INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print) 2222-5234 (Online)
http://www.innspub.net
Vol. 13, No. 5, p. 168-177, 2018

RESEARCH PAPER OPEN ACCESS

Exploration of *Pinus roxburghii* Sargent Dominated Communities in Maidan Valley, Dir (L), Khyber Pakhtunkhwa, Pakistan

Fayaz Ali[1], Jamil Ul Haq[1], Amir Abdullah Khan[2], Waqar Khan[3*]

[1]*Shaheed Benazir Bhutto University sheringal, Dir (U), Khyber Pakhtunkhwa, Pakistan*

[2]*Department of Plant Biology and Ecology, Nankai University, Tianjin, China*

[3]*Department of Plant sciences, Nanjing Agriculture University, Nanjing, 210095, China*

Key words: *Pinus Roxburghii*, Communities, Forests, Maidan, Pakistan.

http://dx.doi.org/10.12692/ijb/13.5.168-177 Article published on November 18, 2018

Abstract

Density of *Pinus roxburghii* has been significantly reduced across its distribution ranges in the studied area due to natural and anthropogenic pressure in the near past. The present endeavor was undertaken to quantify the existing phyto-diversity from studied area during 2014-2016. Species and environmental data from 3 forests were documented by using measuring of 12 × 12 m² quadrates. Total of 7 woody species were recorded belonging to six different families. On the basis of importance value index *Pinus roxburghii* was declared the leading tree species in all the 3 studies sites. *Eucalyptus camaldulensis* was documented as co-dominant species in studied site-I, while other 2 sites were co-dominant by *Pinus wallichiana*. Studied site-II was recorded the most rich forest by having the value of 1350.0 for density/hac and 1000.1 for BAcm²/hac. All the studied forest were located on a gentle slope ranges from 13° to 21° within elevation range of 1826 m to 2000 m above the sea level. Dead loges and cut stumps in the study site shows that the forests are heavily exploited by anthropogenic and natural hazards. Our results suggest that both local and regional scale analyses are warranted to disentangle the vegetation-environment relationships, if the ultimate goal is to conserve these less disturbed, self-sustainable ecosystems.

* **Corresponding Author:** Waqar Khan ✉ waqar.khan399@gmail.com

Introduction

Forests are extensive and continuous areas of land dominating by trees and about 20 to 30% of the total geographical area is desirable (Khan, 2012). In comparison to the desirable amount, Pakistan has only 4.8 % forests of the total geographical area (Ali, 2005; Ahmed *et al*., 2009; Khan, 2012), which is very low. One-third of the total forest area in Pakistan is covered by productive forests while the residual are enclosed by protecting woodlands (Sethi, 2005).Pakistan is roughly categorized in nine (09) ecological areas having almost 6000 plant species (Khan *et al*., 2010; Sher *et al*., 2012). Among all these eco-regions positioned in Hindukush and Himalayan are believed centers to biodiversity with 2500 plant species approximately (Champion *et al*., 1965; Sher and Hussain, 2012). Forests always keep a key role in his accounts by sustaining life in both Himalaya and Hindukush ranges (Khan *et al*., 2012). These forests play major roles in biodiversity, grazing land for animals, watershed protection, and supply of timber and also habitat for threatened fauna (Khan *et al*., 2010; Ali, 2015).

Conferring to Champion *et al*., (1965), the Malakand divisions have contains moist and dry temperate forests types. These forests sites have a number of coniferous tree and broad leaved species i.e. *Cedrus deodara*, *Pinus wallichiana*, *Pinus roxburghii*, *Pinus gerardiana*, *Abies pindrow*, *Piceas mithiana*, *Taxus wallichiana and Juniperus excelsa*. Several angiosperm species including broad leaved like *Quercus baloot, Olea ferruginea* Royle*, Ficus palmata, Quercus dilitata* and *Quercus incana* etc, annual herbs and medicinal plants are also associated with these conifer forests which donates to the whole variety of the eco-regions (Ul-Haq, 2012). From the last few decades these forests are heavily impacted and in bad shape due to anthropogenic factors reported by various ecologists, biologist and foresters (Ahmad *et al*., 2006: Khan *et al*., 2010).Sub-tropical pine forests of Pakistan in Himalaya and Hindukush ranges are dominated by broad leaved and coniferous forests adding a valuable amount to productive forests (Khan *et al*., 2012). According to Nasser Ullah (2012), 8 conifer tree species have been documented till now, of which *Pinus brutia* and *Pinus halepensis* are not native to Pakistan (Khan *et al*., 2012). *Pinus roxburghii* is counted the most vital conifer tree species among the six native conifers (Ganeev, 2007). *P. roxburghii* is a monoecious tree species with an average diameter of 0.6 meter. Large trees species of Pinus ranges from 21 to 33 meter in length having needles in three ranging from 20 to 30 cm in length (Khan, 1992). This tree species is likely to be occurred within elevation ranges of more than 900 meters and below 1800 meters above the sea level (Siddiqui *et al*., 2009). In Pakistan *Pinus roxburghii* is reported from sub-tropical dry and moist temperate areas, Khyber Pakhtunkhwa and Kashmir, (Ahmed *et al*.,2006). *Pinus roxburghii* is drought hardy and can survive 4 months of drought and is well adapted to a precipitation zone of 450 to 1625 mm/yr. It is frost hardy and fire resistant. The tree is free of disease and insect resistant. Natural regeneration occurs readily on bare mineral soils (Khan, 1992).In northern areas of Pakistan *Pinus roxburghii* is the main source of grazing and also provides timber wood and resin (Wahab, 2010). Therefore local inhabitants in the area of its occurrence largely depend on these forests for different activities (Ganeev, 2007).

Ahmed *et al*., (2006) reported the structural and functional study of *P. roxburghii* in Pakistan. The aims of the study are to quantify the relationship of environmental variables with species composition and stand structure attributes of *P. roxburghii* forests. To report the relation of site variables with development and growth patterns of the forest species.

Materials and methods

Study area

Dir is an important and large district of Khyber Pakhtunkhwa and is divided to two districts i.e. Dir Lower and Dir Upper. Dir Lower spins between 35° 50' and 34° 22' North latitude and 71° 2' and 72° 3' East longitude (Hazrat *et al*., 2007). Dir (L) occurs in the elevation ranges of 1200 meters to 2800 meters above the sea level (Hassan *et al*., 2015).

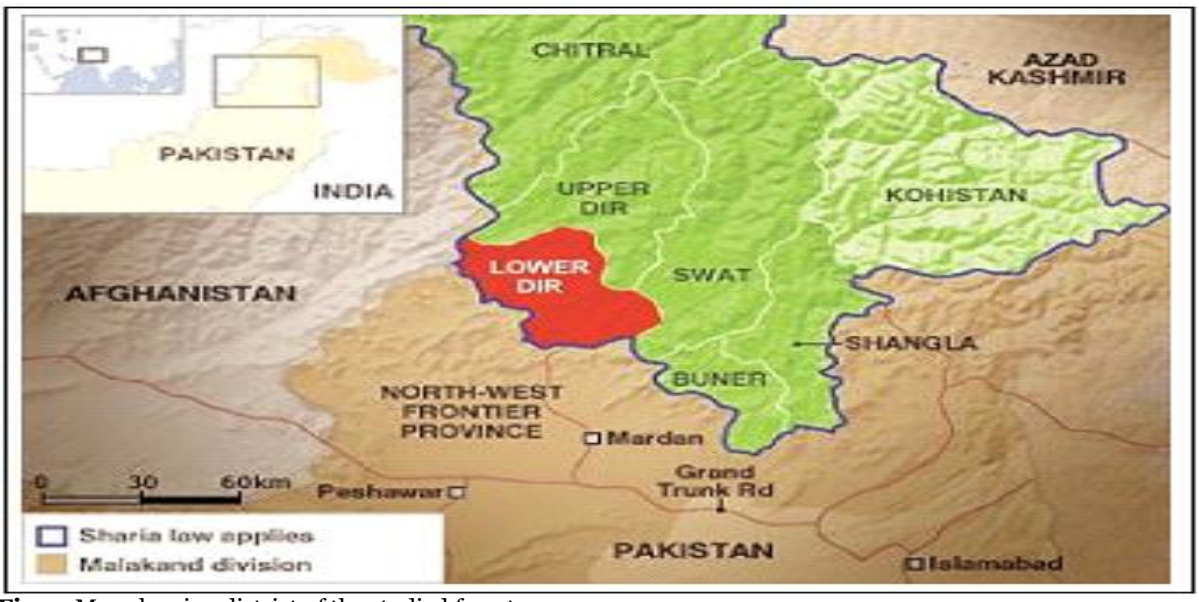

Fig. 1. Map showing district of the studied forests.

The study area is a part of sub-tropical dry temperate areas (Khan, 2010). Dir lies in sub-tropical dry temperate areas of Pakistan; however, part of the district is positioned in moist temperate areas of the country (Champion *et al.*, 1965).

Sampling

Maximum of the timberlands in Dirfits to the sub-tropical deciduous, broadleaved and coniferous forests (Champion *et al.*, 1965). Most important species of these forests zones are *Olea ferruginea*, *Quercus baloot, M. buxifolia, P. granatum, A. modesta*, *C. europea Pinus roxburghii, Pinus wallichiana, Cedrus deodar* and other conifers. After a general reconnaissance 3 forests dominated by *Pinus roxburghii Sargent* located in Maidan, Dir lower, were selected for study. Each of studied stand spread on 2 to 4 hectares in total area and are placed on mountain in clines. *P. roxburghii* plantations displaying no sign of current major turbulences and holding trees of at least 40cm dbh were given priority for data collection.

There are no common instructions and every skilled individual has its own choice to choose that how many quadrates has to be used to get more or preferred statistics from flora(Ahmed and Shaukat, 2012). Quadrate of 10 m × 10 m = 100 m² were established for sampling of phytosociological data for over stories flora after the techniques outline defined by Muller-Dombosis and Ellen berg (1974). Seedlings, saplings and the figures of dead logs were recognized by using 5 m × 5 m = 25 m² plots following the process of Hart *et al.*, 2012; Ahmed and Shaukat, 2012.

At every sampling site twelve (12) quadrates were established along a transect line that crossed through the center of each community. For all trees and woody species having stem dbh ≥ 5 cm within a quadrate, its number, diameter at breast height (DBH) and its height (dbh, ca. 1.4 m above the root collar) were detailed by a lengthy timber (Armbrust *et al.*, 2004). For multi-stemmed trees, diameter approximation was calculated following Russel and Fowler (1999) and Ryniker *et al.*, (2006).

The floral data, like slope angle (Santo clinometers), altitude (altimeter), aspect (compass), geographical coordinator (GPS) and human disturbances were noted. Aspect was measured by using magnetic compass and was classified into common eight aspect groups, i.e. N, NE, E, SE, S, SW, W and NW.

Analysis of the sampled data

The vegetation of data obtained were analyzed for different Phytosociology attributes like frequency (F1), relative frequency (F3), density (D1), relative

density (D3), density ha^{-1},basal area cm^2 ha^{-1} (B.A). Importance values (IVI) were calculated respectively according to Mueller-Dombois and Ellenberg (1974) using the values of F3, D3 and basal area (see table 2). The Phytosociological attributes (relative density, relative frequency & relative basal area) and absolute values (density ha^{-1} and basal area of species m^2/ha^{-1}) were calculated following the methods (Ahmed and Shaukat, 2012).

The importance values (IVI) for each woody tree species in a plot was determined according to the cutis techniques (1967). Phytosociology analysis of recorded tree species, Phytosociological attributes and total values are calculated.

Density size frequency histograms for each site were constructed and weakening analysis was performed to see relationship between Dbh, age and growth rate (Wahab *et al.*, 2008).

Results

Species composition

Total of seven woody tree species belonging to six different families were reported in the studied area (Table 1, Fig. 2).

Table 1. Species and families names of the documented tree species in studied forest.

S.no	Species name	Family name	S.no	Species name	Family name
1	*Pinus roxburghii*	Pinaceae	2	*Pinu swillichiana*	Pinaceae
3	*Eucalyptus camaldulensis*	Myrtaceae	4	*Cupressus sempervirens*	Cupreaceae
5	*Pruns armaniaca*	Rosaceae	6	*Acacia Arabica*	Mimosaceae
7	*Ailanthus altissima*	Simaroubaceae			

The reported tree species were identified in the department of Botany, Shaheed Benazir Bhutto University Sheringal, Dir Upper, Pakistan.

The studied area was dominated by *Pinus roxburghii* Sargent of family Pinaceae. *Pinus wallichiana* of family Pinaceae, *Eucalyptus camaldulensis* of family myrtaceae, *Cupressus sempervirens* of family cupreaceae, *Prunus armeniaca* of family rosaceae, *Acacia Arabica* of family mimosaceae and *Ailanthus altissima* of family simaroubaceae are the other woody tree species that were observed in association with the dominant species. Table 3 shows that 30 % of the documented plants belongs to falimy Pinaceae, while contribution from all other families are same i.e. 14 % each. Site-III is documented as rich in terms of diversity among the other two sites having six (06) number of different tree species. Site-II is composed of sparse vegetation in terms of diversity having two species of family Pinaceae.

Table 2. Phytosociological relative frequency, relative density and relative basal area of *Pinus roxburghii* and other associated species.

S.no	Species	Site I			Site II			Site III		
		F 3	D 3	B.A 3	F 3	D 3	B.A 3	F 3	D 3	B.A 3
1	*Pinus roxburghii*	86.4	90.9	92.8	66.6	93.1	99.9	75.0	79.8	10.2
2	*Pinus willichiana*	7.6	3.4	2.0	33.3	6.9	0.1	7.6	14.9	89.2
3	*Eucalyptus camaldulensis*	5.9	5.5	5.0	*	*	*	*	*	*
4	*Cupressus sempervirens*	3.6	0.1	0.2	*	*	*	0.2	3.04	0.2
5	*Pruns armaniaca*	*	*	*	*	*	*	0.8	0.1	0.03
6	*Acacia Arabica*	*	*	*	*	*	*	1.7	0.9	0.1
7	*Ailanthus altissima*	*	*	*	*	*	*	3.5	1.0	0.06

F 3= Relative frequency, D 3= Relative density, B.A 3= Relative basal area cm^2 ha^{-1} and * indicates absence of the species in the studied site.

Phytosociological Attributes

Phytosociological characteristics of all the studied stands are offered in Table 2. Relative frequency (F3), relative density (D3) and relative basal area (B3) were reported maximum for *Pinus roxburghii* followed by *Pinus wallichiana*. Relative frequency of *Pinus roxburghii*is 86, 92 and 75 in site 1, 2 and 3 respectively. In site three (03) large tree of *Pinus wallichiana* having huge diameter are recorded having relative basal area of 89.2 cm followed *Pinus roxburghii* (10.27 cm) and *Cupressus sempervirens* (0.283 cm). *Pinus roxburghii* and *Pinus wallichiana* are the only two members of Pinaceae present in two sites (see Table 2).

Importance Value Index (IVI)

From values of Importance value index (IVI) it is clearly observable that *Pinus roxburghii* is the only specie that is dominant in all the studied sites. Importance value index of the leading species is recorded 90, 87 and 55 in site 1, 2 and 3 in row. Site 1 and 2 are almost completely dominant by the only specie of *P. roxburghii*. In site-II *Pinus wallichiana* is somewhat found in codomain position with dominant species by contributing value of 39 to the total IVI.

Importance value index of *Cupressus sempervirens* in site is recorded 6, while *Prunus armeniaca* and *Acacia arabica* have the lowest value for IVI i.e. 1 for each. Taking out the members of family pinaceae all the other tree species contributes a negligible amount to IVI in the reported studied sites (see in Table 3).

Table 3. Importance Value Index (IVI) calculated from F3, D3 and B.A3 of all studied sites.

S.no	Species	Site-I	Site-II	Site-III
1	*Pinus roxburghii*	90	87	55
2	*Pinus wallichiana*	4	13	39
3	*Eucalyptus camaldulensis*	6	*	*
4	*Cupressus sempervirens*	*	*	2
5	*Pruns armeniaca*	*	*	1
6	*Ailanthus altissima*	*	*	1
7	*Acacia arabica*	*	*	2

* indicates absence of the species in the concerned site.

Forest structure

Summary of the density per hectare (D ha^{-1}) and basal area centimeter square per hectare (BA cm^2 ha^{-1}) are presented in Table 4. The total tree density for site 1 was1100 tree/ ha ranging from 90 trees/ ha-1 to 840 trees per hectare. In site 2 the dominant tree species comprises 92 % of the total tree density/ha followed by the member of the same specie (08 %). Total of six woody tree species were reported from site 3 with 1200 tree/ ha of which *Pinus roxburghii* shares 85 % to the total i.e. 1020 trees/ha. *Pinus wallichiana* contributes 5.8 %, *Cupressus sempervirens* and *Alianthus altissima* each shares 0.33 % trees per hectare to the total (see Table 4).

Table 4. Values of Density ha^{-1} and Basal area cm^2 ha^{-1} of the documented tree species.

S.no	Species	Site-I		Site-II		Site-III	
		D/ha	BA cm^2/ha	D/ha	BA cm^2/ha	D/ha	BA cm^2/ha
1	*Pinus roxburghii*	840.00	102	1350.00	1000.1	1020.00	928.0
2	*Pinus wallichiana*	170.00	892	100.00	1.9	70.00	20.7
3	*Eucalyptus camaldulensis*	90.00	50.8	*	*	*	*
4	*Cupressus sempervirens*	*	*	*	*	40.00	2.8
5	*Prunus armeniaca*	*	*	*	*	10.00	0.03
6	*Ailanthus altissima*	*	*	*	*	20.00	1.0
7	*Acacia Arabica*	*	*	*	*	40.00	0.6

D/ha = Density per hectare, BA cm^2 ha^{-1} = Basal area centimeter square per hectare.

*indicates absence of the specie in the concerned site.

Basal area centimeter square per hectare of all the reported tree species in the studied sites are offered in table. For the dominant species the absolute values were recorded high among the others. In Site-II the value of density per hectare is1350 for *Pinus roxburghii* followed by *Pinus willichiana*. Basal area cm^2 ha^{-1} value for the dominant species ranges from 102 to 1000 which shows the disturbances to the forests.

Table 5. Environmental and topographic variables of studied sites.

Sites	Latitude	Longitude	Elevation (m)	Slope	Aspect	Canopy
I	34 °58	71 °46	1856.6	15°	E	M
II	34 °51	71 °44	1826.3	21°	S	O
III	34 °31	71 °45	2000.2	13°	S	C

E= east, S= south, M= moderate, O= open, C= close.

Environmental Characteristics of the studied sites

Variability between the topographic and environmental variables of the studied sites are highlighted in Table 5. Site-III is south faced and is located at high elevation (2000 meters) from the sea level. The canopy of this forest is of closed type. Open type of canopy is recorded site-II and located at highest slope (21°) among the all studied sites. The captioned site is situated 1826 meters above the sea level and south facing. Six (06) different environmental factors of studied site-I shows that this site is east facing and having moderate type of canopy.

Discussion

Dominance of P. roxburghii

The flora of the area was representative of the dry temperate areas of the country and was slightly of diverse type (Champion *et al.*, 1965; Alamgir, 2004). In the three studied sites seven woody tree species were recorded, of which *Pinus roxburghii* Sargent was recorded as dominant specie. The dominance of *P. roxburghii* was also reported by Siddiqui *et al.*, (2010) while working on "Phytosociology of *Pinus roxburghii* Sargent (chir pine) in lesser Himalayan and Hindukush range of Pakistan. Two site of the present work shows clear dominance of *Pinus roxburghii*, which are quite in the range of (Ahmed *et al.*, 2006). *P. roxburghii* is the dominant species because it typically grows in pure stands throughout Pakistan, India, Nepal and Bhutan (Sangye, 2005; Ganeev, 2007; Sharma *et al.*, 2009; Siddiqui *et al.*, 2009). The members of Fagaceae, Sapotaceae and Moraceae members are also association as dominant species on lower elevations (Khan *et al.*, 2011; Ali *et al.*, 2017). Khan *et al.*, (2006) investigating effect of environmental variables on vegetation of Chitral forest and reported an equal association of *Pinus wallichiana* with *Cedrus deodara*. In present study site-III is positioned comparatively at high elevation (2000 m) in which *Pinus willichiana* is reported in strong association with dominate specie. Similar trend was reported by Ahmed *et al.*, (2006).

Associated Species

Species like *Q*uercus *baloot*, *Q. incana* and *M. buxifolia* species are the common and normally found exclusive in low altitude evergreen representatives in association with *P. roxburghii* (Badshah *et al.*, 2010; Khan *et al.*, 2007). Singh and Singh, (1986) reported that *Q. incana* and *Q. baloot* are widely distributed in the west with higher concentration in the central Himalaya. However, in the present study both species were completely from the forest stand studies due to its high elevation ranges. Importance value index for the dominant species ranges from 55 to 90. Ali, (2015) reported same from *Olea ferruginea* Royle forests located in Malakand division of Pakistan. Kishwar *et al.*, 2017; Ahmed *et al.*, (2006); Wahab *et al.*, (2008); Alam *et al.*, (2009); Siddiqui *et al.*, (2009) and Khan *et al.*, (2010) reported the density values in the present study are within the range values, in the Himalayan ranges and low-land dry, moist broad leaved and evergreen conifer forests of

the Hindukush. *P. roxburghii* density varied significantly in the present investigation. At dry sites the density of *P. roxburghii* was lower than at moist site occurred more frequently on north facing slopes.

Basal area (cm^2ha^{-1}) recorded in this study ranged from 0.03 to 1000 which is comparatively high for the dominant species and might be attributed to high numbers of individuals in large size classes. However, the basal area values for the associated broad leaved species were low in comparison to the range of 0.03 to 50reported by other workers (Alam *et al.*, 2009; Khan *et al.*, 2011), from undisturbed forests in the lesser Hindukush. The associated broad leaved species contributed less than10% of the total basal area of all species. These forests are highly disturbed due to the removal of all the broad leaved trees for fuel and fodder. During the continuous resin collection, all the surrounding trees and bushes were either felled or destroyed by continuous trampling. Except from the top of the tree, all branches are chopped for fuel purposes. Due to poverty, lack of education and no alternative source for fuel wood, use of vegetation remains the only and most common choice to use as fuel wood in the study area. Deforestation has not only promoted soil erosion but also has caused loss of local fauna in the area. A similar situation in Rajistan India has been reported for deforestation and loss of flora and fauna by Nagothu *et al.*, (2001), in Bangladesh by Danesh *et al.*, (2009) and in Sudan by Alamand Starr, (2009).

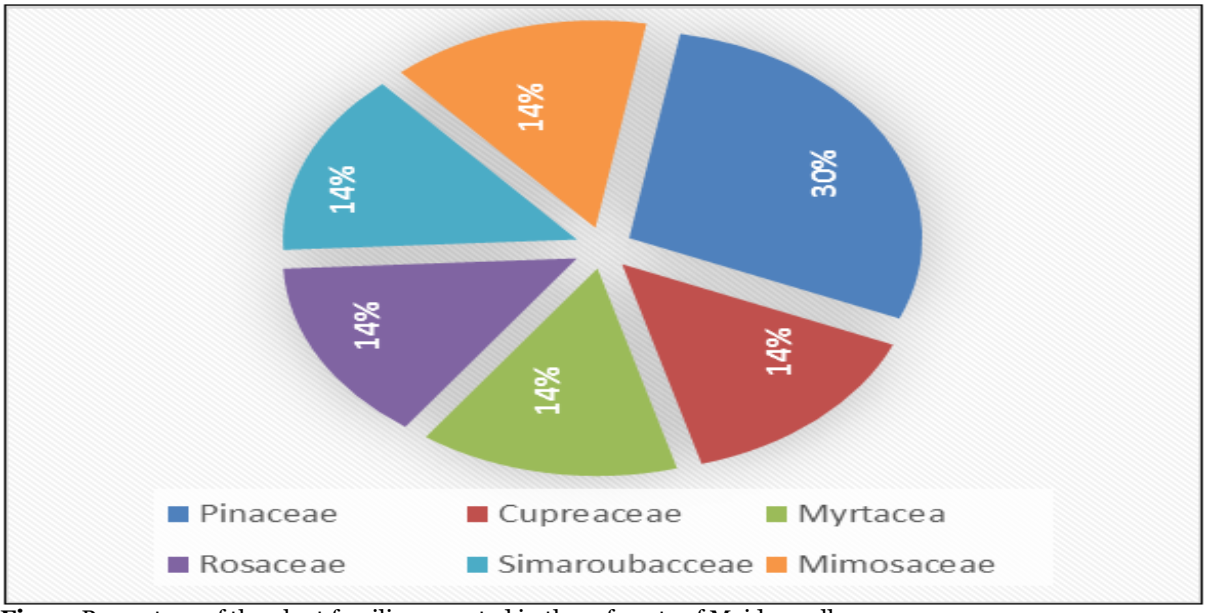

Fig. 2. Percentage of the plant families reported in three forests of Maidan valley.

Canopies

The canopies of the present forest are much of moderate and open type due to disturbances which supports the statement of Siddiqui *et al.*, (2009). The interference effect could be seen in the forest that lower portion of all trees are burned, injured and misshaped. Ground flora is rare without any broadleaved trees, bushes and herbs. At many places, soils have been washed out and rocks are exposed.

To stop soil erosion and to increase regeneration, burning, overgrazing and removal of broad leaved trees and bushes should be stopped for at least ten to fifteen years.

Conclusion

In the present investigation we concluded that forests are dominated by *Pinus roxburghii* Sargent of family pinaceae. While the associated species were poorly distributed this needs to be discouraged. *Pinus roxburghii* is long lived tree with clear boles showing resistivity to different environmental condition in the studied forest. To improve the natural diversity and structure of the forest, to minimize the influence of the surrounding communities and utilize the forest resources sustainably for present and future generations, the basic needs and traditional rights of

the communities over the use of forest resources should be recognized.

The positive attitude toward forest protection and development is possible through the active involvement and sharing unpretentious benefits mechanisms to the local communities.

Acknowledgements

We are also grateful to the anonymous reviewers for all their useful suggestions and contributions. All authors read and approved the final manuscript.

References

Ahamed MT, Hussain AH, Sheikh SS, Hussain, Siddiqui FM. 2006. Phytosociology and structure of Himalayan forests from different climatic zone of Pakistan. Pakistan Journal of Botany **38(2),** 361-383.

Ahmad M, Shaukat SS. 2012. Textbook of vegetation Ecology. Abrar Sons Publishers, Karachi **1, 39** p.

Ahmed M, Khan N, Wahab M, Hamza S, Siddique MF, Nazim K, Khan MU. 2009. Vegetation structure of *olea ferruginea* royle forest of lower dir district of Pakistan. Pakistan journal of botany **41(6),** 2683-2695.

Alam SA, Starr M. 2009. Deforestation and greenhouse gas emissions associated with fuel wood consumption of the brick making industry in Sudan. Science of the total Environment **407(2),** 847-852.

Ali F, Khan N, Ali K, Khan I. 2017. Influence of environmental variables on the distribution of woody species in Muslim graveyards of Malakand division, Hindukush Range Mountains of Pakistan. Pakistan Journal of Botany **49(6),** 2357-2366.

Ali F. 2015. M. phill. Regeneration Patteren and Dendroecology of olea Ferruginea Royle in Malak and Division, Hindu Kush Range of Pakistan.

Ali J, Benjaminsen TA, Hammad AA, Dick OB. 2005. The road deforestation: An assessment of forest loss and its causes in Basho Valley, Northern Pakistan. Global Env. Change **15,** 370-380.

Ali K, Khan S, Khan N, Khan W, Rahman IU, Ullah F, Ali K, Nisar M. 2017. Ethnobotanical and ecological study of Punica granatum in Dir district, Khyber Pakhtunkhwa, *Pakistan*. Regulatory Mechanisms in Biosystems **8(4),** 656–661. http://dx.doi.org/10.15421/0217101.

Armbrust EV, BergesJA, Bowler C, Green BR, Martinez D, Putnam NH, Brzezinski MA. 2004. The genome of the diatom Thalassiosira pseudonana: ecology, evolution, and metabolism. Science **306(5693),** 79-86.

Badshah L, Ibrar M, Hussain F. 2010. An Ethno botanical study on the usage of wild medicinal herbs from Malana hills, Parachinar, Kurram Valley. Journal of Biology Biotech **7(3),** 267-271.

Champion GH, Seth SK, Khattak GM. 1965. Forest types of Pakistan. Pakistan forest institute, Peshawar 111-144.

Danish M, Rashid MHA, Shin MY. 2009. Wood fuel use in the traditional cooking stoves in the rural flood plain areas of Bangladesh: A socio-environmental perspective. Biomass & Bioenergy **33(1),** 70-78.

Ganeev RA, Naik PA, Singhal H, Chakera JA, Gupta PD. 2007. Strong enhancement and extinction of single harmonic intensity in the mid-and end-plateau regions of the high harmonics generated in weakly excited laser plasmas. Optics letters **32(1),** 65-67.

Gutkowski B, Krowiak M, Niedzwiecka J, Oklejewicz IK. 2002. Floristic notes from the Dynow foothills (Western Carpathians). Fragm. F. Geobot. Polonica **9,** 43-47.

Hart HLA, Green L. 2012. The concept of law. Oxford University Press.

Hazrat A, Shah J, Ali M, Iqbal I. 2007. Medicinal value of Ranunculaceae of Dir valley. Pakistan Journal of Botany **39(4),** 1037.

Jones CH. 1967. Parametric production planning. Management Science **13(11),** 843-866.

Khan M, Khan R. 1992. Woody Plant Seed Manual (Pakistan).Retrieved January, 21, 2016.

Khan N. 2012. A community analysis of Quercus baloot Girafft forest Distract Dir Upper, Pakistan, Africa journal of plant science **5(12),** 21-31.

Khan N, Ahmad M, Wahab M, Ajaib M. 2010. Phytosociology, structure and physiochemical analysis of soil in Quercusbhloot, forest district Chitral, Pakistan. Pakistan Journal of Botany **42(4),** 2429-2441.

Khan N, Wahab M, Shaukat SS. 2011. A community analysis in Quercus baloot forest District Dir upper Pakistan. frontier of Agriculture China. (In press).

Khan ZI, Ashraf M, Valeem EE. 2006. Forage mineral status evaluation: The influence of pastures. Pakistan Journal of Botany **38(4),** 1043-1054.

Khan ZI, Ashraf M, Valeem EE, Ahmad K, Danish M. 2007. Pasture concentration of minerals in relation to the nutrient requirements of farm livestock. Pakistan Journal of Botany **39(6),** 2183-2191.

Kishwar A, Farman U, Nasrullah K, Inayat UR, Shariat U, Waqar K, Murad A, Nisar U, Mohammad N. 2017. Ethnobotanical and ecological study of Myrtus communis (L.) in Bajaur agency (FATA) Khyber-Pakhtunkhwa, Pakistan. Journal of Biodiversity and Environmental Sciences **11(1),** 152-164.

Mueller-Dombois D, Ellenberg H. 1974. Aims and methods of vegetation ecology.

Nagothu US. 2001. Fuelwood and fodder extraction and deforestation: mainstream views in India discussed on the basis of data from the semi-arid region of Rajasthan. Geoforum **32(3),** 319-332.

Nasser U, Mohammad N, Suliman N, Zahid A. 2012. Ethno botanical Wealth of Jandool Valley, Dir Lower, Khyber Pakhtunkhwa (Kpk), Pakistan. International Journal of Phytomedicine **4(3),** 351-354.

Russell FL, Fowler NL. 1999. Rarity of oak saplings in savannas and woodlands of the eastern Edwards Plateau, Texas. The Southwestern Naturalist 31-41.

Ryniker KA, Bush JK, Van Auken OW. 2006. Structure of *Quercus gambelii* communities in the Lincoln National forest, New Mexico, USA. Forest Ecology and Management **233(1),** 69-77.

Sangye M. 2005. The impact of fire frequency on the regeneration of Pinus roxburghii in Eastern Bhutan. na.

Sethi HN. 2005. The environment of Pakistan .*peak publishinging London UK*. (ISBN1-901458-490), 1-182.

Sharma CM, Suyal S, Gairola S, Ghildiyal SK. 2009. Species richness and diversity along an altitudinal gradient in moist temperate forest of Garhwal Himalaya. Journal of American Science **5(5),** 119-128.

Sher H, Ali H, Rehman SU. 2012. Identification and conservation of important plant areas (IPAS) for the distribution of medicinal aromatic and economic plants in the Hindu Kush Mountain rang. Pakistan journal of botany **44,** 187-194.

Siddiqui F, Ahmed M, Wahab M, Khan N. 2009. Phytosociology and structure of pinus roxburgi Sergeant (chir pine) in lesser Himalayan rang of Pakistan. Pakistan Journal of Botany **41(5),** 2357-2369.

Siddiqui MF, Ahmad M, Khan N, Khan IA. 2010. Quantitative description of moist temperate conifer forests of Himalayan region of Pakistan and Azad Kashmir. Int. Journal of Biology, Biotech **7(3),** 175-85.

Singh I, Squire L, Strauss J. 1986. Agricultural household models: Extensions, applications, and policy. The World Bank.

Ul-Haq I, Ullah N, Bibi G, Kanwal S, Ahmad MS, Mirza B. 2012. Antioxidant and cytotoxic activities and phytochemical analysis of Euphorbia wallichii root extract and its fractions. Iranian journal of pharmaceutical research **11(1),** 241.

Wahab M, Ahmad M, Khan N, Sarangzai AM. 2010. A phytosociological study of Pine forest from District Dir, Pakistan Journal of Biology. Biotech **7(3),** 219-226.

Wahab M, Ahmad M, Khan N. 2008. Phytosociology and dynamics of some pine forests of Afghanistan. Pakistan journal of Botany **40(3),** 1071-1079.