2	<i>Juglans regia</i>	3	1	3	2
	<i>Pinus wallichiana</i>	50	72	50	57
	<i>Abies pindrow</i>	46	27	46	40
	<i>Taxus wallichiana</i>	4	1	4	3
24 Kuzah Gali 1	<i>Cedrus deodara</i>	70	87	70	76
	<i>Abies pindrow</i>	25	12	25	21
	<i>Pinus wallichiana</i>	5	1	5	3
25 Kuzah Gali 2	<i>Abies pindrow</i>	60	51	60	57
	<i>Pinus wallichiana</i>	25	28	25	26
	<i>Cedrus deodara</i>	15	21	15	17
26 Nathia Gali 1	<i>Pinus wallichiana</i>	64	47	64	55
	<i>Abies pindrow</i>	36	53	36	45
27 Nathia Gali 2	<i>Abies pindrow</i>	95	96	95	91
	<i>Pinus wallichiana</i>	5	4	5	9
28 Thandyani 1	<i>Pinus wallichiana</i>	80	83	80	81
	<i>Cedrus deodara</i>	20	17	20	19
29 Thandyani 2	<i>Cedrus deodara</i>	50	74	70	65
	<i>Pinus wallichiana</i>	50	26	30	35
7- Mansehra (district), Kaghan valley					
30 Paye, Shogran	<i>Pinus wallichiana</i>	57	60	57	58
	<i>Picea smithiana</i>	28	30	28	29
	<i>Abies pindrow</i>	15	10	15	13
31 Sri, Shogran	<i>Picea smithiana</i>	67	70	67	68
	<i>Abies pindrow</i>	33	30	33	32
32 Shogran 1	<i>Pinus wallichiana</i>	62	72	62	65
	<i>Abies pindrow</i>	38	28	38	35
33 Shogran 2	<i>Cedrus deodara</i>	70	92	86	82
	<i>Pinus wallichiana</i>	20	2	7	10
	<i>Abies pindrow</i>	10	6	7	8
34 Shogran 3	<i>Cedrus deodara</i>	84	95	94	91
	<i>Picea smithiana</i>	8	4	3	5
	<i>Abies pindrow</i>	8	1	3	4
35 Paras	<i>Cedrus deodara</i>	55	96	80	76
	<i>Juglans regia</i>	18	1	8	9
	<i>Pinus wallichiana</i>	9	1	4	5
	<i>Quercus ilex</i>	9	1	4	5
	<i>Quercus incana</i>	9	1	4	5
36 Khanian	<i>Cedrus deodara</i>	75	91	83	83
	<i>Pinus wallichiana</i>	25	9	17	17
37 Shinu 1	<i>Cedrus deodara</i>	53	75	72	67
	<i>Pinus wallichiana</i>	47	25	28	33
38 Shinu 2	<i>Cedrus deodara</i>	100	100	100	100
39 Naran valley 1	<i>Pinus wallichiana</i>	65	77	65	69
	<i>Picea smithiana</i>	13	16	13	14
	<i>Cedrus deodara</i>	13	3	13	10
	<i>Populus alba</i>	6	3	6	5
	<i>Abies pindrow</i>	3	1	3	2
40 Naran valley 2	<i>Cedrus deodara</i>	100	100	100	100
41 Lalazar, Naran	<i>Abies pindrow</i>	100	100	100	100

Authority of tree species: *Pinus wallichiana* A.B.Jackson, *Abies pindrow* Royle, *Cedrus deodara* (Roxb.) G. Donf., *Picea smithiana* (Wall.) Boiss., *Taxus fuana* Nan Li & R.R. Mill, *Juglans regia* L. *Quercus incana* Roxb, *Quercus ilex* Griff., Itin., *Albizia chinensis* (Osbeck) Merrill, *Pyrus pashia* Ham ex D. Don, *Populus pamiirica* Komarov and *Populus alba* L.

S.No.	Name of species	Stands Numbers													
		15	16	17	18	19	20	21	22	23	24	25	26	27	28
52	<i>Berberis kunawurensis</i>	*	*	20	*	*	*	*	*	*	*	*	*	*	
53	<i>Bothriochloa bladhii</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
54	<i>Brassica campestris</i>	*	*	*	*	*	50	*	*	*	*	*	*	*	
55	<i>Brassica nigra</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
56	<i>Campanula tenuissima</i>	*	*	30	*	*	*	*	*	*	*	*	*	*	
57	<i>Carissa opaca</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
58	<i>Chrysopogon aucheri</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
59	<i>Companula latifolia</i>	*	*	*	*	*	*	*	*	*	*	*	*	40	
78	<i>Polyporus abietinus</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
79	<i>Quercus dilatata</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
80	<i>Ribes alpestre</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
81	<i>Rubus antennifer</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
82	<i>Rubus niveus</i>	*	*	*	*	*	*	60	*	*	*	*	*	*	
83	<i>Selaginella sanguinolenta</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
84	<i>Sonchus asper</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
85	<i>Carum carvi</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
86	<i>Tetrapogon villosus</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
87	<i>Urtica dioica</i>	*	*	*	*	*	*	*	20	*	*	*	*	*	

S.No.	Name of species	Stands Numbers													
		29	30	31	32	33	34	35	36	37	38	39	40	41	*
1	<i>Pinus wallichiana</i>	*	40	*	30	40	*	*	*	*	60	*	*	*	
2	<i>Pteris cretica</i>	*	20	100	*	60	40	*	*	*	*	*	*	*	
31	<i>Taxus wallichiana</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
32	<i>Argemone mexicana</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
33	<i>Aristida cyanantha</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
34	<i>Asplenium viride</i>	*	*	*	*	*	*	*	*	*	30	10	*	*	
35	<i>Aster mollisculus</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
	<i>Chrysopogon echinulatus</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
36	<i>Chrysopogon echinulatus</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
37	<i>Erianthus griffithii</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
38	<i>Juglans regia</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
39	<i>Pteridium aquilinum</i>	*	*	*	*	*	*	*	50	*	*	*	*	*	
40	<i>Punica granatum</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
41	<i>Pyrus pashia</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
42	<i>Quercus ilex</i>	*	*	*	*	*	*	30	*	*	*	*	*	*	
43	<i>Rosa macrophylla</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
44	<i>Rubus macilentus</i>	*	*	*	80	*	*	*	*	*	*	*	*	*	
45	<i>Rubus ulmifolius</i>	*	*	*	*	40	30	*	*	*	*	*	*	*	
46	<i>Agaricus campestris</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
47	<i>Andropogon tristis</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
48	<i>Anemone falconeri</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
	<i>Asplenium adiantum nigrum</i>	40	*	*	*	*	*	*	*	*	*	*	*	*	
49	<i>Asplenium adiantum nigrum</i>	40	*	*	*	*	*	*	*	*	*	*	*	*	
50	<i>Asplenium trichomanes</i>	*	*	*	*	*	*	*	*	*	40	*	*	*	
51	<i>Athyrium atkinsonii</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
52	<i>Berberis kunawurensis</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
53	<i>Bothriochloa bladhii</i>	20	*	*	*	*	*	*	*	*	*	*	*	*	
54	<i>Brassica campestris</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
55	<i>Brassica nigra</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
56	<i>Campanula tenuissima</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
57	<i>Carissa opaca</i>	*	*	*	*	*	*	*	10	*	*	*	*	*	
58	<i>Chrysopogon aucheri</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
59	<i>Companula latifolia</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
60	<i>Delphinium uncinatum</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
61	<i>Dryopteris barbegera</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
62	<i>Ephedra gerardiana</i>	*	*	*	*	*	*	*	*	*	40	*	*	*	
63	<i>Euphorbia hispida</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
64	<i>Geranium wallichianum</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
65	<i>Hypericum dyeri</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
66	<i>Indigofera gerardiana</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
67	<i>Jasminum grandiflorum</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
68	<i>Lycopodium selago</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	
69	<i>Morus alba</i>	*	*	*	*	*	*	*	*	30	*	*	*	*	

S.No.	Name of species	Stands Numbers													
		29	30	31	32	33	34	35	36	37	38	39	40	41	*
70	<i>Selaginella jacquemontii</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	*
71	<i>Ficus palmata</i>	*	*	*	*	*	*	*	*	*	20	*	*	*	*
72	<i>Pleopeltis clathrata</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	*
73	<i>Polygala abyssinica</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	*
74	<i>Polygala erioptera</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	<i>Polygonum</i>														*
75	<i>amplexicaule</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	*
76	<i>Polygonum caespitosum</i>	*	*	50	*	*	*	*	*	*	*	*	*	*	*
77	<i>Polygala sibirica</i>	*	*	50	*	*	*	*	*	*	*	*	*	*	*
78	<i>Polyporus abietinus</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	*
79	<i>Quercus dilatata</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	*
80	<i>Ribes alpestre</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	*
81	<i>Rubus antennifer</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	*
82	<i>Rubus niveus</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	*
83	<i>Selaginella sanguinolenta</i>	*	*	*	*	*	*	*	30	*	*	*	*	*	*
84	<i>Sonchus asper</i>	*	20	*	*	*	*	*	*	*	*	*	*	*	*
85	<i>Carum carvi</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	*
86	<i>Tetrapogon villosus</i>	*	*	*	*	*	*	*	*	*	*	30	*	*	*
87	<i>Urtica dioica</i>	*	*	*	*	*	*	*	*	*	*	*	*	*	*

Authorities of understorey species: *Pteris cretica* L mant, *Acer caesium* Wall. ex brandis, *Rosa brunonii* Lindl, *Berberis lycium* Royal I.C., *Hedera nepalensis* K. Koch, *Rubus biflorus* Ham ex Sm., *Thymus serpyllum*. L, *Rosa webbiana* Wall ex Royle, *Rubus ellipticus* Smith, *Adiantum venustum* D. Don, *Echinops niveus* Wall ex D.C., *Adiantum capillus veneris* L, *Aristida adscensionis* L, *Cymbopogon jwarancusa* (Jones) Schult, *Duchesnea indica* (Andr), *Dicanthium annulatum* (Forssk), *Indigofera hebeptala* Ali, *Podophyllum emodi* Wall, *Andropogon lancifolius* (Toin) Hochst, *Athyrium filix foemina* (L), *Cotoneaster microphylla* Wall ex Lindl, *Gloriosa superba* L, *Plantago asiatica* L, *Ranunculus muricatus* L, *Sinapis arvensis* L, *Argemone mexicana* L, *Aristida cyanantha* Nus ex. Stand, *Asplenium viride* Huds., *Aster molliusculus* (D.C.) C.B. Clarke, *Chrysopogon echinulatus* Nees ex Steud, *Erianthus griffithii* (Munro) HK.f, *Juglans regia* L (seedlings), *Pteridium aquilinum* (L), *Punica granatum* L, *Rosa macrophylla* Lindl, *Rubus macilentus* Camb., *Rubus ulmifolius* Schott., *Agaricus campestris* L.Ex.Fr., *Andropogon tristis* Nees ex Hack, *Anemone falconeri* T.T, *Asplenium adiantum nigrum*. L, *Asplenium trichomanes* L, *Athyrium atkinsonii* L, *Berberis kunawurensis* Royle, *Bothriochloa bladhii* (Retz), *Brassica campestris* L, *Brassica nigra* (L) Koch., *Campanula tenuissima* Dunn, *Carissa opaca* Stapf ex Haines, *Chrysopogon aucheri* (Boiss) Stapf., *Campanula latifolia* L, *Delphinium uncinatum* H&T, *Dryopteris barbegera* (Moore) O.Kze, *Ephedra gerardiana* Wall ex Stapf., *Euphorbia hispida* Boissier, *Geranium wallichianum* D. Don, *Hypericum dyeri* Rehder, *Indigofera gerardiana* Wall. Ex Baker, *Jasminum grandiflorum* L, *Lycopodium selago* L, *Morus alba* L, *Selaginella jacquemontii* Spring, *Ficus palmata* Forssk (seedlings), *Pleopeltis clathrata* (clarke) Bedd, *Polygala abyssinica* R. Br. Ex Fresen, *Polygala erioptera* (DC), *Polygonum amplexicaule* D. Don, *Polygonum caespitosum* Bl, *Polygala sibirica* L, *Polyporus abietinus* Fr., *Quercus dilatata* Lindl. ex Royle (seedlings), *Ribes alpestre* Dcne. ex Jacq., *Rubus antennifer* Hk. F, *Rubus niveus* Hk. F, *Selaginella sanguinolenta* (L), *Sonchus asper* L, *Carum carvi* (Gracile) Wolff, *Tetrapogon villosus* Huds / Desf, *Urtica dioica* L

*Absent

Results

Fig. 1 shows the main locations, close to the sampling sites. Main locations, sampling sites, elevation, slope angle, aspect, canopy and soil compaction of each forest (site) are presented in Table 1. Phytosociological attributes of each species were presented in Table 2 while the occurrence and frequency of each understory species are presented in Table 3.

A-Malakand division: Five forests were sampled in the moist temperate part of Malakand division, two stands in Dir upper and three stands in Swat district. Two moist temperate sites i.e. Kumrat valley and Panah Kot from Dir upper were selected for vegetation description. Kumrat valley is located between latitude 35° 54' North and longitude 72° 14' East at the elevation of 2400 m with a 5° slope angle. The canopy of forest was closed. The valley is dominated by *Pinus wallichiana* and *Cedrus deodara* with 61 and 28% importance value (IV) respectively. Panah Kot is also dominated by *Pinus wallichiana* and *Cedrus deodara* with 60 and 40% importance value respectively. Panah Kot is located near Lowari top, latitude was 35° 16 North and longitude 71° 50' East. Elevation of sampled forest was 2200 m with 40° slope angle. The canopy of the forest was closed and west exposed. The common understorey species found in both the forests were: *Duchesnea indica*, *Punica*

granatum, *Erianthus griffithii* and *Berberis lycium* while *Indigofera gerardiana*, *Thymus serpyllum* present in Panah kot only. In Kumrat valley *Populus pamicarica* and *Abies pindrow* showed their presence with low abundance i.e. 10 and 1% importance value. Ground was fully covered with several inches of litter. Ground vegetation was healthy and included *Brassica nigra*, *Selaginella jacquemontii*, *Rosa brunonii*, *Pteris cretica*, *Agaricus compestris*, *Polyporus abietinus* and *Carum carvi*. Many dead stems of *Pinus wallichiana* and *Cedrus deodara* were seen on the ground. Many logged trees and decaying stems of *Pinus wallichiana* and *Cedrus deodara* were also recorded. Seedlings of *Pinus wallichiana*, *Abies pindrow* and *Cedrus deodara* were low in number but some saplings of *Pinus wallichiana* and *Cedrus deodara* were present. Emerged rocks are covered by *Punica granatum* and *Selaginella jacquemontii*. Mushroom and, *Polyporus abietinus* found in great numbers. *Polyporus abietinus*, *Selaginella jacquemontii*, *Pteris cretica* and *Agaricus compestris* were growing on dead bark of *Pinus wallichiana*, *Cedrus deodara* and *Abies pindrow*. Lichens were seen thriving on the bark of dead logs of *Pinus wallichiana*. Ground flora is highly disturbed due to human interference. Many cut stumps and decaying logs of *Pinus wallichiana* and *Cedrus deodara* were recorded in Kumrat forest. People use the plants for fuel, fodder and making furniture or timber craft. The overall ground flora is highly disturbed due to anthropogenic factor. Soil of Panah Kot was covered with thin layer of litter. Dry leaves of *Pinus wallichiana* scattered over the soil surface. Some patches of grasses were also observed in the forest. Some seedlings of *Pinus wallichiana* and *Cedrus deodara* were recorded in this forest.

B-Swat, District: Three forests were sampled in Swat district, two stands in Malam Jabba and one stand in Miandam. The valley of Swat sprawls over 10,360 sq. km. The maximum temperature is 21.11 °C and minimum 7.22 °C. Swat lies between 34°-13'-55" and 35°-53'-40" north latitudes and 70°-47'-15" east longitude in Malakand Division of Khyber Pakhtoonkhwah Province of Pakistan. The area of Swat is about 3798 sq. km. Malam Jabba 1 lies on 34° slope angle. The canopy of the forest was moderate and west facing exposure. Malam Jabba 1 was dominated by *Abies pindrow* with 90% importance value while *Picea smithiana* associated with only 10% importance value. Malam Jabba 2 was dominated by *Pinus wallichiana* with 96% importance value while *Abies pindrow* associated with 4% importance value, the dominance abruptly change due to change of exposure. In Miandam *Abies pindrow* and *Pinus wallichiana* were co-dominant with 55 & 45% importance values respectively. Ground flora of Malam Jabba 1 was healthy while poor in Miandam 1 and Malam Jabba 2. The common species in all three sampling sites were: *Adiantum venustum*, *Pteris cretica* and *Duchesnea indica*. Some other species were recorded from Malam Jabba 1 were *Lycopodium selago*, *Rubus biflorus*, *Euphorbia hispida*, *Berberis lycium*, *Rosa macrophylla* and *Pteris cretica*. Soil floor was showing large number of ferns *Hedera nepalensis* was climbing on the trunk of *Abies pindrow*. Malam Jabba 2 is located at the elevation of 2350 meter with 30° slope angle. The canopy of the forest was open with north-west exposure. Grasses covered the soil surface, littered with dry leaves and remains of male cone of *Pinus wallichiana*. Some boulders were scattered over the ground. Some other trees of ground flora were *Punica granatum*, *Polygala erioptera* and *Aristida cynantha*. Seedlings and saplings of any *Pine* tree species were absent which may be due to logging or illegal cutting. Some chopped stumps of *Pinus wallichiana* were also seen. Miandam is 56 km from Saidu Sharif, located between latitude 35° 09' North and longitude 72° 30' East at the elevation of 2600 meter with 49° slope angle. The canopy of the forest was moderate with north facing exposure. Some large rocks were visible and dry leaves of *Cedrus deodara* spread over the ground. Understorey consists of many varieties of plants i.e. *Rubus macilentus*, *Delphinium uncinatum*, *Podophyllum emodi*, *Adiantum capillus veneris*, *Polygala abyssinica*, *Pteris cretica*, *Polygonium amplexicaule* and *Chrysopogon aucheri*. Low number of seedlings of *Pinus wallichiana* and *Cedrus deodara* were recorded. Some saplings of *Pinus wallichiana* were observed.

C-Azad Kashmir: Five stands sampled in Azad Kashmir one in District Neelam and four in District Bagh. Three conifer species were dominant in Azad Kashmir i.e. *Pinus wallichiana*, *Abies pindrow* and *Cedrus deodara* in overlapping conditions. Keran (Neelam Valley) is situated 93 km from Muzaffarabad on the Right Bank of Neelam River at about 1524 meters above sea level. Sampled forest was located between latitude 34° 56' North and longitude 73° 12' East with an elevation of 1960 meter in Neelam division. Canopy of the forest was open, slope angle was 30° with north-east exposure. *Cedrus deodara* and *Pinus wallichiana* were almost co-dominant conifer trees with 60 and 40% importance value in Keran forest while in Chikar *Pinus wallichiana* occurred as monospecific species.

Three stands of Suddhan Gali showed variability in abundance i.e. *Pinus wallichiana* and *Abies pindrow* were the co-dominant conifer species having 45 and 42% importance value respectively while *Cedrus deodara* was associated with 13% importance value. Suddhan Gali 2 occupied by *Abies pindrow* with 83% importance value while *Pinus wallichiana* and *Cedrus deodara* were associated with 15 and 3% importance value respectively. Suddhan Gali 3 dominated by *Pinus wallichiana* with 95% importance value while *Abies pindrow* was associated with only 5% importance value. Ground flora of Keran consists of *Quercus ilex*, *Rubus antennifer*, *Quercus dilitata*, *Pteridium aquilinum* and *Dicanthium annulatum*. Soil is covered with dry leaves and cones of *Pinus wallichiana* and *Cedrus deodara*. Huge boulders and rocks are propping up from the ground

surface. *Asplenium filix foemina* was propping out from rocks. *Pinus wallichiana* branches are lopped up to 80 feet. A dry stream path was also indicating the disturbance in this forest.

Bagh (District): Bagh, the district headquarters of district Bagh is 100 Kilometers from Muzaffarabad via Kohallah and 80 km via Suddhan Gali, 205 km from Islamabad and 48 km from Rawalakot. District Bagh, as a whole is rich in variegated natural beauty. Topographically, this district falls into mountainous zone. Chikar, Jehlum valley is a beautiful summer station at a distance of 46 Kms from Muzaffarabad is situated on top of the mountain on the southern side of Muzaffarabad. Sampled stand is located between latitude 34° 54' North and longitude 73° 10' East with the elevation of 1930 meter. Thick grasses cover the ground surface. *Pinus wallichiana* attained 100% importance value to form monospecific forest. Rocks and boulders are negligible. Different varieties of Bryophytes form the healthy ground flora. Undershrubs consist of different varieties of Ferns i.e. *Ribes alpestre*, *Jasminum grandiflorum*, Broad leaf plants were also common. Some puff balls were also seen here. Large number of seedlings and saplings of *Pinus wallichiana* are present. Some stems of *Pinus wallichiana* are seen to have oil / resin collector pots. Snails, butterflies and birds are very common.

Sudhan Gali 1 is located between latitude 34° 20' North and longitude 73° 22' East with the elevation of 2450 meter in District Bagh. The canopy of the forest was moderate with 22° slope angle and the exposure of the site was east. Soil surface was covered with thick and long grasses. Undergrowth is rich. Spices of Ferns i.e. *Pteris cretica*, *Adiantum cappillus veneris* were common along with *Dicanthium annulatum*. Other species like *Podophyllum emodi*, *Rubus biflorus*, *Gloriosa superba* and *Berberis lycium* were common. On some places some boulders were propping up Seedlings and Saplings of *Pinus wallichiana* were abundant as compared to *Cedrus deodara* and *Abies pindrow*. Cut stumps of trees were also seen which showed human interference.

Sudhan Gali 2 is located in District Bagh between latitude 34° 22' North and longitude 73° 28' East with the elevation of 2500 meter. The canopy of the forest was partly closed with 32° slope angle and north expose. Due to change in elevation and exposure the level of dominance are changed. Ground flora was rich and healthy, covered by thick grasses, small herbs and broad leaved plants. Fern species of *Asplenium fulix*, *Felix foemina*, *Athyrium atkinsonii*, *Pteris cretica*, *Adiantum cappillus veneris* common were along with other species of *Rubus biflorus*, *Gloriosa superba*, were common. Few *Quercus incana* trees were present in the sampling site. Some climbers are found on the trunk of *Abies pindrow*. Seedlings and saplings of *Pinus wallichiana* and *Cedrus deodara* were observed while seedlings and saplings of other species were absent. Cut stumps were also observed on different places.

Sudhan Gali 3 is located between latitude 34° 19' North and longitude 73° 25' East with an elevation of 2420 meter in District Bagh. Exposure of this stand was west, 38° slope angle with moderate canopy. This sampling stand exhibits high level of moisture. Ground flora was rich, soil covered with grasses, bryophyte species, and broad leaf plants were common. Three varieties of Ferns i.e. *Adiantum capillus veneris*, *Pteris cretica* and *Jasminum grandiflorum*. Species of grass *Andropogon tristis* was common. Saplings of *Pinus wallichiana* were frequent while *Abies pindrow* were rare. Vegetation is somewhat disturbed due to human interference.

D-Murree Hills, Rawalpindi Division: Five stands sampled in Murree hills one in Ghora Gali, three in Patriata and one in Kashmir point. Four conifer species recorded from these locations i.e. *Pinus wallichiana*, *Cedrus deodara*, *Abies pindrow* and *Taxus fuana*, while some angiospermic species were also associated with these forests.

Ghora Gali is located between latitude 33° 52' North and longitude 73° 20' East with an elevation of 2100 meter in Rawalpindi division. The canopy of the sampled forest was moderate, 29° slope angle and north exposure. Among four tree species *Pinus wallichiana* was the leading dominant species occupied 87% importance value while *Pyrus pashia*, *Taxus fuana* and *Quercus incana* associated with 7, 3, 3% importance value respectively. Ground was moist and soft, covered with grasses. Understorey vegetation was thick consisted of *Berberis lycium*, *Rosa moschata*, *Rosa webbiana*, *Rubus biflorus*, *Pteris cretica*, *Indigofera*, *hebeptala*, *Argemone mexicana*, *Plantago asiatica* and *Rosa brunonii*. Few seedling and saplings of *Pinus wallichiana* and *Taxus fuana* were observed.

Patriata is located between latitude 33° 50' North and longitude 69° 56' East with the elevation of 2000-2300 meter in Rawalpindi division on South-East facing exposure. Surprisingly the canopy of the forest was closed even with the steep slope angle i.e. 40°. 210 TIP soil compaction was also not suitable for thick growth. *Cedrus deodara* was the dominant species attained 78% importance value while *Pinus wallichiana* had 22% importance value. Patriata 2 was monospecific forest of *Pinus wallichiana* while Patriata 3 was dominated by *Pinus wallichiana* with 91% importance value while *Albizia chinensis* was associated with 9% importance value. In Kahmir point *Abies pindrow* and *Pinus wallichiana* form a community with 56 and 26% importance value respectively while *Juglans regia* and *Cedrus deodara* attained low importance values i.e. 13 and 5% importance value. Understorey species were common in three stands of Patriata *Berberis lycium*, *Pinus wallichiana* seedlings, *Rosa brunonii*, *Rosa webbiana* and *Cotoneaster microphylla*. Some broad leaved species

like *Argemone mexicana*, *Indigofera hebeptala*, *Plantago asiatica*, *Echinops niveus*, *Hedera nepalensis*, *Rosa moschata*, fern species of *Pteris cretica* and trees of *Pyrus pashia*.

Rocks, big boulders were exposed over the ground. Soil is covered with long grasses, dry leaves and cones of *Cedrus deodara* and *Pinus wallichiana*. Human disturbance is observed here, many cut stumps found at regular intervals. Seedlings and Saplings of *Pinus wallichiana* were common but *Cedrus deodara* was very few. *Hedera nepalensis* was climbing on the trunk of *Pinus wallichiana*. Alpine flower were dominant.

Kashmir point forest is located between latitude 34° 54' North and longitude 73° 24' East with the elevation of 2500 meter in Rawalpindi division on South facing aspect. It was a thick forest with closed canopy and steep slope angle 39°. Ground was covered with long grasses, rocks were propping up at some places. Ground flora was rich consist on *Hedera nepalensis* which is climbing on the trunk of *Abies pindrow*. *Hypericum dyeri*, *Pteris cretica*, *Echinops niveus* and *Rosa webbiana*. Some *Agaricus* (mushroom) also present. Very few seedlings and saplings of *Abies pindrow* and *Pinus wallichiana* were observed.

E- Ayubia: Ayubia is 38 km from Abbottabad, located in Hazara Division of Khyber Pakhtoonkhwah. A cluster of four small hill stations of Khanaspur, Khaira Gali, Changla Gali and Ghora Dhaka is called Ayubia. The complex is spread over an area of 26 KM. five stands sampled on different exposure and elevation in Ghora Dhaka and vegetational gradients was observed.

Ghora Dhaka is located between latitude 34° 02' North and longitude 73° 26' East with the elevation of 2500 to 2800 meter in Hazara division. Slope angle varies from 32° to 40°. Exposures of the forests were North-East, South-East, South-West and South. Four stands occupied closed canopy while one had moderate canopy. Four conifer species were recorded from this location. In stand 1 *Abies pindrow* was the dominant species occupied 89% importance value while *Taxus fuana*, *Pinus wallichiana* and *Cedrus deodara* present with low importance value i.e. 7, 2 and 2% importance value each. In stand 2 *Abies pindrow* and *Pinus wallichiana* were almost co-dominant species, having 57 and 39% importance value respectively. *Taxus fuana* were also associated with 4% importance value. Due to change of exposure and environment the dominance of species have changed in stand 3, here *Pinus wallichiana* was the dominant species with 87% importance value while *Abies pindrow* became associated with 13% importance value. Among three conifer species in stand 4 *Abies pindrow* attained highest importance value (60%) while *Pinus wallichiana* and *Taxus fuana* were associated with 35 & 5% importance value. In stand 5 *Abies pindrow* attained highest importance value (55%) while *Pinus wallichiana*, *Cedrus deodara* and *Juglans regia* associated with 17, 13 and 8% importance values respectively. Variation in dominance is due to change in environmental condition. Ground flora of all five sample sites was almost healthy. The most common understorey species encountered from Ayubia were *Acer caesium*, *Pteris cretica*, *Pinus wallichiana* & *Abies pindrow* seedlings, *Rubus biflorus* and *Rubus ellipticus*. Some other understorey species included *Hedera nepalensis*, *Berberis kunawurensis*, *Campanula tenuissima*, *Rosa brunonii*, *Rosa webbiana*, *Quercus incana*, *Ranunculus muricatus*, *Adiantum venustum*, *Thymus serpyllum*, *Plantago asiatica*, *Aristida cyanantha*, *Chrysopogon echinulatus*, *Gloriosa superba*, *Brassica campestris* *Podophyllum emodi* and *Geranium wallichianum*. Ground is covered with grasses, few rocks and boulders were spread over the soil surface. Mistletoe (stem parasite) present on the trunk of *Abies pindrow*. As compared to *Cedrus deodara* and *Pinus wallichiana* the seedlings of *Abies pindrow* were in lesser numbers. Soil of the forest was covered with thick humus and long grasses. Large rocks and boulders were exposed on the ground. Soil erosion is observed at initial stage at one location. Human interference prevails as seen by some cut stumps that are found in this area. . Urban litter scattered over the ground due to human interference. Cut and lopped stumps were observed. Villagers slowly and gradually cut the plants, especially conifers. Soil erosion was found on all four directions of the site.

Galyat: Seven stands were sampled in Galyat forests. Khaira Gali is also the part of Ayubia located between latitude 33° 57' North and longitude 73° 23' East with the elevation of 2730 meter in Hazara division on South-East facing exposure. Minimum soil compaction indicates the maximum humus, that facilitates closed canopy of the forest even in steep slope angle of 42°. *Cedrus deodara*, *Pinus wallichiana* and *Abies pindrow* were the dominants in Galyat forests. At Khaira Gali *Cedrus deodara* dominated with 57% importance value while *Pinus wallichiana* and *Abies pindrow* attained 30 & 13% importance value. Ground flora was very rich consisted of *Indigofera habepetala*, *Rosa webbiana*, *Rubus niveus*, *Thymus serpyllum*, *Aster molliusculus*, *Acer caesium*, *Adiantum venustum*, *Pteris cretica*, *Pleopaltis clathrata*, *Dryopteris harbegeera* and *Cymbopogon jwarancusa*. *Hedera nepalensis* seen trailing on the ground and climbing on the trunk of *Cedrus deodara*. Seedlings and saplings of *Pinus wallichiana* are very common. Few seedlings of *Abies pindrow*, *Cedrus deodara* and *Juglans regia* were recorded. Saplings of *Abies pindrow* and *Cedrus deodara* were observed but not more than *Pinus wallichiana*. Soil covered with long grasses. Some rocks are propping up, there is no soil erosion, and whole environment is healthy. In some plants of *Cedrus deodara* side branches are lopped and some cut stumps were also observed, indicating anthropogenic disturbance.

Two stands sampled in Changla Gali, located between latitude 33° 59' North and longitude 73° 23' East with the elevation of 2650 to 2670 meter in Hazara division on West & South facing exposures. Steep slope 35 to 47° causes the unavailability of nutrients to the plants resulted in open canopy forest in one stand while closed in stand 2. *Abies pindrow* was the dominant conifer species with 64% importance value while *Pinus wallichiana*, *Taxus fuana* and *Juglans regia* occupied 20, 14 & 2% importance value in stand 1 while *Pinus wallichiana* and *Abies pindrow* were the co-dominant conifer species with 57 & 40% while *Taxus fuana* associated with 3% importance value in stand 2. In stand 1 ground flora was healthy and rich. *Acer caesium* and *Dicranthium annulatum* were present in 40 & 50% of plot sampled while *Urtica dioica* and *Peris cretica* found 20 & 30% of the total plots. In stand 2 *Acer caesium* and *Sinapis arvensis* attained 83 and 67% of the plots while *Hedera nepalensis*, *Indigofera hebeptela*, *Pteris cretica*, *Adiantum venustam* and *Dicranthium annulatum* occupied 50% each of the total plots. *Hedera nepalensis* was climbing on the trunk of *Pinus wallichiana* and *Taxus fuana*. Seedlings and saplings of *Abies pindrow* and *Pinus wallichiana* were common while *Taxus fuana* and *Juglans regia* were few. Soil was covered with long grasses and dry leaves of *Pinus wallichiana*. Some rocks were exposed on the ground. Two eroded water channel were found in this stand and some cut stumps were also seen.

Two stands were sampled in Kuzah Gali, located between latitude 34° 02' North and longitude 73° 24' East with an elevation of 2560 meter in Hazara division. Slope angle was zero and 28°. One stand had moderate and other had closed canopy. In stand 1 *Cedrus deodara* attained 76% importance value while *Abies pindrow* and *Pinus wallichiana* associated with 21 & 3% importance value. In stand 2 *Abies pindrow* was the dominant species attained 57% importance value while *Pinus wallichiana* and *Cedrus deodara* associated with 26 & 17% importance value respectively. Ground flora of site 1 was not rich, only three understorey species were recorded i.e. *Acer caesium*, *Pteris cretica* and *Andropogon lancifolius* occupied 80, 60 and 40% of the plots while site 2 had *Rubus ellipticus* and *Aristida adscensionis* 100 & 80% of the plot sampled. Other plants included *Acer caesium*, *Sinapis arvensis* and *Pteris cretica* on 40% each of the plots. Few seedlings and saplings of *Pinus wallichiana* and *Abies pindrow* were observed while no seedlings and saplings of *Cedrus deodara* were recorded. Human interference was obvious which is indicated by many cut stumps and very poor ground flora.

Nathia Gali: Two stands sampled in NathiaGali, Lalazar. It is 32 km from Abbottabad as well as from Murree. Nathia Gali is 2501 meter above sea level and is surrounded by lush green lofty mountains. Nathia Gali (sampled stands) are located between latitude 34° 54' North and longitude 72° 46' East with the elevation of 2630 to 2640 meter, in Hazara division on South and North-West facing exposure. The canopy of the forest was moderate and open with 35° & 33° slope angle. *Pinus wallichiana* and *Abies pindrow* were co-dominant with 55 and 45% importance value in stand 1 while due to opposite exposure *Abies pindrow* became a dominant species with 91% importance value while *Pinus wallichiana* associated with 9% importance value. Ground flora was very rich, *Acer caesium* occurred in 70% of the plots sampled while *Rosa macrophylla*, *Rosa brunonii*, *Echinops niveus*, *Pyrus pashia* and *Andropogon loncifolius* (tall grasses) attained 30% of the plots. *Duchesnea indica* and *Rosa webbiana* were also with 14% in plot sampling in stand 1. Seedlings and saplings of *Pinus wallichiana*, *Cedrus deodara* and *Juglans regia* were observed in greater numbers. *Hedera nepalensis* was climbing on the trunk of *Pinus wallichiana*. Human disturbance is almost absent here. Ground flora of stand 2 was also very rich consisted of *Acer caesium*, *Chrysopogon echinulatus* (long grasses) and *Rosa brunonii* (100, 60 & 60% of the plots while *Quercus incana* (seedlings), *Anemone falconeri*, *Rubus ellipticus*, *Aster molliusculus*, *Echinops niveus*, *Polygala sibirica* and *Pteris cretica* (40% each of the plots). Seedlings and saplings of *Pinus wallichiana* and *Abies pindrow* were found in this stand. Human disturbance is not observed.

Thandiani: Two stands were sampled in Thandyani. It is 31 km from main Abbottabad City and 25 km from Thandiani-Nathia Gali crossing. Thandiani is located between latitude 34° 14' North and longitude 73° 22' East with the elevation of 2300 to 2320 meter in Hazara division. The canopy of the forests of both stands was moderate with 31 and 38° slope angle. Both stands sampled on south exposure. *Pinus wallichiana* attained 81% importance value while *Cedrus deodara* had 19% importance value in stand 1 while *Cedrus deodara* and *Pinus wallichiana* were the co-dominant species attained 65 & 35% importance value respectively in stand 2. Ground flora was rich. Circular plot investigation showed that *Berberis lycium* and *Rubus ellipticus* found in 100% plots while *Thymus serpyllum* and *Pteris cretica* (60% each) and *Andropogon loncifolius* (a grass), *Acer caesium*, *Echinops nivius*, *Campanula latifolia*, *Rosa brunonii*, *Rosa macrophylla* and *Hedera nepalensis* attained 40% of the plots of stand 1. Ground flora of stand 2 was also rich and covered with *Rubus ellipticus*, *Berberis lycium* and *Cymbopogon jwarancusa* occurred in 100% of the plot sampled while *Rosa brunonii*, *Andropogon loncifolius* (a grass), *Thymus serpyllum*, *Rosa brunonii*, *Asplenium adiantum* and *Bothriochloa bladhii* with low frequencies Seedlings and saplings of conifer trees were absent. Some boulders are found on the ground. Dry leaves of *Pinus wallichiana* are scattered over the ground.

F- Kaghan valley: Eleven stands were sampled in Kaghan valley. The valley extends 155 km, rising from an elevation of 2,134 feet (650 m) to its highest point, the Babusar Pass, at 13,690 feet (4,170 m). In May the temperature ranges between a maximum of 11 °C (52 °F) and a minimum of 3 °C (37 °F). From the middle of July up to the end of September the road beyond Naran is open right up to Babusar Pass. The road from Balakot ascends along the Kunhar River through lovely forests and the villages of Paras, Shinu, Jared and Mahandri. The valley is somewhat narrow along this stretch and the views are limited but as you ascend, the surrounding peaks come into view. One spot that is quite famous for its spectacular view and scenery is 'Shogran'. This village is surrounded by peaks and forests, towards the east of the main Kunhar River. It hosts the famous Sri Paye Lake mountain with breathtaking views at its top.

Shogran: It is only 10 km from village Kiwai or 34 km from Balakot. Shogran 1 is located between latitude 34° 37' North and longitude 73° 28' East. Three stands were sampled at the elevation of 2400 to 2500 meter on South-West and South exposures. Thick forest lies on 23° to 33° moderate slopes. Thick forests were identified by closed canopies. In stand 1 *Pinus wallichiana* and *Abies pindrow* attained 65 & 35% importance value respectively. In stand 2 *Cedrus deodara* attained 82% importance value while *Pinus wallichiana* and *Abies pindrow* were also associated with 10 & 8% importance values respectively. In stand 3 again *Cedrus deodara* occurred in dominating position (91% importance value) while *Picea smithiana* and *Abies pindrow* attained 5 & 4% importance values respectively. Ground flora were almost moderate, *Acer caesium* were common in all three stands while *Andropogon lancifolius* (a grass), *Rubus macilentus*, *Thymus serpyllum* (75% each in the plots), *Pteris cretica* recorded from stand 1. *Cymbopogon jwarancusa* (a grass), *Rubus ulmifolius*, *Peris cretica*, *Thymus serpyllum* and *Adiantum capillus* observed in stand 2 while *Pteris cretica*, *Aristida adscensionis*, *Rubus ellipticus* and *Hedera nepalensis* found in stand 3. Soil consists of humus, large number of mature cones and dry leaves of *Pinus wallichiana* spread over the soil surface. Ground was covered with dry leaves of *Picea smithiana*, *Pinus wallichiana* and *Cedrus deodara*. Seedlings and saplings of *Pinus wallichiana* and *Abies pindrow* were few in number, few cut stumps were also observed. Most of the plant species were cut by the residents, cut stumps were also observed which exhibit the anthropogenic disturbance.

Sri and Paye: The sampled forest at Sri and Paye is located between latitude 34° 47' North and longitude 73° 30' East. Sri is located on the elevation of 2900 while Paye on 3100 meter in district Mansehra on north and south facing exposure at 39° & 38° slope angle, respectively. Sri forest was dominated by *Picea smithiana* with 68% importance value while *Abies pindrow* attained 32% importance value. *Pinus wallichiana* was the leading dominant conifer attained 58% importance value while *Picea smithiana* and *Abies pindrow* associated with 29 & 13% importance value respectively in Paye forest. Circular plot investigation exhibited that the following species were common in both the locations i.e. *Acer caesium*, *Pteris cretica* (100% in plots), *Abies pindrow* and *Picea smithiana* seedlings. Other species that were present in Sri were *Adiantum venustum*, *Polygonum caespitosum* and *Rubus ellipticus*, *Ranunculus muricatus* and *Quercus incana* (seedlings) had fewer frequencies.

Undergrowth of Paye consists on *Rosa webbiana*, *Rubus biflorus* occupied 80 & 60% of the plots while *Thymus serpyllum*, *Sonchus asper*, and *Sinapis arvensis* in low frequencies

Seedlings and saplings of *Pinus wallichiana* and *Abies pindrow* were few in number. Soil consists of several inches of thick humus, large number of mature cones and dry leaves of *Pinus wallichiana*, *Picea smithiana* and *Abies pindrow* were scattered over the ground. Ground flora was rich, big boulders were scattered over the ground and few cut stumps were also observed.

Paras and Khanian: Sampled forest in Paras is located between latitude 34° 41' North and longitude 73° 35' East on the elevation of 1600 meter in district Mansehra on North-East exposure. In Kaghan valley; Khanian is located between latitude 34° 47' North and longitude 73° 32' East on the elevation of 2000 meter in district Mansehra on East exposure. Both the forests are occupied in closed canopy with 20° & 35° slope angle. Paras forest consisted of a mixture of conifer and angiospermic species. *Cedrus deodara* was the dominant species occupied 76% importance value while *Juglans regia* (9% importance value), *Pinus wallichiana*, *Quercus ilex* and *Quercus incana* attained 5% importance value of each. In Khanian *Cedrus deodara* was dominated with 83% importance value while *Pinus wallichiana* attained 17% importance value. Soil of Paras consists of thick humus, some rocks were also exposed on the ground. Ground flora was moderate covered with *Hedera nepalensis* trailing on the ground and seedlings of *Cedrus deodara* occurred in both forests. *Acer caesium*, *Rubus ulmifolius*, *Rosa brunonii* and *Rosa webbiana* found in Paras. *Thymus serpyllum*, *Podophyllum emodi* (cobra plants) and *Acer caesium* was the part of ground flora. *Selaginella sanguinolenta* was trailing on moist rocks in Khanian forest. Ground was littered with dry grasses and dry leaves of *Cedrus deodara*, *Pinus wallichiana* and *Quercus ilex*. Seedlings and saplings were almost absent due to human disturbance.

Shinu: Two stands sampled in Shinu, located between latitude 34° 38' North and longitude 73° 26' East on the elevation of 1900 meter in district Mansehra on North-West exposure with Moderate canopy. Stand 2 was

located between latitude 34° 38' North and longitude 73° 26' East at an elevation of 1650 meter in district Mansehra on West exposure with closed canopy. *Cedrus deodara* was in dominant position (67% importance value) while *Pinus wallichiana* was on 33% importance value in stand 1 while stand 2 was monospecific forest of *Cedrus deodara*. Ground flora was moderate. Undergrowth consists of *Acer caesium*, *Pteridium equilinum*, *Rubus biflorus*, *Ficus palmate*, *Cymbopogon jwarancusa*, *Aristida adscensionis* and *Hedera nepalensis* climbed the trunk of *Pinus wallichiana*. Seedlings of *Pinus wallichiana* and *Cedrus deodara* were very few in number but saplings were greater in number. Soil was littered with humus, dry leaves of *Cedrus deodara* and *Cymbopogon jwarancusa* (short grass). Small rocks spread over the ground. Some patches of long grasses were also seen here.

Naran valley: Three stands sampled in Naran valley, two near river belt while one at Lalazar. Naran is located between latitude 34° 53' North and longitude 73° 39' East. Stand 1 & 2 located at the elevation of 2500 meter while stand 3 on 3000 m in district Mansehra. All stands exposed on North-West. First two stands had moderate canopy while third stand had closed canopy. Slope angle of first two stands was zero while third stand lies on 45°. *Pinus wallichiana* was the dominant species with 69% importance value while *Picea smithiana*, *Cedrus deodara*, *Populus alba* and *Abies pindrow* attained low importance value in stand 1. Stand 2 and 3 were the monospecific stands of *Cedrus deodara* and *Abies pindrow* respectively. Undergrowth was poor consists of *Asplenium trichomenses*, *Tetrapogon villosus*, *Ephedra gerardiana* and *Asplenium viride* with low frequencies in stand 1 while only two understorey species were present in stand 2 i.e. *Asplenium viride* and *Aristida adscensionis*. Ground flora of Lalazar was also poor consists of *Aristida adscensionis* and *Echinops niveus*. Seedlings of *Pinus wallichiana*, *Abies pindrow* and *Cedrus deodara* were few whereas saplings of these plants were greater than seedlings. No seedlings and saplings of *Abies pindrow* were recorded from Lalazar. Large rocks were propping out from the soil surface. Some dry leaves of *Pinus wallichiana* were scattered over the ground. The plants grow near four river beds. Icy cold stream was present on either side. Ground flora was highly disturbed due to human interference and overgrazing.

Discussion

Different workers described the vegetation distribution of some parts of moist temperate areas of Himalayan region of Pakistan but no comprehensive study have been made to cover the whole area. It is the first attempt to cover the greater part of moist temperate area. The vegetation describe in this study is almost similar to that described by the other researchers, like Champion *et al.*, (1965) the major floristics is that of conifers. The main genera of conifers are *Pinus*, *Cedrus*, *Picea*, and *Abies* while *Taxus* occurs locally in as the undercanopy cover. With regard to broad-leaved species the most important genus is *Quercus* which is represented by several species while it is often associated with *Rhododendron*. Among the other common broad-leaved trees of the area are: *Acer*, *Aesculus*, *Prunus*, *Almus*, *Fraxinus*, *Ulmus*, *Corylus*, and *Alnus*. In addition, they also described the common shrubs and herbs occurring in the area. They designated the major subdivisions of the vegetation types occurring in the area, describing their floristics as well as ecological conditions. Chaghtai *et al.*, (1989) observed temporal changes in vegetation of Miranjani top, Galis, Hazara, and NWFP. They also observed the vegetation of Miranjani top has considerably changed in twelve years (1974-86). Greater changes have occurred in the vegetation on east-, west-, and south-facing aspects. Hussain and Badshah (1998) presented vegetation structure of Pirghar hills, South Waziristan, Pakistan. They investigated Phytosociological attributes, edaphic variables, temperature, importance values of species, life forms, leaf size and grass biomass. The oak forest was found in the lower part of the hills and coniferous forest (*Pinus wallichiana*, *Abies pindrow* and *Cedrus deodara*) at the upper part. Shafique (2003) described about some aspect of Bio-Ecology of Ayubia National park, Khyber Pakhtoon khwah. The park is internationally known as a hot spot in the moist temperate West Himalayan mountainous range in the sense that many endangered or threatened species are inhabited in the park. The park is purely build to protect this beautiful landscape predominantly enriched with coniferous forest (*Abies pindrow*, *Cedrus deodara*, *Pinus wallichiana*, *Picea smithiana* and *Taxus fuana*) mixed with broad-leaved evergreen (*Quercus floribunda*, *Q. glauca* and *Q. incana*) and deciduous broad-leaved trees (*Acer caesium*, *Aesculus indica*, *Cornus microphylla*, *Juglans regia*, *Populus ciliata*, *Prunus cornuta*, *Salix tetrasperma* and *Ulmus wallichiana*). Ahmed & Naqvi (2005) described the quantitative vegetation description of *Picea smithiana* from Himalayan range of Pakistan. Phytosociological attributes and absolute values are calculated. Five stands of moist temperate and dry temperate area were also included in sampling stands. They also estimated the size frequency distribution of trees of studied forests. Ahmed *et al.*, (2006) presented phytosociological and structural description of Himalayan forest (including moist temperate forests) from different climatic zones of Pakistan. They reported 24 different communities and 4 monospecific forests types on the basis of floristic composition and importance values of species. Some communities exhibited similar floristic composition but different quantitative values, description of understorey species were also recorded.

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