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PHOTOSOCIOLOGY AND DYNAMICS OF SOME PINE FORESTS OF AFGHANISTAN

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Abstract

Phytosociological sampling, structure, age and growth rates studies were carried out in 5 places of Dangam District of Afghanistan. Vegetation compositions of non tree species were also presented. On the basis of floristic composition and importance value index of tree species, two monospecific and one bispecific communities were recognized in the study area. It is shown that in *Picea smithiana* (Wall.) Boiss., Dbh, age and growth rates are not significantly correlated. Lack of tree seedlings indicate poor regeneration status of the forests.

Introduction

Afghanistan is under crisis since quarter of the century. Each and every aspect of the human life, wild life and physical structure of the land is affected due to the crisis. Therefore, no such quantitative study was conducted or presented from this country. However, Beg (1974) and Khan (1978) conducted vegetational and phytosociological investigations in Chitral Gol from Pakistan. Population dynamics of Juniper and Chilghoza pine was presented by Ahmed *et al*., (1990) and Ahmed *et al*., (1991) respectively. Above mentioned sites are close to the Afghanistan border. This is the first quantitative vegetational study from this area.

Border of Afghanistan and Pakistan lies between longitudes 61^0E to 74^0E (±1100Km), on the higher mountain of Hindu Kush and Western Mountain. The mountain ranges fall under dry temperate climate and support conifer, Juniper, broad leaved forests and shrubs in many places. Due to long lasting war, political uncertainty, human migration, lack of education, poverty and absence of any infrastructure, no management plan and scientific study exists for these forests. Cutting of trees for illegal trade, fuel and construction is still going on and semi-natural vegetation is taken over gradually. Therefore, it was thought that, before the natural vegetation has been completely altered it is necessary to explore prevailing pattern of vegetational distribution. The study area is located in Dangam district of Asadabad, closed to the Dir through Shahi town in Binshai border of Afghanistan (Fig. 1). Asadabad is situated about 200 Km northeast from Kabul, capital of Afghanistan. No meteorological station is located into study area. The closest weather station is situated at Dir upper in Pakistan, so climatic data of this station is presented here. The data show (Fig. 2) that July is the hottest month while January is the coldest month. Relative humidity is higher in January, February, August and December while area received highest rainfall in March and lowest in July, October and November snowfalls from December to March.

Fig. 1. Location of sampling area.

Material and Methods

Though the whole area was disturbed, the least disturbed locations were selected for quantitative sampling. At each area at least one hectare area was included and global positioning system (GPS) was used to locate these sites on map. Elevation, aspect, slope angle, physical conditions of the ground and ground flora were recorded. Point centered Quarter (PCQ) method (Cottom & Curtic, 1956) was used for tree species. Tree from 10cm Dbh were included in the sampling. In each sampling area at least 15 PCQ points were taken after 25 m distance. Point to plant distance and Dbh of each tree within the sampling point was recorded. Ground vegetation was sampled by 1.5 m radius circular plots, placed at each PCQ point. Species list with frequency was obtained. Statistical analysis was performed following Mueller-Dombois & Ellenburg (1974) and phytosociological attributes and absolute values were calculated accordingly. Density size frequency histograms for each location were constructed and regression analysis

were performed to see correlation between Dbh, age and growth rate. Modern Dendrochronological technique (Stokeys & Smiley 1968) were used to obtain wood samples from the trees and laboratory preparation of wood samples, microscopic analysis, age and growth rates of various species were carried out according to Ogden (1981) and Ahmed (1984).

Results and Discussion

Details of sampling sites are given in Table 1.

Phytosociological attributes, frequency, density, basal area, importance value and absolute values, are given in Table 2. Two locations were dominated by different single species while three sampling sites were characterized by one community.

1. *Cedrus deodara* community,
2. *Picea smithiana* community and
3. *Cedrus deodara-Pinus wallichiana* community.

Description of above mentioned communities are given below. Detailed tables of non-tree species (ground flora) are not presented, however these are summarized in Table 4.

Surgulo sar (DSS): The area is located about 23Km from Pakistan border and dominated purely by *Cedrus deodara*. No other tree species existed here. All the trees were young. Through 95 individual/ha^{-1} were recorded basal area was quite low (7.4 ^{m2}/ha^{-1}). Forest floor was highly disturbed due to grazing and cutting. Seventeen species of shrubs, herbs and grasses were recorded in circular plot study, in which *Convolvulus arvensis, Rubus fruticosus* and *Viola canescens* were found from 70 to 90% of the plots. *Cynodon dactylon, Geranium rotundifolium* and *Rumex hastatus* were recorded from 60% of the plots. Many places rocks and soil is exposed and no seedling *of Cedrus deodara* was recorded. Size class distribution showed that despite disturbance and low number of plants in lowest size class, histogram indicated a balanced distribution. Due to lack of seedling there will be a gap in future, however the forest could be saved by proper management.

Sheshan (SD) sampling sites: This sampling site is situated 23Km North from the previous location. Like Surgulo, this site is also dominated by single tree species, *Picea smithiana*. Trees were large in size showing lowest density (35/ha^{-1}) with the highest basal area (15.9 m^2/ha^{-1}) among the various sampling sites. This species is also distributed nearby areas in Pakistan, with much higher values of density and basal area. Almost flat structure of density size class show poor distributional pattern. This site needs extensive care as it might disappear with time. The understory was scattered. During the sampling 18 species <10cm Dbh were recorded in which *Sisymbrium irio, Impatiens brachycentra, Fragaria vesca, Viola canescens, Convolvulus arvensis* and *Rubus fruticosus* were found in 50 to 57% sampling plots. Species like *Artemisia maritima, Polygonum viviparum* and *Cynodon dactylon* were present in 43% plots. *Indigofera gerardiana, Carum carvi* (not found in previous sampling sites) and *Geranium rotundifolium* were found in 29% of the plots. Density size class structure (Fig. 4) showed flat surface and unable to postulate any future trend due to extensive cutting. However lack of seedling and low number of plants in small size classes suggested lack of recruitment in this stand.

Table 1. Characteristics of sampling sites.

S. No.	Sampling sites	Code	Aspect	Slope	Canopy	Altitude (m)	Latitude N	Longitude E
1.	Surgulo Sar	DSS	North	32°	Open	2246	35.03°	71.32°
2.	Sheshan	SD	North	45°	Open	2529	35.02°	71.32°
3.	Zoor Barawal	ZB	East	40°	Open	2528	35.02°	71.32°
4.	Shenki Khur	SGC	South	42°	Open	2911	35.05°	71.34°
5.	Sur Kamar	SK	East	35°	Open	2726	35.07°	71.37°

Table 2. Phytosociological attributes and summary of vegetation sampling sites.

Stand No.	Locations	Species code	RF[1]	RD[2]	RBA[3]	IVI[4]	D/ha[5]	BA/m^2/ha[6]
1.	DSS	C D	100	100	100	100	95	7.44
2.	SD	P S	100	100	100	100	35	15.9
3.	ZB	C D	59	65	63	63	77	6.6
		PW	41	35	37	37	41	3.8
4.	SGC	C D	55	56	55	55	28	2.6
		PW	45	44	45	45	22	2.1
5.	SK	C D	78	89	91	86	104	11.5
		PW	22	11	9	14	12	1.2

Note: 1. Relative frequency, 2. Relative Density, 3. Relative Basal area, 4. Important Value Index, 5. Density per hectare (D/ha^{-1}), 6.Basal area m^2/ha
CD =*Cedrus deodara*, PS = *Picea smithiana*, PW=*Pinus wallichiana*

Table 3. Age and growth rates of *Picea smithiana* from Sheshan.

Classes	DBH*	AGE**	Average age	Average G. rate y/cm	Smallest Dbh	Age	Largest Dbh	Age
1.	90- 100	133	133	4.0	98	133	154	140
2.	100.1-110	269-277	273	5.4 ±0.71				
3.	110.1-120	160-245	202	4.7 ±0.44				
4.	120.1-130	245	245	4.2				
5.	130.1-140	170-210	190	4.0 ±0.15				
6.	140.1-150	176-217	196	3.6 ±0.16				
7.	150.1-160	140-198	169	7.1 ± 0.4				

Note: DBH* = Range of DBH, Age** = Range of ages in particular classes, G. rate y/cm = Growth rate years/cm

Rest of the three sampling sites are located north of the Asadabad and lies about 16Km from the 2nd sampling sites. All three sites are dominated by *Cedrus deodara* (I.V.I range from 55 to 86) while second dominated species was *Pinus wallichiana*, forming *Cedrus-Pinus* community. Highest stand density (118/ha^{-1}) was recorded from Zoor Barawal area (ZB) while lowest stand density (50/ha^{-1}) was recorded from Shenki Khur (SGC) sampling site. This area also shows the lowest (4.7 m^2/ha^{-1}) amount of basal area. Density size class structure of these forests (Fig. 4) show higher number of plants in small size classes with a gradual decrease in big size classes. It is a good sign of recruitment and these forests could be saved by adding regenerating seedling of the same tree species. The ground flora of three sampling sites showed different pattern of distribution. At Zoor Barawal 19 species were listed in which *Aconitum leave, Impatiens brachycentra* and *Silene vulgaris* were found 50, 70 and 80% of the plot respectively. Other species were in forty or less than 40% plots. Shenki area which is located at highest (2911 m) elevation, showed 24 species with highly scattered form. Only 7 species viz., *Aconitum leave, Carum carvi, Rosa webbiana, Micromeria biflora, Barleria cristata, Heteropogon contortus* and *Viola canescens* fall in one third of the sampling plots. Surkumar sampling site also show the similar situation where 22 species were observed in circular plot study in which *Oxalis corniculata, Artemisia maritima, Duchesnea indica, Cynodon dactylon* and *Rubus fruticosus* were recorded in 33 to 42% of the plots.

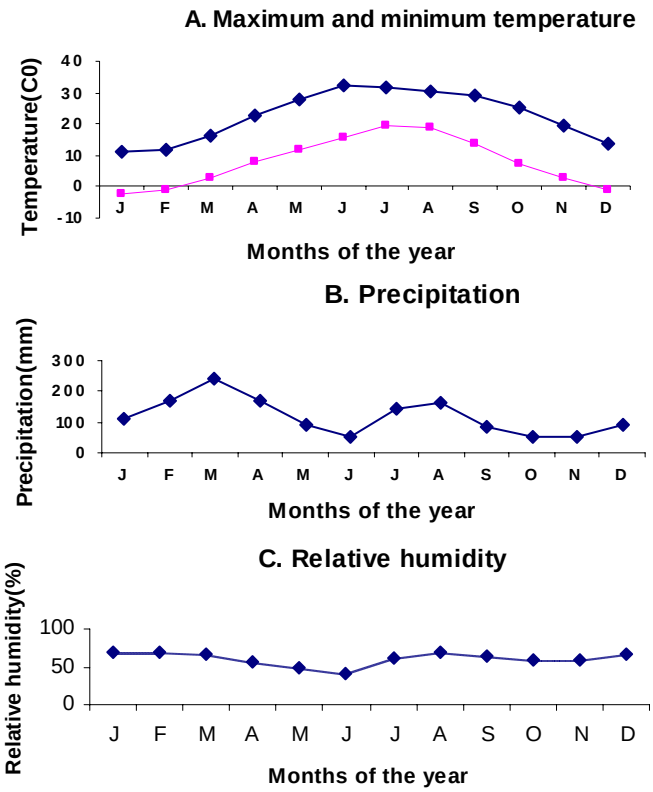

Fig. 2. A, B and C are showing temperature, precipitation and humidity conditions of Dir Upper.

Table 3 shows the age and growth rates of *Picea smithiana* only. Due to small sample size data of *Cedrus deodara* and *Pinus wallichiana* are not presented here. *Cedrus* and *Pinus* species show almost similar (1.5 to 3.6 year/cm) growth rate. Ages and growth rates are also variable. A tree with 35Dbh and 55 cm Dbh may have the similar (65 to 68 years) age. Same situation was also found in *Picea smithiana.*

During the present study no significant relation was observed between Dbh and age, age with growth rates and Dbh vs growth rate (Fig. 3). These finding supports the work of various worker (Ogden, 1983; Ward, 1983; Norton, 1983; Knowles & Grant, 1993), who have suggested that Dbh is not a good indicator of age. Ahmed *et al*., (1991) also used dendrochronological methods to estimate age and growth rates of various species from Himalayan Range of Pakistan and in many cases he found highly significant correlation between Dbh and age. However, due to wide variance he also advised not to draw conclusion about the age of even closely situated trees of the same species. Some density figures (95 to 118) are within the lower range of other finding in Pakistan (Ahmed & Naqvi 2005; Ahmed *et al*., 2006; Ahmed *et al*., 1990a, b, 1991), however the basal area value are lower than recorded in any pine forest of Pakistan, most probably due to the higher disturbed nature of the area.

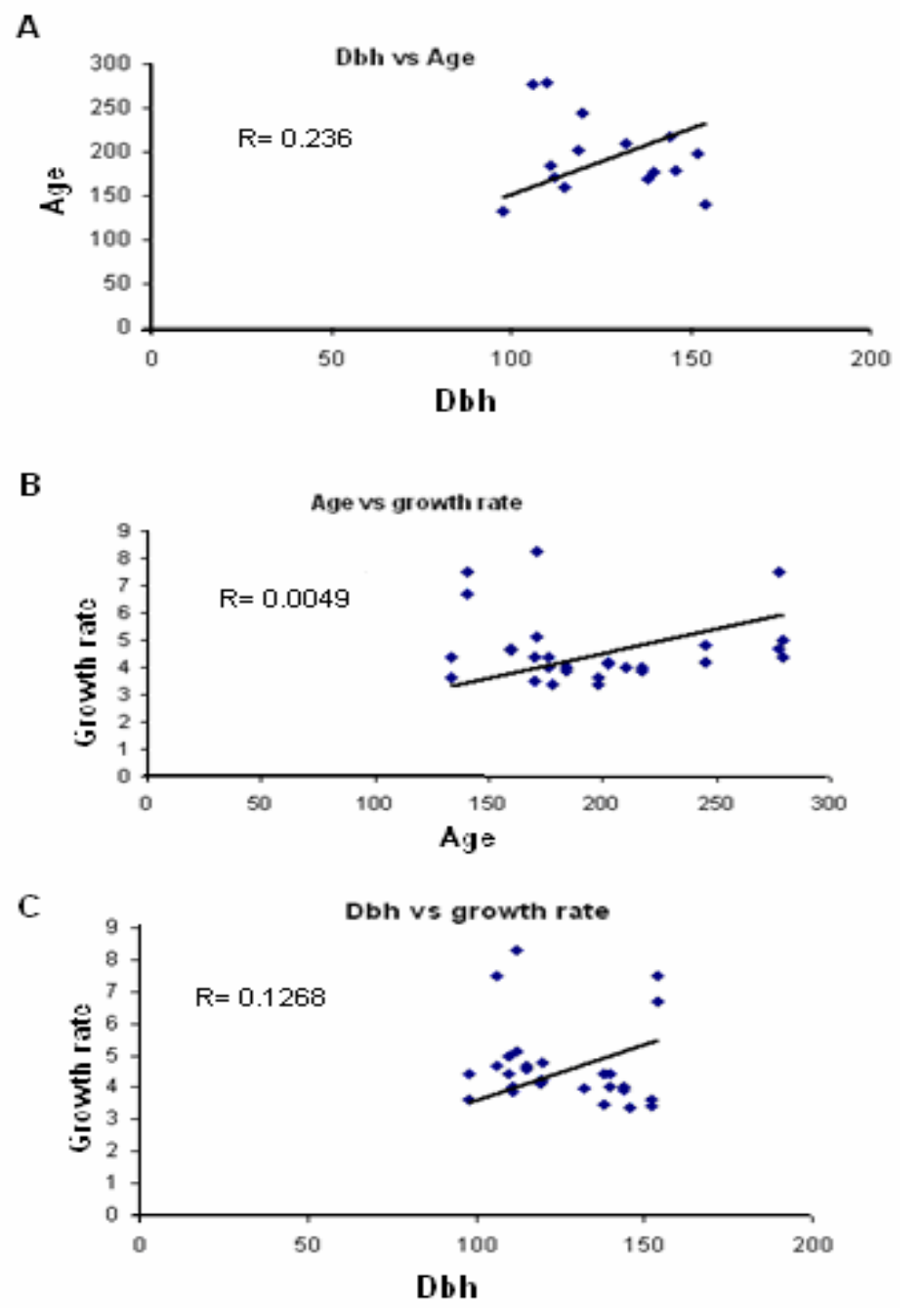

Fig. 3. Regression analysis- Correlation between Dbh, ages and growth rates of *Picea smithiana* trees in study area.

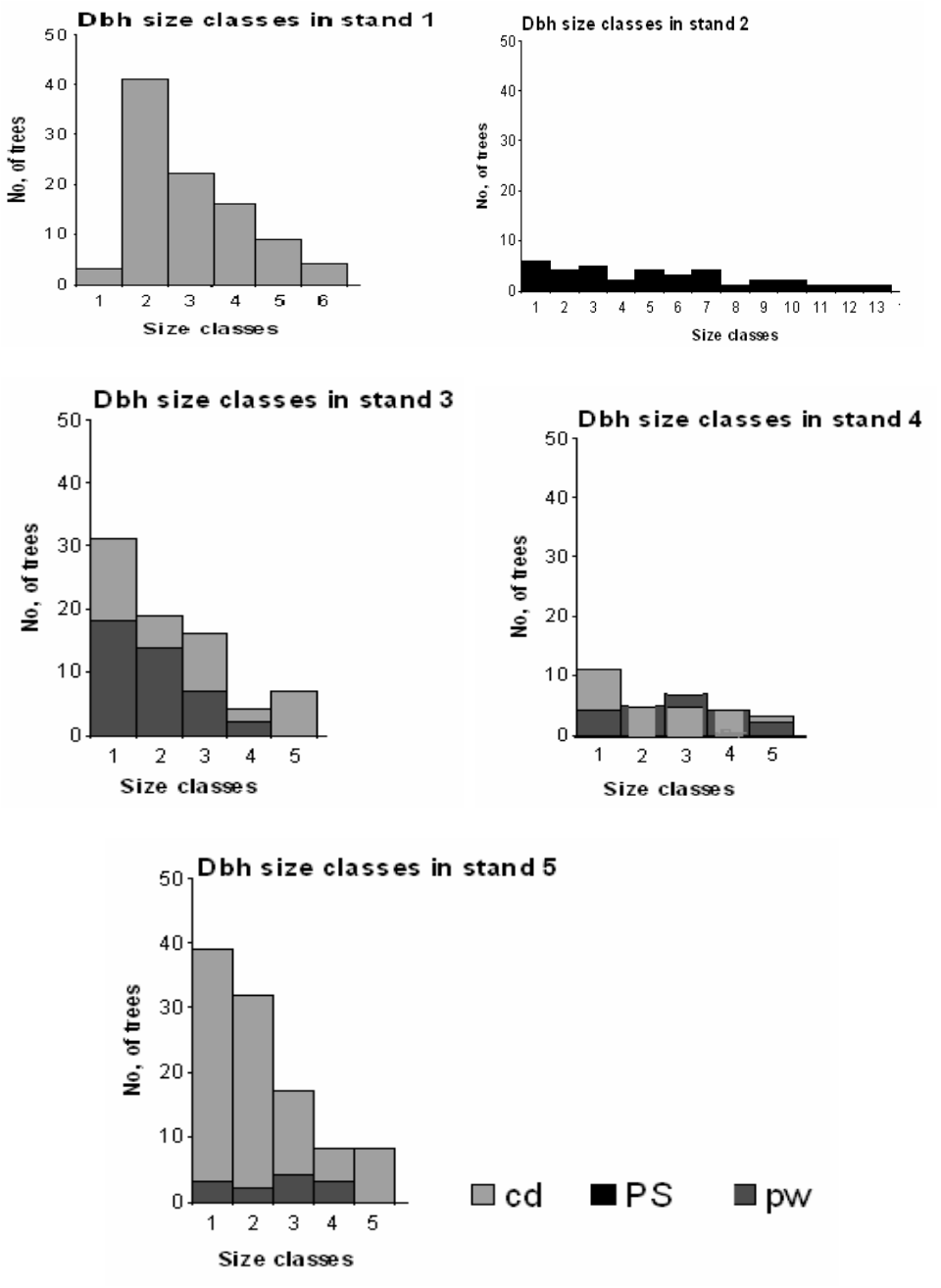

Fig. 4. Frequency size classes of species in sampling area number 1,2,3,….are various classes each class based on 10 cm Dbh, started from 10 cm Dbh.

Table 4. Distribution of ground flora in sampling area.

S. No.	Name of species	PRNQ	RFSA	PRST	RF in stands
1.	*Rubus fruticosus* Hkf.non L	28	8.51	5	4.34---21.95
2.	*Viola canescens* Wall. Ex Roxb	23	6.99	5	2.32---21.95
3.	*Convolvulus arvensis* L.	19	5.77	5	2.32---17.95
4.	*Cynodon dactylon* (L.) Pers.	22	6.68	5	6.52---14.63
5.	*Polygonum viviparum* L.	14	4.25	5	3.32---11.09
6.	*Artemisia maritima* L.	11	3.34	5	4.31----19.22
7.	*Urtica dioica* L.	18	5.47	4	6.50----28.33
8.	*Indigofera gerardiana* Wall. Ex Baker	11	3.34	4	2.32----8.69
9.	*Fumaria indica* (Hausskn.) H.N.	16	4.86	4	2.17----7.04
10.	*Carum carvi* L. forma gracile (Lindl.) Wolff	13	3.95	4	5.06----20.03
11.	*Silene vulgaris* (Moench) Garcke	9	2.73	4	3.21----22.44
12.	*Fragaria vesica* Lindl. ex Hk. f.	14	4.25	4	6.12-----22.11
13.	*Rumex dentatus* L. ssp. Halacsyi (Rech.) Rech. f.	7	2.12	3	2.17----7.54
14.	*Aconitum laeve* Royle	11	3.34	3	5.07-----14.22
15.	*Impatiens brachycentra* Kar. & Kir.	12	3.64	3	7.81----13.22
16.	*Sonchus asper* (L.) Hill	6	1.82	3	2.32----13.04
17.	*Dryopteris odontoloma* (Moore) C. Chr.	6	1.82	3	2.32----6.52
18.	*Ammi visnaga* (L.) Lamk,	7	2.12	3	4.34----8.69
19.	*Sisymbrium irio* L.	15	4.55	3	4.02----12.66
20.	*Heteropogon contortus* (L.) P. Beauv. Ex Roem. & Schult.	4	1.21	3	2.17----3.77
21.	*Ajuga bracteosa* Wall. ex Bth.	7	2.12	2	2.01----6.97
22.	*Taraxacum officinale* Weber	3	0.91	2	2.17---6.69
23.	*Geranium rotundifolium* L.	10	3.04	2	5.22---14.23
24.	*Duchesnea indica* (Andr.) Focke.	5	1.52	2	9.75---13.20
25.	*Rosa webbiana* Wall. ex Royle	7	2.12	2	2.17---9.30
26.	*Heracleum candicans* Wall. ex DC.	8	2.43	2	2.32---8.69
27.	*Daphne mucronata* Royle.	5	1.52	1	5.07---11.09
28.	*Berberis lycium* Royle.	2	0.60	1	6.52
29.	*Oxalis corniculata* L.	4	1.21	1	4.65
30.	*Barleria cristata* L.	4	1.21	1	9.3
31.	*Hypericum perforatum* L.	2	0.60	1	8.69
32.	*Sedum multicaule* Wall. ex Lindl.	1	0.30	1	4.65
33.	*Micromeria biflora* (Ham.) Bth.	4	1.21	1	2.32
34.	*Rumex hastatus* D. Don	1	0.30	1	8.69

Note: PRNQ = Presence in number of Quadrats, RFSA = Relative frequency in sampling area, PRST= Presence in number of stands, RF=Range of relative frequency in stands.

Distribution of ground flora (non tree species) is present in Table 4. First two column postulated the species distributed in overall sampling area. In general 34 different species were recorded in these forests, none of these attained 50% distribution. Last two column of the same Table showed presence of a species in different sampling area. The distribution pattern is extremely poor, scattered and with low relative frequency. Fourteen species were rare, found only one or two locations. The whole area is subjected to over grazing and extensive cutting and trees over 60cm Dbh have been taken out, therefore,

not only the tree species but ground vegetation is also in a bad shape. This type of vegetation distribution increase soil erosion which could be seen in various locations of the study areas. The forests of sampling areas are highly deteriorating and it is suggested if present practice is not stopped they will be eliminated by time, therefore, prompt management, conservational and logicilative action is necessary to save the natural forests of district Dangam of Afghanistan.

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References

Ahmed, M. 1984. *Ecological and Dendrochronological studies on Agathis australis (Salisb) Kauri*. Ph.D. Thesis University of Auckland, New Zealand.

Ahmed, M. and A.M. Sharangezi. 1991. Dendrochronological approach to estimate age and growth rate of various species from Himalayan Region of Pakistan. *Pak. J. Bot*., 23(1): 78-89.

Ahmed, M. and S.H. Naqvi. 2005. Tree-ring chronologies of *Picea smithiana* (Wall) Boiss., and its quantitative vegetational description from Himalayan Range of Pakistan. *Pak. J. Bot*., 37(3): 697-707.

Ahmed, M., A. Mohammad and S. Mohammad. 1991. Vegetation structure and dynamics of *Pinus gerardiana* forests in Baluchistan. *Pakistan. J. of. Veg. Sci*., 2: 119-124.

Ahmed, M., E.E. Nagi and E.L.M. Wang. 1990b. Present state of Rodhmallazi forest of Baluchistan, Pakistan. *Pak. J. For*., July, 227-236.

Ahmed, M., S.S. Shaukat and A.B. Buzdar. 1990a. Population structure and dynamics of Juniperus excelsa in Baluchistan. *Pakistan. J. of Veg. Sci*., 1: 271-276.

Ahmed, M., T. Husain, A.H. Sheikh, S.S. Hussain and F.M. Siddiqui. 2006. Phytosociology and structure of Himalayan Forest from different climatic zones of Pakistan. *Pak. J. Bot*., 38: 361-383.

Beg, A.R. 1974. Vegetation on the scree slipes of Chitral Gol. *Pak. J. Forestry*., 24(2): 393-402.

Cottam, G. and J.T.Curtis. 1956. The use of distance measures in Phytosociological sampling. *Ecology*, 37(3): 451-460.

Khan, M.H. 1978. Phytosociological studies in Chitral Gol. *Pak. J. Forestry*, 28(2): 99-110.

Knowles, P. and M.C. Grant. 1983. Age and size structure analyses of Engelmann spruce, ponderosa pine, lodgepole pine and timber pine in Colorado. *Ecology*, 67(1): 1-9.

Mueller-Dombois, D. and H. Ellenburg. 1974. *Aims and Methods of Vegetation Ecology*. John Wiley and Sons. New York.

Norton, D.A. 1983. *A Dendroclimatic analysis of three indigenous tree species, South Island, New Zealand*. Ph.D. Thesis, University of Canterbury, New Zealand.

Ogden, J. 1983. Community matrix model prediction of future forest composition at Russel state Forest. *New Zealand Journal of Ecology*. 6: 71-79.

Ogden, J. 1983. Dendrochronological studies and the determination of tree age in the Australian tropics. *Jour. Biogeography*, 8: 405-420.

Stokes, M.A. and T.L. Smiley. 1968. *An Introduction to Tree-Ring Dating*. Uni. Chicago Press. Chicago. 68pp.

Ward, L.K. 1982. The conservation of Junupers, longervity and old age. *Journal of Applied Ecology*, 19: 917-928.

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