A COMPARATIVE STUDY OF THE DEFORESTATION AND REGENERATION STATUS OF ZIARAT JUNIPER FOREST

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Abstract

This study was carried out in Ziarat Juniper forest {(*Juniper excelsa* (M. Bieb)} through surveying the five selected locations viz., Zangoon Jungle, Salik Sakhobi, Warkai Zazri, Ambaar Zawar Sar and Nishpa. The data obtained were statistically analyzed for analysis of variance (ANOVA), mean, standard deviation and also for multiple comparison tests of mean values. Results showed that there was statistically an intra non-significant variance but inter significant variance ($p < 0.01$) in the average diameter at breast height (DBH), old (OR), new regeneration (NR) and deforestation (DFR) of the Juniper grown in five selected locations. The OR percentage was calculated to be 13.17, 12.92, 9.92, 8.78 and 6.61 in Zangoon Jungle, Salik Sakhobi, Warkai Zazri, Ambaar Zawar Sar and Nishpa. Likewise the NR percentage found was 10.43, 13.11, 9.74, 5.86 and 7.93 in aforementioned localities, respectively. In comparison to regeneration, the DFR percentage was alarmingly high and it was 20.95, 14, 13.76, 10.22 and 19.02 at Zangoon Jungle, Salik Sakhobi, Warkai Zazri, Ambaar Zawar Sar and Nishpa, respectively. Therefore, the survival chances of Ziarat Juniper forest is equally dangerous/alarming, which is in an urgent need of conservation for its sustainability.

Introduction

Pakistan is among the 10 most populated countries in the world with a geographic area of 307,000 square miles, and a population of over 135 million, with a population density of 389 persons per square mile (Anon., 1998), and the population might reach to 170 million by the end of the year 2011. Pakistan suffers far more severe forest scarcities than most other countries in South Asia. Its natural forest assets are too small, with forest area and national land utilization figures ranging from 3.1% (Anon., 2003) to 3.6% of total land area (Khan, 2002). The forest or woodland area per person is one of the worlds lowest i.e., one-thirtieth of a hectare and most forests are slow-growing (including Juniper). Studies revealed that conifer forests have been declining @ 1.27% per annum (Ahmad *et al.,* 2012). Yet Pakistan's demands on its forests and other natural resources are high. The population is growing at 2.3% annually (Anon., 2002). With a relatively high industrial growth rate of about 6% and huge construction needs, Pakistan continues to put increasing demands on its forests for timber, fuel-wood, and water (Anon., 2000).

Balochistan is one of the largest province of the country, has approximately 141,000 hectares of *Juniperus excelsa* M. Bieb forests, out of which nearly 86,000 hectares of these are found in Ziarat and Loralai districts. The *J. excelsa* typically grows as pure stands, and are characteristically open and multi-storied forests between elevations of 2000-3000 meters (Sheikh, 1985). The valley of Ziarat is situated in northern Balochistan, which possess one of the largest natural, and rare forest type i.e., dry temperate Juniper forest (Ahmed *et al.,* 2006). Ziarat Juniper forest is the second largest Juniper forest in the world the first being the Juniper forest California. It is the only forest area of Balochistan, and one of the oldest juniper trees of the world having trees as old as 2500 to 3500 years are found here (Marcoux, 2000). The growth of Juniper is extremely slow, perhaps slowest in the world only one inch per year. In 100 years the tree attains a height of 8 feet and 3-4 inches in diameter. The Ziarat forest consists of approximately 88,000 ha of nearly pure, open grown stands of *Juniper excelsa*. Apart from their aesthetic value, the greatest contribution of this forest is their watershed value. Much of this forest is in degraded condition, due to excessive levels of fuel wood harvesting and over grazing. The forest also provides many benefits to regional ecosystems and local economies of surrounding communities (Sarangzai *et al.,* 2010). The study area includes irregular and rugged ridges with steep terrain. According to Champion *et al.,* (1965), the Juniper tract falls within the dry temperate forest region. The meteorology and soil physicochemical characteristics of the region have already been explained by Ahmed *et al.,* (1990a&b; 2006).

Research revealed that the population growth and urbanization are amongst the root causes of deforestation. Horticulture practices not only resulted in deforestation, it also led to excavation of ground water. The heart rot fungus attacked Juniper forest and partially decomposed litter is found only under trees and bushes. Therefore, anthropogenic activities appear to play an important role in shaping the vegetation of the area (Bazai *et al.,* 2006). British environmentalist Norman Myers believes that 5% of deforestation is due to cattle ranching 19% due to over-heavy logging, 22% due to the growing sector of palm oil plantations, and 54% due to slash-and-burn farming (Hance, 2008). However, grazing is not very important factor that affects the establishment and growth of young re-growth in the forests. There is no difference in the abundance of new and old regeneration between grazed and non-grazed forests. For instance, Juniper is generally known for its low establishment potential under the closed canopy of mature parent trees (Teketay & Bekele, 1995). Its regeneration is adapted to forest clearing, gaps and forest edges where there is bright sunlight. The extensive

re-growth in intensively logged over forest areas with open canopies (Friis, 1992). No comprehensive quantitative ecological studies have yet been published on Juniper forests; hence the population structure and dynamics of *Juniperus excelsa* in Balochistan have remained almost unknown. However, very little is explained by Ahmad *et al.,* (2012) and Ahmed *et al.,* (1990a&b; 1991). They stated that the rapid degradation of Ziarat Juniper forests is correlated with human disturbance. Sarangzai *et al.,* (2012) also observed that the degraded status of the Juniper forest of Ziarat might be due to anthropogenic disturbances, drought, poor soil conditions, climate change, mistletoe and fungal infections. Keeping severe deforestation in view, Zaidi *et al.,* (2012) studied the micropropagation, regeneration and conservation of three *Juniperus* species. They explain that best roots were produced in IBA applied @1.0 mg/l and significantly high number of roots were produced in *J. chinensis.* Ahmed *et al.,* (2006) noted that the average density of *Juniper excelsa* was 175 stems ha^{-1} with an average basal area of 42m^2 ha^{-1}. It attains 98% of the total importance value. They further stated that the diameter distribution within stands were mostly skewed and unimodel with gaps appearing in large size classes. Therefore, the present study was undertaken with an aim to assess the possible future survival chances of the existing endangered Juniper forest of Ziarat, which is also called "living forest fossils".

Materials and Methods

A total of 15 plots each with an area of 3 acres @ 3 plots per locality were laid out randomly. In each and every of the 15 plots total number of mature trees (tree density), diameter at breast height (DBH), the individual number of new (NR) and old regenerated (OR) trees, and manmade deforestation (DFR) were determined. The NR and OR of Juniper trees were counted in each plot and percentage was calculated. The DFR caused by anthropogenic activities was also calculated by counting the number of fresh cut stumps present in each plot. Data was recorded in pre-designed Performa for each plot/locality separately and subjected to statistical analysis by using the computer software SPSS. This package was used for analysis of variance (ANOVA), mean, standard deviation (SD) and also for multiple comparison tests of mean values.

Results and Discussion

The results of one-way analyses of variance (ANOVA) for average diameter brest height (DBH), new regeneration (NR), old regeneration (OR) and deforestation (DFR) of Juniper trees grown in 5 different localities of Ziarat (Table 1) are found to be non-significant (p<0.05). However, the results obtained for mean and standard deviation (SD) values for aforementioned growth parameters/traits (Table 2) are found to be highly significant (p<0.01). Results further showed that a maximum mean values i.e., 40.13, 4.37, 4.39 and 6.98 for DBH, NR, OR and DFR are obtained for Warkai Zazri, Salik Sakhobi and Zangoon Jungle, respectively (Table 3). While minimum for the same traits are obtained for Zangoon Jungle (DBH) and Ambaar Zawar Sar (NR, OR, DFR). Results also depicted that maximum SD values for DBH (7.09), NR (2.76), OR (2.39) and DFR (2.37) are obtained for Salik Sakhobi, Warkai Zazri and Zangoon Jungle. Whereas minimum for the same attributes are achieved for Ambaar Zawar Sar (1.63), Nishpa (1.23) and also Ambaar Zawar Sar (0.55 and 0.68), respectively. Result based on pooled SD showed that maximum value of 4.69 is received for DBH followed by 1.98, 1.90 and 1.85 for NR, DFR and OR, respectively. Results obtained for multiple comparison test for mean values of DBH exhibited highly significant differences (P<0.01) with NR, OR and FR (Table 4). Whereas the mean values for NR, OR and DFR exhibited non-significant difference with each other at standard error of 1.03346. The maximum non-significance value (0.638) for mean difference is recorded for NR and OR (-0.4887) or for OR and NR (+0.4887).

Table 1. One-way analyses of variance for average diameter breast height (DBH), new regeneration (NR), old regeneration (OR) and deforestation (DF) of Juniper trees grown in 5 different locations of Ziarat.

Source	DBH				NR				OR				DFR			
	SS	MS	F	P	SS	MS	F	P	SS	MS	F	P	SS	MS	F	P
Locations	78.7	19.7	0.90	0.502 NS	9.88	2.47	0.63	0.651 NS	5.45	1.36	0.40	0.807 NS	24.86	6.21	1.71	0.223 NS
Error	219.9	22.0			39.12	3.91			34.39	3.44			36.26	3.63		
Total	**298.6**				**48.99**				**39.84**				**61.12**			
S =	4.689				1.978				1.854				1.904			
R-Sq =	26.36%				20.16%				13.68%				40.67%			
R-Sq(adj) =	0.00%				0.00%				0.00%				16.94%			

Degrees of freedom (dF) for locations, error and total for all are 4, 10 and 14 respectively. SS = Sum of squares; MS = mean squares; F = Fisher's values, and P = probabilities

Table 2. Mean and standard deviation (SD) values for average diameter brest height (DBH), new regeneration (NR), old regeneration (OR) and deforestation (DFR) of Juniper trees grown in 5 different locations of Ziarat.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected model	13382.938^a	3	4460.979	556.911	0.000 **
Intercept	9525.348	1	9525.348	1.189E3	0.000**
Traits	13382.938	3	4460.979	556.911	0.000**
Error	448.573	56	8.010		
Total	23356.858	60			
Corrected total	13831.510	59			

a= R Squared = 0.968 (Adjusted R Squared = 0.966) and **Highly significant at p<0.01

Table 3. Mean and standard deviation (SD) values for average diameter breast height (DBH), new regeneration (NR), old regeneration (OR) and deforestation (DFR) of Juniper trees grown in 5 different locations of Ziarat.

Localities	DBH		NR		OR		DFR	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Zargoon Jungle	35.97	2.97	3.48	2.05	4.39	1.35	6.98	2.37
Salik Sakhobi	37.73	7.09	4.37	2.76	4.31	2.22	4.67	2.01
Warkai Zazri	40.13	6.05	3.25	2.10	3.31	2.39	4.59	0.81
Ambaar Zawar Sar	41.97	1.632	1.95	1.33	2.93	0.55	3.43	0.68
Nishpa	36.37	3.40	2.64	1.23	3.20	2.11	6.34	2.71
Pooled SD	4.689		1.978		1.854		1.904	

Table 4. Multiple comparison test for mean values of average diameter breast height (DBH), new regeneration(NR), old regeneration (OR) and deforestation (DFR) of Juniper trees grown in 5 different locations of Ziarat.

YLSD		Multiple comparisons				
(T) Traits	(t) Traits	Mean difference (T-t)	Std. error	Significance	95% Confidence interval	
					Lower bound	Upper bound
DBH	NR	35.2960[**]	1.03346	0.000	33.2257	37.3663
	OR	34.8073[**]	1.03346	0.000	32.7371	36.8776
	DFR	33.2333[**]	1.03346	0.000	31.1631	35.3036
NR	DBH	-35.2960[**]	1.03346	0.000	-37.3663	-33.2257
	OR	-0.4887NS	1.03346	0.638	-2.5589	1.5816
	DFR	-2.0627NS	1.03346	0.051	-4.1329	0.0076
OR	DBH	-34.8073[**]	1.03346	0.000	-36.8776	-32.7371
	NR	0.4887NS	1.03346	0.638	-1.5816	2.5589
	DFR	-1.5740NS	1.03346	0.133	-3.6443	0.4963
DFR	DBH	-33.2333[**]	1.03346	0.000	-35.3036	-31.1631
	NR	2.0627NS	1.03346	0.051	-0.0076	4.1329
	OR	1.5740NS	1.03346	0.133	-0.4963	3.6443

Based on observed means. The error term is Mean Square (Error) = 8.010. ** The mean difference is highly significant at the 0.01 level

The gravity of the situation can be noticed from the comparison shown in the Fig. 1. The maximum deforestation (DFR) viz., 21.55, 18.60, 14.63, 14.25 and 11.35% has been observed at Zangoon Jungle followed by Nishpa, SaliK Sakhobi, Warkai Zazri, and Ambaar Zawar Sar, respectively. The highest old regeneration (OR) percentage recorded was 13.17 at Zangoon Jungle, 12.92 at Salik Sakhobi and 9.92, 8.78 and 6.61 at Warkai Zazri, Ambaar Zawar Sar and Nishpa, respectively. The new regeneration (NR) percentage found was 10.43, 13.11, 9.74, 5.86 and 7.93 at Zangoon Jungle, Salik Sakhobi, Warkai Zazri, Ambaar Zawar Sar and Nishpa, respectively.
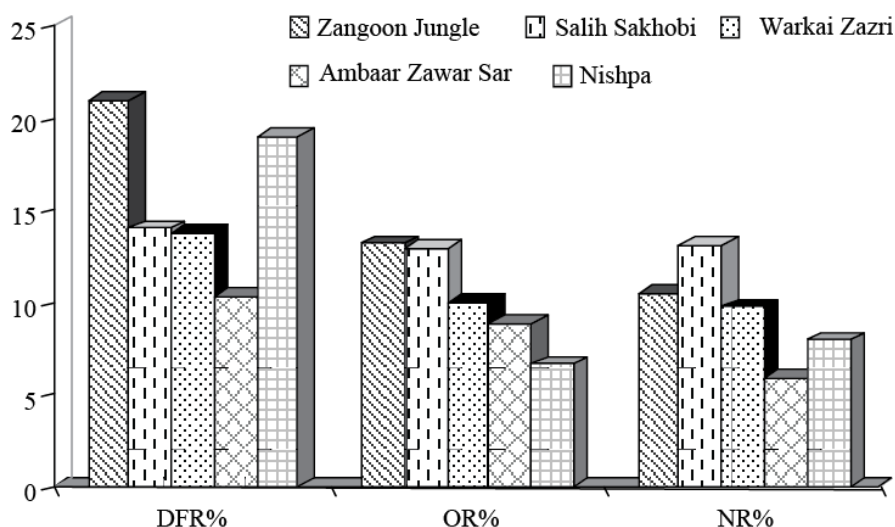

Fig. 1. Deforestation %age versus regeneration %age. DFR = Deforestation, OR = Old Regeneration, and NR = New Regeneration.

The instant data indicate a high rate of deforestation when compared with the regeneration. Moreover, it is not sure that the marginal new regenerations would turn in to mature trees or otherwise other factors. Grazing could be one of the major threats in the area responsible for decrease in regeneration % age. In all the five locations a large proportion of community is dependant on the forest for feeding their livestock. According to PRA study made in the area the livestock are grazed on the forest rangeland for about 7-8 months/year. The situation was not that bad 20-30 years ago and livestock populations were adjusted according to the availability of forage in rangelands to avoid severe damage to livestock and vegetation (Buzdar & Jameson, 1984). The community prefers to keep goats because the sheep feed on soft grasses which are not easily available in these areas. The goats can easily climb and feed on small trees and shrubs which mostly compose the vegetation of the rangelands of these areas. Goats dominate livestock and approximately comprising of 73% population, followed by sheep 25%, and 1% cattle and donkeys. Ahmed *et al.,* (1990a) also reported poor regeneration in *J. excelsa* in Balochistan. The rapid degradation of these forests was correlated with the human disturbance. Ahmed *et al.,* (1990b) also concluded that size class and low seedlings/ sampling densities are the consequence of anthropogenic disturbance.

Conclusion

The results indicate serious deforestation status of the Ziarat Juniper forest, and the future survival chances of the forest are alarming, which is in urgent need of conservation for its sustainability.

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