

QUANTITATIVE FORESTS DESCRIPTION FROM SKARDU, GILGIT AND ASTORE DISTRICTS OF GILGIT-BALTISTAN, PAKISTAN

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Abstract

A quantitative study of forest vegetation was conducted in 40 stands from three District of Gilgit-Baltistan. On the basis of phytosociological analysis and maximum important value index, following 5 pure stands and 5 communities of mixed tree species were recognized and quantitatively analyzed.

Pinus wallichiana -*Juniperus* community, *Pinus wallichiana*-*Betula* community, *Picea-Juniperus* community, *Picea-Pinus wallichiana*, *Pinus wallichiana*-*Pinus gerardiana* community, *Picea smithiana* pure stands, *Pinus wallichiana* pure stands, *Betula* pure stands, *Juniperus macropoda* pure stand and *Abies pindrow* pure stand. Eighty three plants species of various herbs, shrubs and tree seedlings were observed and identified on the forest floor. Numbers of seedlings were also counted in each stand. These important forests are existing under anthropogenic threat and environmental disturbances. Some of them may easily be managed as indicated by the presence of large number of seedling, however, stands with paucity of seedlings shall need more serious attention.

Introduction

The importance, locations and climate of District Skardu is briefly described by Akbar *et al.* (2010). Gilgit is the capital city of Gilgit-Baltistan. The city extends from 35° 55' 0" North, 74° 17' 49" East. The elevation ranges 1600 to 3000 m above sea level and area covered 3800 km². It is bounded by Afghanistan in the north, China in the northeast and east Skardu, Astore and Diamer in the south and Ghizar District to the west. Gilgit city is covered with snow mountains. The combination of three great mountains range is also situated in this District. Maximum temperature ranges from -10 to above 40 °C. In summer temperature is hot and cold in winter. The rainfall ranges from 120 to 240 mm. Population of Gilgit city is approximately 216,760 (1998 report). Administratively it is divided into four Tehsil and Shina is the main language of this District. Vegetation of Gilgit is covered with shrub/ herbs, grasses and patches of many forests on mountainous areas. The most forested areas are Jutial, Karghah, Naltar, Haramosh, Bagrot, Joglotgah, Danyore and Pahote.

Astore is one of the six districts of the Gilgit Baltistan. It is located at 35° 2'20.30"N, 75° 6'36.91"E covered by 5,092 km² area with elevation from 2600 to 3500m. Astore existed to the west by Diamer, to the north by Gilgit to the east by Skardu and to the south by Khyber-Pakhtunkhwa and Neelum District of Azad Kashmir. The population was 71,666 (1998). Climate of Astore is moderate during summer. In winter it may receive 6 inches to 3ft snow from main valleys to the mountains. The main language spoken in the valley is mostly Shina then Urdu. Due to its unique climatic conditions the valley provides excellent fauna and flora, especially economically important medicinal plants. Main forested areas of this District are Rama, Muhken, Dashken, Guhdae, Chilem and Minimarag.

First quantitative and multivariate analysis of the vegetation around Skardu was presented by Ahmed (1976), during a scientific expedition of Northern Areas of Pakistan. This was funded by Planning Commission of Pakistan, Pakistan Science Foundation and National Development and Volunteer Program of Government of Pakistan in (1973). Ahmed and Qadir (1976), Ahmed (1986, 1988) also presented phytosociological investigation from Gilgit to Shandur and Gilgit to Astor respectively, during the same expedition. Ahmed (1988), Ahmed *et al.* (1989, 1990, and 1991) carried out quantitative vegetational work at Quetta plantation, regenerating juniper, *Juniperus exelsa* and *Pinus gerardiana* forests of Baluchistan. Hussain *et al.* (1991) studied vegetation of Lesser Himalayan Pakistan. Ahmed and Naqvi (2005) and Ahmed *et al.* (2006) presented results from *Picea smithiana* forest and structure and description of various forests belonging to various climatic zones of Pakistan. Siddiqui *et al.* (2009, 2010) described *Pinus ruxburghii* and moist temperate forest of Pakistan. Wahab *et al.* (2008, 2010) and Khan *et al.* (2010) analyzed pine forests and *Monotheca buxifolia* forests of Dir District while Khan *et al.* (2010) and Ahmed *et al.* (2009) presented structure and quantitative description of *Quercus baloot* and *Olea ferruginea* forests of Chitral. Ahmed *et al.* (2010) summarized the status of vegetation analysis in Pakistan Hussain and Mustafa (1995) investigated the ecological study of plant and animal relation from Nasirabad Hunza Pakistan. Rasool (1998) worked on the protection of medicinal plants of Northern Areas of Pakistan. Shinwari and Gillani (2003) also reported the sustainable harvest of medicinal

plants from Astor. Wali and Khatoon. (2007) listed the detail of economically important species of Bagrot Gilgit. Ahmed *et al.* (2010) studied the floristic composition and communities of deodar forest from Himalayan range of Pakistan. Akbar *et al.* (2010) also studied the phytosociology and structure of Skardu District. Hussain *et al.* (2010) presented Phytosociology and structure of Central Karakorum National park.

Beside this work no detailed phytosociological investigation were carried from Skardu, Gilgit, and Astore forested area, therefore, present work is presented to explore and provide further information from 40 forested locations of these areas. This information can be used for conservation and management of forest in Gilgit-Baltistan.

Materials and Methods

PCQ method of (Cottam & Curtis 1956) was used in various forests of Skardu, Gilgit and Astore for quantitative sampling. In each stand 20 points were taken at 20-meter intervals. Vegetation sampling was carried out according to the criteria that it contained trees at least 60 cm Dbh (diameter at breast high); with no sign of recent disturbances and covering at least two hectares in area. Lower plants were neglected. Phytosociological attributes (relative density, relative frequency & relative basal area) and absolute values (density ha^{-1} and basal area of species $\text{m}^2/\text{ha}^{-1}$) were calculated, according to the method described by Mueller-Dombois & Ellenberg (1974) and Ahmed and Shaukat (2012). Geographical coordinates and aspect were recorded using GPS and angles were recorded using by slope meter. 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. The plant community was named on the basis of dominant species and the floristic composition. Using a circular plot (1.5 m diameter) at each sampling point frequency and relative frequency of tree seedling, shrubs and herbs were recorded. Plants samples were collected from the field and identified with the help of flora of Pakistan (Nasir & Ali, 1972)

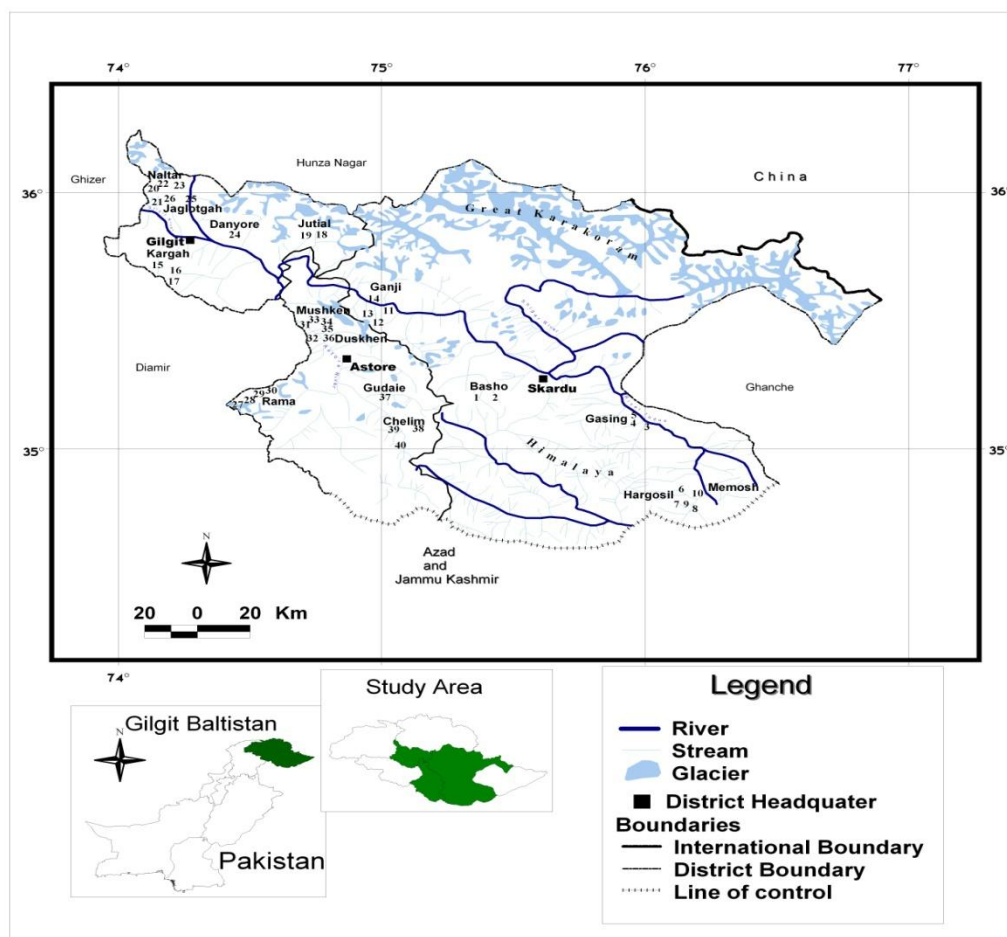


Fig. 1. Map of study area, numbers are stand numbers, for site detail refer to the Table. 1.

Results and Discussion

Geographical coordinates and other environmental characteristics of each site are given in Table.1, phytosociological attributes and absolute values are presented in Table-2 while complete list of plants are presented in Table.3. On the basis of phytosociological analysis, importance value index and floristic compositions following communities and pure stands were identified.

1. *Pinus wallichiana* -*Juniperus* community
2. *Pinus wallichiana* -*Betula* community
3. *Picea*-*Juniperus* community
4. *Picea*-*Pinus wallichiana* community
5. *Pinus wallichiana*-*Pinus gerardiana* community
6. *Picea smithiana* pure stands.
7. *Pinus wallichiana* pure stands.
8. *Betula utilis* pure stands.
9. *Juniperus macropoda* pure stand.
10. *Abies pindrow* pure stand.

1. *Pinus-Juniperus* community: This community was distributed at Skardu district (Stands 1,2,3,4,5,6,7,8,9,10, 12) with the elevation from 3414 to 3700 m. The slope angle ranged between 15° to 35° (Table.1). Due to illegal cutting the canopy was mostly open but in some areas it was closed. In few stands moderate canopy was also observed. Soil texture was silt and loamy in both Basho and Gasing. Ground surface was covered with dense vegetation but mostly the trees were tilted and disturbed due to higher elevation and snow fall for the larger part of the year. In Memosh and Hargosil, soil erosion was rampant. Boulders were scattered in all stands. *Pinus wallichiana* was the first dominant species with importance value ranging from 63.2 to 93%, density from 73.34 to 180/ha and basal area 1 to 42.38 m²/ha. Second dominant species was *Juniperus excelsa* with importance value ranging between 12.2 to 24.4%, 7.68 to 129.3/ha density and 0.7 to 14.63m²/ha basal area. *Betula utilis* appeared in seven stands (3,4,5,8,9,10,12) with 4.36 to 34.39% importance value, 3.2 to 159.4/ha density and 0.22 to 2.35m²/ha basal area. Understorey flora comprised of 57 species including herbs, shrubs and seedlings of tree species. *Anaphalis nepalensis*, *Astragalus zanskarensis*, *Berberis orthobotrys*, *Heracium lanceolantum*, *Oxyria digyna*, *Pinus wallichiana*, *Potentilla anserina*, *Rosa webbiana*, *Tanacetum artiemisiodes*, *Taraxacum baltistanicum*, *Thymus linearis*, and *Lentopodium himalayanum* were frequently distributed in all the stands. *Tanacetum fruticosum* was only found in Basho-B (Stand-2) while 70% similarities were found in others floristic composition among stands.

Table 1. Characteristics of sampling sites of Skardu, Gilgit and Astore Districts

Stn	Main Location and sites	Lat	Long	Ele	Slope		Canopy
		(N)	(E)	(M)	Aspect	(°)	
Skardu District							
1	Basho-A	35.17	75.38	3700	NE	35	Mdr
2	Basho-B	35.17	75.38	3550	NE	30	Opn
3	Gasing-A	35.09	75.98	3500	E	25	Mdr
4	Gasing-B	35.09	75.98	3400	W	20	Cls
5	Gasing-C	35.09	75.98	3600	N	27	Opn
6	Hargosil-A	34.75	76.14	3586	E	20	Sct
7	Hargosil-B	34.68	76.15	3463	N	15	Opn
8	Memosh-A	34.71	76.18	3463	NE	35	Opn
9	Memosh-B	34.72	76.17	3414	E	30	Opn
10	Memosh-C	34.73	76.18	3477	E	23	Mdr
11	Ganji-A	35.56	74.98	3310	SE	15	Cls

Table 1. Continue...

12	Ganji-B	35.56	74.98	3472	SW	35	Cls
13	Ganji-C	35.56	74.98	3585	SE	37	Cls
14	Ganji-D	35.60	74.96	3374	SE	35	Cls
Gilgit District							
15	Kargah-A	35.76	74.17	3255	NE	43	Mdr
16	Kargah-B	35.74	74.19	3427	E	33	Opn
17	Kargah-C	35.72	74.18	3216	SE	25	Opn
18	Jutial-A	35.90	74.75	3250	N	40	Mdr
19	Jutial-B	35.90	74.74	3250	N	40	Mdr
20	Naltar-A	36.09	74.11	2930	S	36	Mdr
21	Naltar-B	36.08	74.11	3401	S	40	Mdr
22	Naltar-C	36.11	74.18	2893	Pln	5	Mdr
23	Naltar-D	36.11	74.18	2893	Pln	5	Mdr
24	Danyore	35.90	74.42	3736	NE	45	Opn
25	Joglotgah-A	36.07	74.24	3523	W	35	Mdr
26	Joglotgah-B	36.07	74.22	3055	Pln	5	Mdr
Astore Distrit							
27	Rama-A	35.20	74.48	3508	NE	40	Opn
28	Rama-B	35.20	74.48	3464	NW	45	Mdr
29	Rama-C	35.20	74.48	3275	S	35	Opn
30	Rama-D	35.20	74.48	3016	S	15	Mdr
31	Mushken-A	35.49	74.72	2691	E	40	Mdr
32	Mushken-B	35.48	74.73	2719	SE	35	Cls
33	Mushken-C	35.48	74.74	2659	NE	25	Cls
34	Mushken-D	35.48	74.74	3078	NE	40	Mdr
35	Mushken-E	35.49	74.75	2639	NE	30	Opn
36	Dashken	35.46	74.77	2616	E	45	Mdr
37	Gudaie	35.17	74.97	3775	N	50	Cls
38	Chelim-A	35.03	75.10	3458	SE	45	Cls
39	Chelim-B	35.01	75.07	3559	E	40	Mdr
40	Chelim-C	35.00	75.06	3596	E	20	Sct

Note: Stn= Stand number Lat=Latitude, Long=Longitude, Ele=Elevation, Opn=open, Mdr=Moderate, Sct=Scatted, Cls=Close , Pln=Plain

2. *Pinus-Betula* community: This community was recorded from Ganji,C and D on South East facing slope in District Skardu with close canopy and Chelim,B on East facing in District Astore with moderate canopy. *Pinus wallichiana* appeared as dominant species attending from 71.35 to 82.6% IVI, 70.51 to 168.5/ha density and 6.77 to 16.8m²/ha basal area while the co-dominant angiospermic tree *Betula utilis* showed IVI from 28.65 to 39.77%, density 29.49 to 63.91/ha and from 2.63 to 3.68 m²/ha basal area. The slope angle ranged from 35° to 40° and elevation ranged from 3374 to 3585 m.

As far as ground flora of these three locations is concerned *Bergenia stracheyi*, *Lenotopodium sp*, *Bistorta affinis*, and *Potentilla sp* commonly distributed in all stands but in Chelim C (Stand-40) *Solidigo vlgaurea*,

Tanacetum falconeri, *Sedum sp*, and *Polygonum alpinum* recorded and *Berberis orthobotrys* was found only in Ganji .C(Stand-13).

3. *Picea-Juniperus* community: This community was situated in two location of sampling area Jutial-A on North facing with 40° slope at District Gilgit while another was found in Dashken district Astore on East facing with 45° slope angle. The canopy was moderate in both stands. The elevation ranged from 2616-3150 m, *Picea smithiana* showed higher IVI ranged from 70.25 to 82.6%, density 78.2-161.7/ha while co-dominant *Juniperus excelsa* contained from 29.75 to 39 to 77% IVI, 29.66 to 73.51/ha density and 1.66 to 14.05 m²/ha basal area.

Thirty species including seedling of dominant tree species were observed from the ground floor surface of these sampling site in which few species like *Picea smithiana* seedlings, *Lentopodium sp*, *Fragaria nubicola*, *Geranium pratense*, and *Anaphalis virgata* were found in both stands .Jutial-A (stand-18) sampling site indicated quite different species composition in which *Thymus sp*, *Urtica dioica*, *Viola rupestris*, *Bistorta affinis*, *Berginia stracheyi* and grasses were abundant in 80% circular plot. There were no any seedlings of co-dominant tree species in circular plots.

4. *Picea-Pinus* community: This community was distributed at Rama-C (Stand-29) on south facing with 45° slopes and at Mushken (Stand-32) on South East facing with 35° slopes. The canopy was closed in Mushken while in Rama it was open due to illegal cutting. The elevation ranged from 2719 to 3275 m. Ground surfaces was covered with dense vegetation in Rama where as scattered boulders and dead fallen trees were observed in Mushken. *Picea smithiana* attained from 38.16 to 61.04% IVI, 43.05 to 45.24/ha density and 3.57 to 3.18 m²/ha basal area while in this community *Pinus wallichiana* showed from 38.96 to 61.84% IVI, from 23.05-94.71/ha density and 3.17 to 5.96 m²/ha basal area.

During the ground flora analysis, 16 plants species were recognized in which *Fragaria nubicola*, *Geranium sp*, *Taraxacum sp*, *Trifolium sp*, *Urtica dioica*, and *Viola ruperstris* was common in both stands. *Potentilla anserina*, *Colutea nepalensis*, *Lonicera coerulea*, *Ribes alpestre*, *Rubus irritans*, *Rumex sp*, and seedlings of trees was found only in Mushken while *Inula rhizocephala*, *Juniperus communis*, and *Lentopodium sp*, were recorded in Rama.

5. *Pinus wallichiana-Pinus gerardiana* community: Mushken E sampling site (Stand-35) situated on North East facing with 30° slopes. The canopy was open at 2639 m above sea level. *Pinus wallichiana* attained 63.4% IVI, 56.04/ha density and 6.02 m²/ha basal area while the co-dominant species *Pinus gerardiana* received 36.3% IVI, 41.41/ha Density with (1.9 m²/ha) basal area.

Table 2. Phytosociological attributes, rank, and absolute values of 40 stands in District Skardu, Astore and Gilgit

Main Location and sites	Name of Species	Phytosociological Attributes				Rank	Absolute Values	
		R.F	R.D	R.B.A	IVI		D/ha ⁻¹	BAm ² ha ⁻¹
Stn. Skardu District								
1. Basho-A	<i>Pinus wallichiana</i>	75.3	91.7	96.66	87.8	1 st	184.3	42.38
	<i>Juniperus excelsa</i>	24.2	8.93	3.34	12.2	2 nd	18.06	14.63
2. Basho- B	<i>Pinus wallichiana</i>	77.8	92.5	91.32	87.3	1 st	159.5	32.39
	<i>Juniperus excelsa</i>	22.2	7.14	8.67	12.7	2 nd	12.26	3.09
3. Gasing-A	<i>Pinus wallichiana</i>	49.2	67.6	73.73	63.2	1 st	132	16.17
	<i>Juniperus excelsa</i>	35.8	21.3	16.67	24.4	2 nd	41.69	3.7
	<i>Betula utilis</i>	15.7	10.1	10.59	12.4	3 rd	20.83	2.35
4. Gasing-B	<i>Pinus wallichiana</i>	39.3	35.1	39.12	28.1	2 nd	141.7	10.38
	<i>Juniperus excelsa</i>	30.8	24.1	11.41	22.2	3 rd	95.63	3.02
	<i>Betula utilis</i>	29.7	40.7	49.46	39.7	1 st	159.4	13.12
5. Gasing-C	<i>Pinus wallichiana</i>	19.4	11.1	11.32	14	2 nd	18.88	1
	<i>Juniperus excelsa</i>	59.7	79.6	77.95	72.3	1 st	129.3	6.93

Main Location and sites	Name of Species	Phytosociological Attributes				Rank	Absolute Values	
		R.F	R.D	R.B.A	IVI		D/ha ⁻¹	BAm ² ha ⁻¹
6.Hargosil- A	<i>Betula utilis</i>	21.7	8.92	10.73	13.6	3 rd	14.51	0.95
	<i>Pinus wallichiana</i>	73.8	88.9	91.94	84.7	1 st	73.34	7.97
	<i>Juniperus excelsa</i>	26.1	11.1	8.05	15.3	2 nd	9.65	0.7
7. Hargosil- B	<i>Pinus wallichiana</i>	87.5	94.64	96.94	93	1 st	38.78	5.26
	<i>Juniperus excelsa</i>	12.9	5.36	3.05	6.76	2 nd	3.2	0.17
8.Memosh-A	<i>Pinus wallichiana</i>	75	88.9	80.83	81.4	1 st	113.9	17.35
	<i>Juniperus excelsa</i>	16.6	8.92	17.05	14.2	2 nd	11.49	3.65
	<i>Betula utilis</i>	8.33	2.67	2.1	4.36	3 rd	3.44	0.45
9. Memosh-B	<i>Pinus wallichiana</i>	75.8	91.6	91.96	86.5	1 st	158.4	26.6
	<i>Juniperus excelsa</i>	13.1	4.46	5.76	7.93	2 nd	7.68	1.66
	<i>Betula utilis</i>	10.2	3.57	2.28	5.36	3 rd	6.15	0.22
10. Memosh- C	<i>Pinus wallichiana</i>	68.9	85.1	85.3	79.8	1 st	180	21.74
	<i>Juniperus excelsa</i>	22	10.1	7.82	13.5	2 nd	22.49	3.35
	<i>Betula utilis</i>	9.75	3.57	6.78	6.7	3 rd	7.49	1.43
11. Ganji -A	<i>Pinus wallichiana</i>	100	100	100	100	Pure	308.92	36.02
12.Ganji-B	<i>Pinus wallichiana</i>	48.57	46.25	56.27	50.4	1 st	99.06	12.16
	<i>Betula utilis</i>	31.43	36.25	35.52	34.4	2 nd	77.64	7.67
	<i>Juniperus excelsa</i>	20	17.5	8.213	15.3	3 rd	37.48	1.77
13.Ganji-C	<i>Pinus wallichiana</i>	70.83	75.5	83.76	75.1	1 st	168.5	16.8
	<i>Betula utilis</i>	29.17	27.5	16.24	24.9	2 nd	63.91	3.83
14.Ganji-D	<i>Pinus wallichiana</i>	65.51	67.5	81.02	71.4	1 st	102.6	11.23
	<i>Betula utilis</i>	34.48	32.5	18.98	28.7	2 nd	49.41	2.63
District Gilgit								
15.Kargah-A	<i>Picea smithiana</i>	100	100	100	100	Pure	91.58	34.48
16.Kargah-B	<i>Picea smithiana</i>	100	100	100	100	Pure	106.3	13.84
17.kargah-C	<i>Pinus wallichiana</i>	100	100	100	100	Pure	99.2	10.15
18.Jutial-A	<i>Picea smithiana</i>	62.5	68.75	79.51	70.3	1 st	161.7	56.25
	<i>Juniperus excelsa</i>	37.5	31.25	20.49	29.8	2 nd	73.51	14.25
19.Jutial-B	<i>Picea smithiana</i>	100	100	100	100	Pure	104.5	14.04
20.Naltar-A	<i>Picea smithiana</i>	100	100	100	100	Pure	237.4	51
21.Naltar ,B	<i>Betula utilis</i>	100	100	100	100	Pure	96.3	10.81
22.Naltar-C	<i>Pinus wallichiana</i>	100	100	100	100	Pure	112.9	6.99
23.Naltar-D	<i>Betula utilis</i>	100	100	100	100	Pure	73.81	6.33
	<i>Juniperus macropoda</i>	100	100	100	100	Pure	125.7	10.08
25.Joglotgah-A	<i>Picea smithiana</i>	100	100	100	100	Pure	216.3	17.33
26.Jogloygah-B	<i>Betula utilis</i>	100	100	100	100	Pure	121.8	7.07
District Astore								
27.Rama-A	<i>Betula utilis</i>	100	100	100	100	Pure	105.7	4.99
28.Rama-B	<i>Abies pindrow</i>	100	100	100	100	Pure	107.4	7.87
29.Rama-C	<i>Picea smithiana</i>	60.04	66.25	64.24	61	1 st	45.24	3.18

Main Location and sites	Name of Species	Phytosociological Attributes				Rank	Absolute Values	
		R.F	R.D	R.B.A	IVI		D/ha ⁻¹	BAm ² ha ⁻¹
	<i>Pinus wallichiana</i>	38.96	33.75	35.76	39	2 nd	23.05	3.17
30.Rama-D	<i>Pinus wallichiana</i>	100	100	100	100	Pure	115.3	11.14
31.Mushken-A	<i>Pinus wallichiana</i>	100	100	100	100	Pure	98.43	8.39
32.Mushken-B	<i>Pinus wallichiana</i>	54.29	68.75	62.5	61.8	1 st	94.71	5.96
	<i>Picea smithiana</i>	45.71	31.25	37.5	38.2	2 nd	43.05	3.57
33.Mushken-C	<i>Pinus wallichiana</i>	100	100	100	100	Pure	156.3	14.74
34.Mushken-D	<i>Pinus wallichiana</i>	100	100	100	100	Pure	142.1	13.25
35.Mushken-E	<i>Pinus wallichiana</i>	51.61	57.5	81.09	63.4	1 st	56.04	6.02
	<i>Pinus gerardian</i>	48.39	42.5	18.89	36.6	2 nd	41.41	1.9
36.Dashken	<i>Picea smithiana</i>	58.82	72.5	81.8	71	1 st	78.2	7.48
	<i>Juniperus excelsa</i>	41.18	27.5	18.2	29	2 nd	29.66	1.66
37.Gudaie	<i>Pinus wallichiana</i>	100	100	100	100	Pure	146.6	10.36
38.Chelim-A	<i>Pinus wallichiana</i>	100	100	100	100	Pure	180.1	8.73
39.Chelim-B	<i>Pinus wallichiana</i>	59.38	67.5	84.65	82.6	1 st	70.51	6.77
	<i>Betula utilis</i>	40.63	32.5	15.35	39.8	2 nd	29.49	1.23
40.Chelim-C	<i>Pinus wallichiana</i>	100	100	100	100	Pure	92.28	5.37

Note: R.F= Relative Frequency, R.D = Relative density, R.B.A = Relative Basal area, IVI= Importance value Index, D/ha⁻¹=Density/hectar of species, BAm²ha⁻¹=Basal area of species m²/hectar, 1st = First dominant species, 2nd= Second dominant species, 3rd= Third dominant species, Stn = Stand numbe

Table 3. List of Plants and families associated with dominant tree species of the study area.

S.No	Name of Plants species	PRST	RF in stands (range)	Family
1	<i>Acantholimon lycopodioides</i> (Girad) Boiss.,	6	2.2---5.2	Plumbaginaceae
2	<i>Acnotium heterophyllum</i> Wall.ex.Royle,	1	0---3.8	Ranunculaceae
3	<i>Anaphalis nepalensis</i> (spreg.) Hand.	13	1.1---13	Compositae
4	<i>Anaphalis virgata</i> T.T.ex Clarke	8	1.5---11.3	Compositae
5	<i>Aquilegia moorcroftiana</i> Wall.ex <i>Artemisia brevifolium</i> (Wall.ex DC)	2	0.7---1.8	Ranunculaceae
6	Ling &Y.R.Ling	10	2.7---15.3	Compositae
7	<i>Artemisia obsinthium</i> L.	1	0---5	Compositae
8	<i>Aster sp</i>	1	0---3.8	Compositae
9	<i>Astragalus gilgitensis</i> Ali,	1	0---3.0	Fabaceae
10	<i>Astragalus rhizanthus</i> Royle exBth.	6	1.8---6.87	Fabaceae
11	<i>Astragalus zanskarensis</i> Bth.ex Bunge,	19	0.9---12	Fabaceae
12	<i>Berberis lycium</i> Royle	3	1.9---3.3	Barberidaceae
13	<i>Berberis orthobotrys</i> Bien ex Aitch.,J.L.S	7	0.9---9.7	Barberidaceae
14	<i>Bergenia stracheyi</i> (H. &T.) Engl.	17	1.5---16.2	Barberidaceae
15	<i>Betula utilis</i> D.Don,	7	1.0---7.0	Betulaceae
16	<i>Bistorta affinis</i> (D.Don) Green	16	2.2---15.1	Polygonaceae

S.No	Name of Plants species	PRST	RF in stands (range)	Family
17	<i>Cerastium alpinum</i>	1	0---2.8	Celastraceae
18	<i>Cicer songaricum</i> Steph.ex DC.,	12	2.0---7.8	Fabaceae
19	<i>Colutea nepalensis</i> Sims,	2	2.2---4.8	Fabaceae
20	<i>Corydalis moorcroftiana</i> Wall.ex H.&T.	2	2.4---4.4	Fumariaceae
21	<i>Cotoneaster integerrima</i> Medik.,	3	1.5---6.5	Rosaceae
22	<i>Daphne oleoides</i> Scherb.,	3	1.9---10	Thyaleaceae
23	<i>Delphinium brunonianum</i> Royle,	2	1.8---2.8	Ranunculaceae
24	<i>Dictyolimon macrorrhados</i> (Boiss.) Rech.f.	3	1.5---3.2	Plumbaginaceae
25	<i>Ephedra gerardiana</i> Wall ex Stapf,	4	0.9---2.3	Caryophyllaceae
26	<i>Ephedra tibetica</i> Stapf,	3	2.1---4.8	Caryophyllaceae
27	<i>Epilobium angustifolium</i> L.,	3	0.9---1.9	Ornagraceae
28	<i>Erigeron multicaulis</i> Wall.ex DC.,	3	1---3	Compositae
29	<i>Fragaria nubicola</i> Lindl.ex Lacaita	25	3.8---17.5	Rosaceae
30	<i>Geranium pratense</i> L.,	27	0.7---17.2	Geraniaceae
31	<i>Geranium wallichianum</i> .D.Don .ex Sweet,	4	6.0---15	Geraniaceae
32	<i>Hieracium lanceolatum</i> Hk.,f.,	9	0.9---10.4	Compositae
33	<i>Hippophae rhamnoides</i> L.,	6	0.9---3.6	Elaeagnaceae
34	<i>Impatiens balfourii</i> Hook.f.	6	1.6---9.0	Balsaminaceae
35	<i>Inula rhizocephala</i> Wend,	9	1.5---12.2	Compositae
36	<i>Juniperus communis</i> L.	23	1.2---13.7	Cupressaceae
37	<i>Juniperus excelsa</i> M.B.,	3	1.9---7.6	Cupressaceae
38	<i>Juniperus macropoda</i> H.k.f.,	1	0---3	Cupressaceae
39	<i>Leontopodium himalayanum</i> D.C., <i>Leontopodium leontopodium</i> (DC)	10	3---14.9	Compositae
40	Hand.Mazz.,	19	3.7---17.1	Compositae
41	<i>Leonurus cardiaca</i> L.,	3	3.1---4.7	Labiatae
42	<i>Lonicera coerulea</i> L.	2	6.6---13.6	Caprifoliaceae
43	<i>Mentha longifolia</i> (L.) Huds.,	4	3.9---6.6	Labiatae
44	<i>Myostis asiatica</i> Schischk.&Serg.,	7	1.0---11.2	Boraginaceae
45	<i>Nepeta discolor</i> Role ex Bth.	10	1.5---10	Labiatae
46	<i>Oxyria digyna</i> (L.) Hill,	13	2.2---13.2	Polygonaceae
47	<i>Picea smithiana</i> (Wall.) Boiss.	6	2.2---5	Pinaceae
48	<i>Pinus wallichiana</i> A.B. Jackson <i>Podophyllum hexandrum</i> (Royle)	12	1.0---13.9	Pinaceae
49	Chatt.Mukh.,	2	1.1---2.9	Berberidaceae
50	<i>Polygonum alpinum</i> All.,	4	2.8---8.8	Polygonaceae
51	<i>Potentilla anserina</i> L.,	23	4.9---13.2	Rosaceae
52	<i>Pseudomertensia echioides</i> Riedl	3	3.1---5.2	Boraginaceae
53	<i>Rheum tibeticum</i> Maxim.ex Hk.f.,	8	1.1---5.4	Polygonaceae
54	<i>Rheum webbianum</i> Royle,III.	3	2.9---4.5	Polygonaceae
55	<i>Ribes alpestre</i> Dcne.exJacq.,	12	1.2---8.3	Grossulariaceae
56	<i>Ribes himalensis</i> Royle,	2	1.9---4.1	Grossulariaceae

S.No	Name of Plants species	PRST	RF in stands (range)	Family
57	<i>Ribes orientale</i> Desf.,	13	1.0---11.3	Grossulariaceae
58	<i>Rosa webbiana</i> Wall.ex Royle,	31	0.9---10.6	Rosaceae
59	<i>Rubus irritans</i> Hk.f.,	8	0.9---12.1	Rosaceae
60	<i>Rumex dentatus</i> L.	4	2.8---12	Polygonaceae
61	<i>Rumex hastatus</i> D.Don,	9	2---8.3	Polygonaceae
62	<i>Saxifraga flagellaris</i> Willd.	1	0---7.6	Saxifragaceae
63	<i>Sedum quadrifidum</i> Pall.,Reise	2	3.3---4	Carsulaceae
64	<i>Silene moorcroftiana</i> Wall.ex Bth.	6	0.9---7.5	Umbelliferae
65	<i>Silene vulgaris</i> (Moench) Garcke,	6	0.9---7.2	Umbelliferae
66	<i>Soldigo virgaurea</i> L.Sp.Pl.	3	8.8---10.7	Compositae
67	<i>Spiraea canescens</i> D.Don,	9	1---5.4	Rosaceae
68	<i>Swertia petiolata</i> D.Don,	2	2.7---2.8	Gentianaceae
69	<i>Tamarix indica</i> Willd.,	3	0.9---1.9	Tamaricaceae
70	<i>Tanacetum falconerii</i> Hk.f.,	2	3.6---5.8	Compositae
71	<i>Tanacetum artemisioides</i> Sch.Bip.exHk.f.,	14	1.2---15.2	Compositae
72	<i>Tanacetum fruticulosum</i> Clarke,	1	0---3.7	Compositae
73	<i>Taraxacum</i> sp	16	1.2---10.5	Compositae
74	<i>Taraxacum baltistanicum</i> v.Soet	10	2---10	Compositae
75	<i>Thalictrum alpinum</i> L.	3	8.2---9.8	Ranunculaceae
76	<i>Thymus linearis</i> Benth.,	6	6.2---15.1	Labiatae
77	<i>Thymus serpyllum</i> L.	19	2.8---18	Labiatae
78	<i>Tragopogon orientalis</i> L.	2	6.5---7.7	Compositae
79	<i>Trifolium partense</i> L.	8	1.1---7.3	Fabaceae
80	<i>Trifolium repens</i> L.	12	1.8---11.2	Fabaceae
81	<i>Urtica dioica</i> L.	17	1.0---15.2	Urticaceae
82	<i>Verbascum thapsus</i> L.Sp.Pl.	7	1.0---5.5	Verbenaceae
83	<i>Viola rupestris</i> F.W.Schm.,	15	1.9---15	Violaceae

Note: PRST =Number of stand in which a species occur, RF= Relative frequency

A total of 10 species of ground flora were recorded in this community but 80% forest floor was covered with *Fragaria nubicola*, *Geranium* sp, *Lonicera coerulea*, *Rosa webbiana*, *Tanacetum artemisioides*, *Thymus* and seedlings of *Pinus wallichiana*.

6. *Picea smithiana* pure stands: *Picea smithiana* pure forest was distributed in five sites i.e.Stand-15, 16, 19, 20, 25.The elevation ranged from 2993-3275 m while slope ranged between 5° to 43°.The canopy was open in (Stand-16) while moderate in others. In these stands *Picea* was recorded as single dominating species. In these locations *Picea smithiana* density ranged from 91.58 to 237.4 /ha with 13.84 to 51 m²/ha basal area.

Under these stands composition of ground flora comprised of 42 species including seedlings the of *Picea smithiana*. In these sampling site floristic configurations was 20% similar. In all stands *Fragaria nubicola*, *Rosa webbiana*, *Ribes* sp, and *Rumex* sp found in 40 to 70%, plots. (Stands-16, 19, 20, 25) while *Urtica dioica* was recorded in 50 to 80% circular plots.

7. *Pinus wallichiana* pure stands: These pure stands of *Pinus wallichiana* was distributed in 10 different locations (11, 17, 22, 30,31,33,34,37,38,40 stands).These stands were situated at the elevation ranging from 2691 to 3775 m and 5° to 50° slope. *Pinus wallichiana* pure stands were most prominent in Skardu and Astore District where density ranged from 92 to 180 /ha with 8.72 to 36.02 m²/ha basal area.

During the analysis of ground flora 56 species were recorded. Among them *Geranium* sp, *Lentopodium* sp, *Rosa webbiana*, *Thymus* sp and *Viola* sp were recorded in all stands while *Ribes himalyansis* was recorded in Ganj-A (Stand-11), *Acantholimon lycopodioides* in Kargah-C (Stand-17), *Polygonium alpinum*, *Acnotium heterophyllum*, *Swertia petiolata*, *Saxifraga flagellaris* and *Dalphonium brononium* found in Chelim-A,C(Stand-38,40). In Gudaie (Stand-37) *Oxyria digyna* and *Happophae rhamnoides* were present and *Lonicera coerulea* was recorded only in Mshken-D (Stand-34). *Impatiens balfourii* and *Hieracium lanceolantum* found only in Mshken-A (Stand-31) seedling of *Pinus wallichiana* was also present in these stands

8. *Betula utilis* pure stands: *Betula utilis*, in a pure form is distributed in Naltar A (Stand-21) on South facing Naltar D (Stand-23) Plain, Joglotgah (Stand-26) Plain and Rama A (Stand-27) on North East facing. The elevation ranged from 3055 to 3508 m while degree of slope ranged between 5° to 40°. The canopies were open in Rama while others showed moderate. In Joglotgah dead and fallen trees were present, soil was sandy Huge cutting was observed there fore land sliding was common while in Naltar soil was loamy, and over grazing was recorded. In Rama (Stand-27) ground surface was covered with dense vegetation with loamy soil. The density of *Betula utilis* ranged from 73.81 to 121.8/ha with 4.99 to 10.81 m²/ha basal area.

Ground flora of these sampling site composed of 26 plant species including seedlings of *Betula utilis* eleven species *Anaphalis nepalensis*, *Bergenia stracheyi*, *Bistorta affinis*, *Fragaria nubicola*, *Geranium pratense*, *Inula rhizocephala*, *Ribes* sp, *Thymus* sp, *Urtica dioica*, *Viola ruperstris* and seedling of *Betula utilis* similar and occupied 42% of circular plot. *Happophae rhamnoides* and *Acantholimon lycopodioides* were recorded only in Joglotgah B (Stand-27) while *Oxyria digyna* found in Rama A only (Stand-27).

9. *Juniperus macropoda* pure stand: This unique pure stand was recorded only one location of sampling area Danyore Stand-24) on the North East facing, steep slope 45° with open canopy at 3736m above sea level this location is very important due to the population of endangered wild animal species *Capra falconeri* (Markhor) and *Juniperus macropoda* is one of the favorite food of Markhre. *Juniperus macropoda* attained density 125.7/ha with 10.08 m²/ha basal area.

The ground surface of this stand was lush green covered with dense vegetation, cut stem, burning, soil erosion and bad shaped tree were also present in this site. Ground flora comprised of fourteen plant species among them *Acantholimon lycopodioides*, *Anaphalis nepalensis*, *Artimisia brevifolium*, *Bistorta affinis*, *Leontopodium* sp, *Potentilla anserina* and *Rubus irritans* in abundant. The seedlings of *Juniperus macropoda* were also recorded in ground flora.

10. *Abies pindrow* pure stand: This species formed pure stand only in District Astore on North West exposure with moderate canopy and 30° degree of slope at 3464 m above sea level. *Abies pindrow* showed density of 107.4/ha with 7.87 m²/ha basal area.

During the analysis of ground flora total fifteen plant species were identified among them *Bergenia stracheyi*, *Fragaria nubicola*, *Geranium* sp, *Juniperus communis*, *Lonicera coerulea*, *Nepeta* sp, *Polygonium alpinum*, *Rosa webbiana*, *Solidago virgaurea* and *Thalictrum alpinum* were frequently found in circular plots.

Like other forested areas of Pakistan these forested areas are also under the severe anthropogenic pressure i.e. cutting, over grazing, urbanization and climatic change. These areas are included under dry temperate area. According to Ahmed *et al* (2006) *Pinus wallichiana* and *Abies pindrow* are characteristic of moist temperate area while *Picea smithiana* leading to dry temperate area but due to the wide ecological amplitude these species are distributed in both dry and moist temperate. *Pinus gerardiana* and *Juniperus* species are restricted to drier sites of dry temperate area Ahmed *et al*. (1990, 1991). In this area both species occupied timber line area (elevation about 3700 m) where moisture is limiting factor in contrast to *Betula utilis* and *Pinus wallichiana* which prefer moisture on fire line.

Many stands showed seedlings of tree species indicating regeneration potential despite the illegal cutting and over grazing. These stands or forests could easily be saved by better planning and management, however stands without regenerating seedlings indicating the presence of disturbance. Therefore, it is suggested that if present disturbance continued, these forests will vanish within a few decades. Serious and immediate action plan to save these forests is recommended. Besides tree species, shrub/herbs and grasses should also be saved due to their ecological and medicinal importance.

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