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A PHYTOSOCIOLOGICAL STUDY OF PINE FORESTS FROM DISTRICT DIR, PAKISTAN

[1]Muhammad Wahab, [1]Moinuddin Ahmed, [1]Nasrullah Khan and [2]Atta Mohammad Sarangzai

[1]*Department of Botany, Federal Urdu University of Arts, Science & Technology ,Gulshan-e-Iqbal Campus, Karachi 75300, Pakistan.*
[2]*Department of Botany, University of Balochistan, Quetta, Pakistan*
*Author's E-mail: m_wahabdir@yahoo.com,

ABSTRACT

Phytosociological study was conducted in pine forests throughout district Dir. Point centered quadrate method was used for sampling and twenty five pine forests were sampled between elevation ranges 1400-2672 meters above mean sea level. Phytosociological attributes (frequency, density, basal area, importance value) and absolute values (Density.ha^{-1} and Basal area m^{2}ha^{-1}) were calculated for each species and the forest respectively. A total of six pine tree species belonging to 2 families and 5 genera were recorded from various stands at different altitudes, exposure and degree of slopes. Among the tree species *Cedrus deodara* (Roxb. Ex Lamb) G.Don was the dominant tree species recorded in fourteen stands followed by *Pinus wallichiana* A.B. Jackson which showed presence in eight stands. *Abies pindrow* Royle, and *Picea smithiana* (Wall.) Boiss were recorded from high elevation and occurred in three and six stands respectively. Lower elevation supports *Pinus roxburghii* Sargent forests while *Taxus wallichiana* (Zucc.) was rarely associated with deodar only in one stand. It was recorded that most of the forest stands exhibited open canopies due to the over exploitation of forests for timber purposes. Ten communities were recognized based on the importance values and floristic composition of the stands. *Pinus wallichiana*- Deodar Community was the most widely distributed community of the study area.

Key Words: P hytosociological attributes, district Dir, *Cedrus deodara, Pinus wallichiana and Abies pindrow*

INTRODUCTION

District Dir is located in Hindukush range of western Himalayas; consisting of two districts Upper and Lower Dir. It lies between 34.65° to 35.81° North latitudes and 71.52° to 72.52° East longitudes. The district is bounded by Swat in the East while Afghanistan and Bajour Agency in the West. In the North Chitral and in the south Malakand Agency is situated (Fig.1). Panjkora River rises in the northern high mountains of the distict. It flows toward south along Chitral Peshawar road and joins the Swat river in Malakand district. The mean elevation of the study area ranges about 760 to 3100 meters above sea level. The area is mostly mountainous consists of different types of parent materials such as residual and alluvial materials constitute the soil of the area. Major type of rocks includes igneous, sedimentary and metamorphic and their various sub types. The soil depth varies from very shallow or rocks exposed on the foothills slopes while the deep soils found the riversides, terraces and some foothills.

The climate of the area is broadly described as continental, which is hot during summer and cold in winter. The climate varies considerably between the north and south due to elevation differences. The temperature increases gradually from January to June and then gradually decreases upto December. The area is generally comprised by four season's i.e. Spring, summer, autumn and winter. However, summer and winter are the two distinct seasons. The summer season is moderate and warm; June and July are the hottest months. Winter season is cold and severe usually in the months of December and January. The only Meteorological observatory of the area is established at Dir Upper.

According to their recorded climate data since 1976-2005, in June the mean maximum and minimum temperature has been recorded 34.4°C and 11.5°C, respectively. The average rainfall receives more in winter as compare to other seasons. The maximum average rainfall in March is 269.6 mm (Fig.2).

Various workers have presented quantitative investigations and described various plants communities from different part of the country, Champion *et al* (1965), and Beg and Khan (1984), carried out the present and future status of dry Oak forest in Swat. Beg (1974) and Khan (1978) also conducted vegetational and phytosociological investigations in Chitral Gol and recognized different plant communities. Recently Ahmed *et al* (2009) analyzed only *Olea ferruginea* forest in various graveyards of District Dir. Vegetation structure of some mountainous areas of Baluchistan and northern Pakistan have been analyzed by Ahmed *et al*, (1990a, 1990b, 1991 and 2006). Wahab *et al* 2008 has presented phytosociology of some pine forests from Afghanistan and they recognized two mono specific and one bispecific communities there. However, little attention has paid to explore Pine forest of Dir area. Therefore, an extensive sampling was conducted to describe the vegetation and plant communities of Dir forests.

MATERIALS AND METHODS

Field data were collected throughout the forested area of District Dir in 2006 to 2008. Point centered quarter method of Cottam & Curtis (1956) was used for vegetation analysis. Sampling was carried out in twenty five pine dominating forests. Mature and least disturbed forests were selected for vegetation analysis. At each stands twenty points were taken at twenty five meters intervals along the transects**.**

In each quadrant, point to plant distance was measured. Tree species were identified and Dbh was recorded at breast height (1.3m) above ground surface.

Data of each stand was analyzed to find out phytosociological attributes (relative frequency, relative density, relative basal area and important value index) and absolute values (density per hectare and basal area meter square per hectare) according to the method described by Mueller-Domboiss and Ellenberg (1974).

Importance value index was used to rank each species and the tree species with the highest importance value in the stand was considered the dominant species (Brown and Curtis**,** 1952)**.** The plant community of a particular area was named on the basis of first two dominant species. Based on importance values and floristic composition, various communities were recognized.

Global Positioning System (GPS) was used to record elevation and geographical coordinates of each site; Compass was used to locate aspect while degree of slope was recorded by the help of clinometer.

RESULTS AND DISCUSSION

Five tree communities and monospecific pine forests were recognized from the study area. Details of sampling sites are given in Table 1. Phytosociological attributes, frequency, density, basal area, importance value and absolute values, are given in

1 – *Pinus wallichiana*- Deodar Community

The combination of these species is widely distributed in of the study area**.** This community was recorded at six different locations from 1950m to 2310m elevation on plain to very steep slopes (table.1). In many places the canopy was open but closed at Kumrat and moderate at Panhakot.

On the basis of importance value, this community is designated as *Pinus wallichiana* – deodar community at five stands (1, 5, 9, 13 and 16) table-2. In these forests importance values indexes of *Pinus wallichiana* were higher than deodar have ranged 56-78% and 40-276 individuals ha^{-1}. Co-dominant deodar was ranged from 21% to 43% with 15 to 110 individual's ha^{-1}.

In stand no.18 deodar appeared as a first leading dominant, its importance values has 65% and 88 stem per hectare while *Pinus wallichiana* I.V.I and stem per hectare were 35% and 42 respectively. However due to similar floristic composition and long history of human disturbance it was included in the community. It is anticipated that low amount of deodar may be due cutting. In Kumrat a broad leaved species *Populus caspica* as a third dominant and a few trees of Abies pindrow were also scattered.

2 – Deodar – *Taxus wallichiana* Community

Janis Banda sampling site (stand 8) was located on South facing moderately steep slope on 2120 meters elevation amsl. *Cedrus deodara* showed higher (83%) importance value with 152 stem density ha^{-1} while the co-dominant specie *Taxus wallichiana* I.V.I was recorded 17% with 26 individuals per hectare. This is one of the endanger gymnospermic tree specie of Pakistan. People used its wood as tiles for decoration in their houses. Therefore it may be detonated that its low density may be related to the harsh cutting without management.

3 – Deodar – *Picea smithiana* Community

This community was recorded from Salam Baiky Sar on West facing steep slope on 2534 meter elevation. At this location co-dominant specie *Picea smithiana* were low in number and distributed in scattered form. It attains only 12% importance value with 7 individual's ha^{-1}. Leading dominant species deodar occupies 88% of importance value with 68 stem ha^{-1} density.

4 – *Picea-Pinus wallichiana* Community.

This community was located at an elevation 2480 meters on west facing steep slope at Danair. *Pinus wallichiana* as a co-dominant species has 17% importance value with 22 trees ha^{-1}. *Picea smithiana* IVI and basal area proportions 82% and 92%, respectively and was forming Open canopy.

Table 1. Characteristics of the sampling Sites.

Main Location	Sites		[1]Lati (N)	[2]Long (E)	[3]Ele (m)	[4]Asp	Slope[(0)]	Canopy
A— Barkand Dara	1	Souray Bailo	35 º21`	72 º 08`	2130	E	42	Open
	2	Batkalae	35 º22`	72 º 06`	2527	NW	46	Open
B— Usheri Dara	3	Satto Khwar	35 º08`	72 º 11`	2670	N	48	open
	4	Danair	35 º09`	72 º 11`	2480	W	43	Open
	5	Sore Kamar	35 º13`	72 º 13`	2310	S	33	open
	6	Panerako Awar	35 º13`	72 º 13`	2640	N	38	open
C— Sheringal	7	Shahoor	35 º28`	72 º 02`	2150	N	48	moderate
D— Janis Valley	8	Janis Banda	35 º37`	72 º14 `	2120	S	30	moderate
E— Kohistan	9	Kumrat	35 º54`	72 º 14`	2200	Plain	Plain	close
F— Dok Dara	10	Salam Baiky Sar	35 º20`	71 º 55`	2534	W	41	open
	11	Salam Baiky Ghar	35 º20`	71 º 55`	2672	S	40	open
G— Lowari	12	Gojar Kalie	35 º19`	71 º 49`	2575	E	35	open
H—Dir Khas	13	Penhakot	35 º16`	71 º 50`	1991	NW	27	moderate
I— Barawal	14	Shahikot	35 º11`	71 º 73`	1920	W	34	open
	15	Barawal Banda	35 º13`	71 º 69`	1800	EN	38	open
	16	Shalthalo Bala	35 º07`	71 º 69`	1950	E	40	open
J— Shahi	17	Shahi Khwar	35 º09`	71 º 32`	2080	N	35	open
	18	Shahi Awar	35 º03`	71 º 37`	2150	W	40	open
	19	Benshahi	35 º02`	71 º 32`	2529	N	45	open
L— Talash	20	Bagh Dushkhel	34 º39`	71 º 51`	1435	N	28	open
	21	Kattan Bala	34 º36`	71 º 54`	1670	N	30	moderate
M— Paito Dara	22	Anbarzie	34º 47`	71 º 51`	1400	N	35	open
N— Yar Khan Banda	23	Khazana	34 º47`	71 º 51`	1455	N	32	open
O— Tormang Dara	24	Batharae	34º52`	72 º 03`	1875	NW	37	open
	25	Manji Baba	34 º51`	72 º 03 `	2033	N	28	moderate

Note:Latitude,2= Longitude,3=Elevation(m),4=Aspect,5=Species sampled

5 – *Picea-Abies pindrow* Community

This community is situated at the last end of Usheri valley (Panerako) which lies on North facing moderate slope on 2640 meters elevation. *Picea smithiana* showed 67% importance value with 90 individual ha^{-1} and 90 m^2ha^{-1} basal areas, while co-dominant *Abies pindrow* was scattered with in form 30 individual ha^{-1} with a low value of basal area.

6 - Deodar forests

At six locations, deodar was recorded as pure dominating species. These sampling stands were located at the elevation range between 1800-2672 meters a.m.s.l, while slopes were ranged 28 to 48^o at different exposures (Table-1). In these monospecific stands deodar density ranged from 95-394 individuals ha^{-1} with 6.35 to 115 m^2ha^{-1} basal area. In these areas community was not recognized, and the stands were named based on the only dominant species. Most of these forests stands were located in west part of the district. *Pinus wallichiana* were also scattered in some forests stands but were found as in regeneration state.

Table 2. Phytosociological Attributes and Absolute Values of Pine Tree Species.

S.No	Site Name	Species	Phytosociological Attributes				Absolute Values	
			[1]RF	[2]RD	[3]RBA	[4]IVI	[5]D.ha^{-1}	[6]BA.m^2.ha^{-1}
1	Souray Bailo	*Pinus wallichiana*	52.94	65	63.26	60.4	40	5.54
		Cedrus deodara	47.05	35	36.74	39.6	22	3.41
2	Batkalae	*Picea smithiana*	100	100	100	100	112	21.52
3	Satto Khwar	*Abies pindrow*	100	100	100	100	123	24.63
4	Danair	*Picea smithiana*	69.57	85.94	92.38	82.63	137	34.17
		Pinus wallichiana	30.43	14.06	7.62	17.37	22	2.82
5	Sore Kamar	*Pinus wallichiana*	64.52	83.75	85.88	78.05	79	15.92
		Cedrus deodara	35.48	16.25	14.12	21.95	15	2.43
6	Panerako Awar	*Picea smithiana*	55.17	75	71.78	67.32	90	23.48
		Abies pindrow	44.83	25	28.22	32.68	30	9.23
7	Shahoor	*Cedrus deodara*	100	100	100	100	394	65.8
8	Janis Banda	*Cedrus deodara*	78.57	85.42	86.44	83.48	152	34.28
		Taxus wallichiana	21.43	14.58	13.56	16.52	26	5.37
9	Kumrat	*Pinus wallichiana*	71	61	43	58	245	41
		Cedrus deodara	16	28	40	28	110	4
		Populus religeosa	12	10	10	11	40	9
		Abies pindrow	1	1	7	3	5	11
10	Salam Baiky Sar	*Cedrus deodara*	82.61	91.25	90.23	88.03	68	86.45
		Picea smithiana	17.39	8.75	9.77	11.97	7	9.37
11	Salam Baiky Ghar	*Cedrus deodara*	100	100	100	100	104	115.17
12	Lowari pass	*Picea smithiana*	100	100	100	100	105	84.52
13	Penhakot	*Pinus wallichiana*	60.87	75	70.91	68.93	276	35.05
		Cedrus deodara	39.12	25	29.08	31.07	92	14.38

14	Shahikot	*Cedrus deodara*	100	100	100	100	99	6.35
15	Barawal Banda	*Cedrus deodara*	100	100	100	100	129	8.02
16	Shalthalo Bala	*Pinus wallichiana*	55.17	54.17	60.07	56.47	56	6.2
		Cedrus deodara	44.83	45.83	39.93	43.53	47	4.12
17	Shahi Khwar	*Cedrus deodara*	100	100	100	100	116	8.37
18	Shahi Awar	*Cedrus deodara*	54.84	68	72.05	64.96	88	10.77
		Pinus wallichiana	45.16	32	27.95	35.04	42	4.32
19	Benshahi	*Picea smithiana*	100	100	100	100	72	39.73
20	Bagh Dushkhel	*Pinus roxburghii*	100	100	100	100	48	12.8
21	Kattan Bala	*Pinus roxburghii*	100	100	100	100	155	9.3
22	Anbarzie	*Pinus roxburghii*	100	100	100	100	46	13
23	Khazana	*Pinus roxburghii*	100	100	100	100	118	18.13
24	Batharae	*Pinus wallichiana*	100	100	100	100	43	39.63
25	Manji Baba	*Cedrus deodara*	100	100	100	100	277	47

Note: 1=Relative frequency, 2= Relative density, 3= Relative basal area, 4= Importance Value Index, 5= Density per hectare and 6= Basal area meter square per hectare.

Table 3. Summary of Phytosociology of Pine Tree species of sampling area.

S.No	Species Name	PRS	Importance Value Index			Density per hectare			Basal Area.m^2.ha^{-1}			D.S	
			Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	1st	2nd
1	*Cedrus deodara*	14	100	22	72.5 ±6.9	394	15	112±22	115.2	2.4	24.4 ±7.8	9	5
2	*Pinus wallichiana*	8	100	14	51.8 ±7.7	276	12	80±28	41	1.2	14.3 ±4.9	6	2
3	*Picea smithiana*	6	100	12	80.3 ±12.3	137	7	80±17	84.5	9.4	32.7 ±9.5	3	1
4	*Pinus Roxburghii*	4	100	100	100	155	46	92±27	18.1	9.3	13.3 ±1.8	4	-
5	*Abies pindrow*	3	100	3	45.2 ±28.7	123	5	53±36	24.6	9.2	15± 4.9	1	1
6	*Taxus wallichiana*	1	16.52			25.99			5.37			-	1
7	*Populus religiosa*	1	11			40			9			-	-

Note: PRS= Presence in numbers of stands**,** Max=Maximum, Min=Minimum and D.S= Dominance in stands

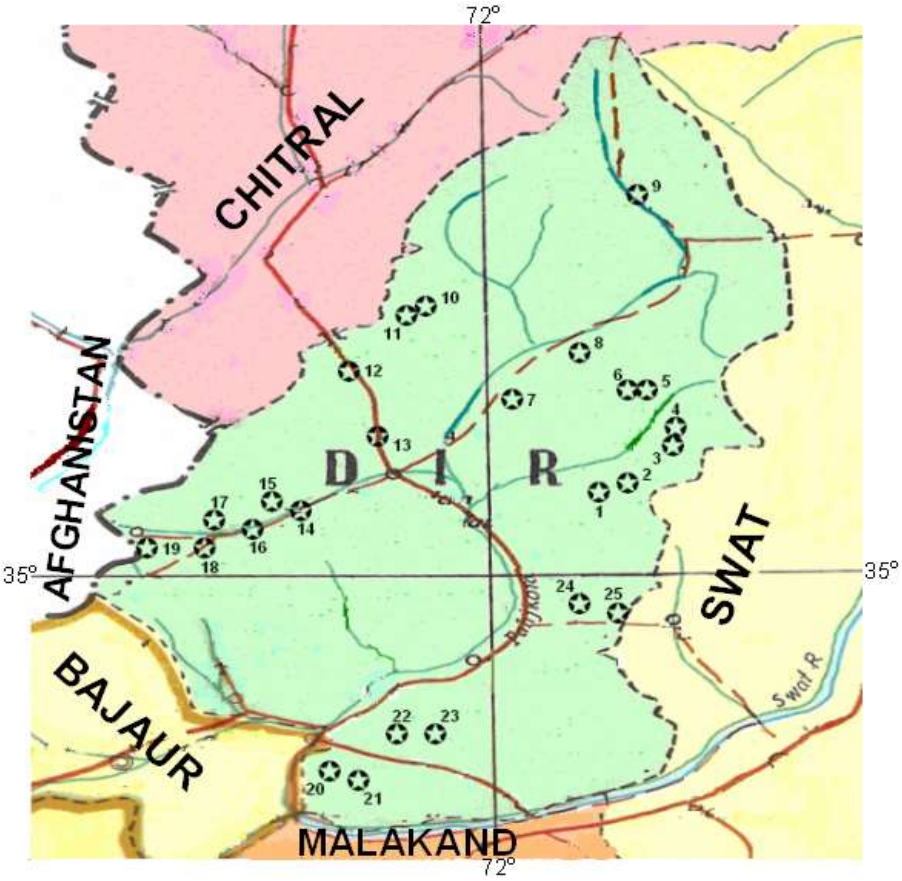


Fig.1.Map of Dir, stars and numbers indicating Sampling Sites of Pine Forests.
Note: Name of the Locations is given in Table.1.

7---*Pinus roxburghii* forests

Pinus roxburghii is distributed as single dominated species in four sites (Stands, 20, 21, 22 and 23). Name and location of these sites is given in Table.1. All these sites are facing towards north with moderate slopes from 1400 to 1670 meters elevation. Due to extreme anthropogenic disturbances, at all locations the canopy was completely opened. In these monospecific stands tree density ranged from 48 to 115 individual's ha^{-1} with 9.3 to 18.1 m^2ha^{-1} basal area. These stands are distributed mainly in sub-tropical dry temperate areas of Dir lower. In these pure sites community was not recognized, and the stands were identified based on the only dominant specie. Most of the lower braches of trees have been chopped for fuel, and roof thatching purposes.

8---*Picea smithiana* forests

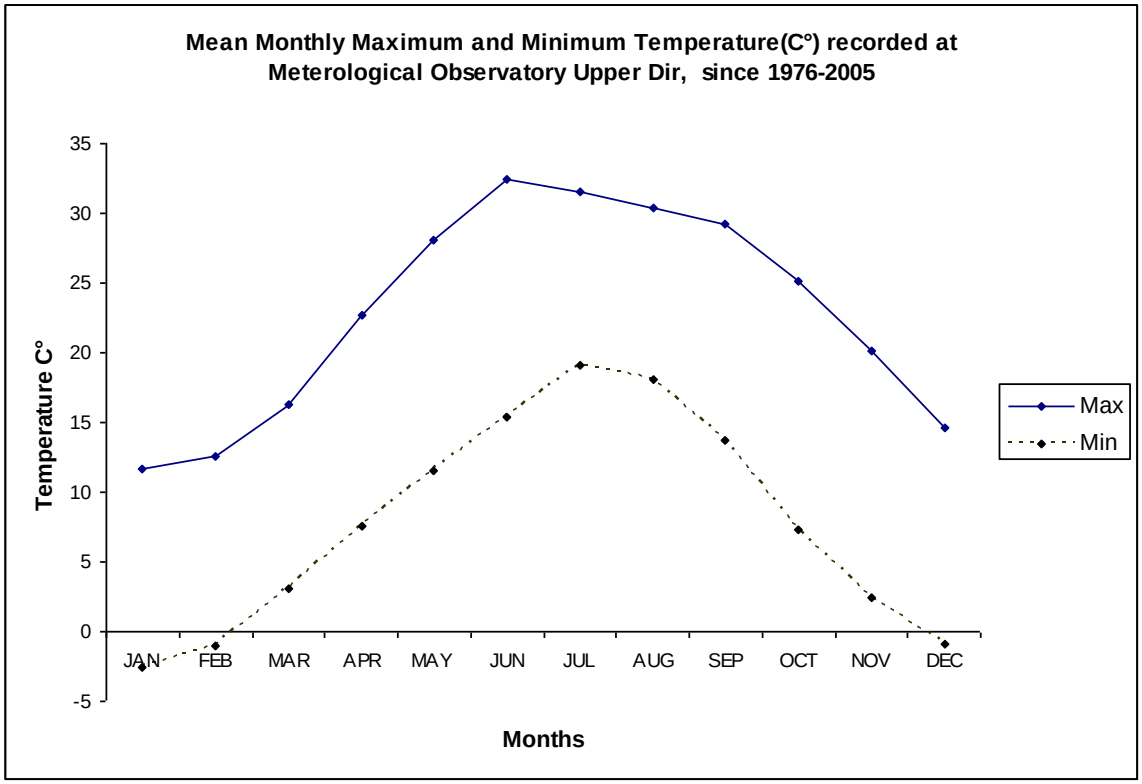
At three sites *Picea smithiana* was the leading dominant species i.e. stand 2, 12 and 19. These sampling stands were located at the elevation range of 2527-2645 meters altitude a.m.s.l. on moderate to steep slopes on different aspects and areas. Stands density was ranged from 35 to 112 ha^{-1} with 15.9 to 112 m^2ha^{-1} basal area. These stands are located slightly on high altitude near timber line with open canopy.

9---*Abies pindrow* forest

This forest (stand.3) was dominated purely by *Abies pindrow*. No other tree species contributed in the community and was located on steep north facing slope with an elevation of 2670 meter. *Abies pindrow* occupied only 24.6 m^2ha^{-1} basal areas with 123 individual per hectare.

10---*Pinus wallichiana* forests

This pine specie was dominated purely in Batharae (Stand 24), situated at an altitude 1875 meters on north west facing slope. *Pinus wallichiana* attain 43 stem per hectare with 39.6 m^2ha^{-1} basal area.



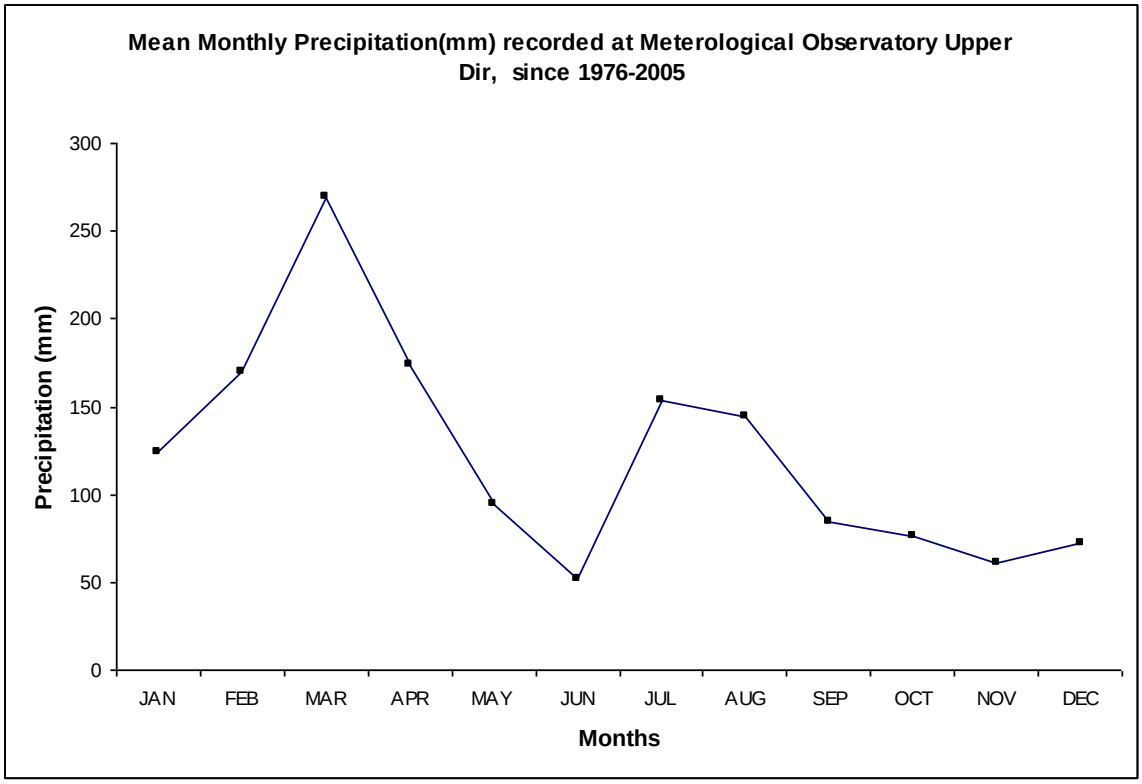


Fig.2 Temperature and Precipitation of the area.

It is shown that gymnospermic forests of Dir District was dominated by *Cedrus deodara* and *Pinus wallichiana* while *Taxus wallichiana* and *Populus religiosa* was found rare Table.3. Many communities showed similar floristic composition, however, their quantitative value were different. Table.2. This Phenomenon was also noted by Ahmed *et al* 2006 in Himalayan forests of different climatic zones of Pakistan. All the sampled pine forests were growing on elevation range1400 – 2672 meters a.m.s.l. *Pinus roxburghii* was found on lower elevation while *Abies pindrow* and *Picea smithiana* were growing on high altitude on steep slopes. The slopes angles was ranged 0 -48°. Mostly forests were exposed to north and about 80% forests canopies were opened which may be due to long history of human interference, logging and cutting. Therefore it is hard to conclude that the low density of these species is natural. It is anticipated that due its consumption for fodder and fuel broad leaved species are almost completed eliminated from these forests. Many forests were in bad shape and need proper conservation and cutting of these valuable forests should be seriously discouraged through environmental protection laws.

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