PLANT COMMUNITIES OF THE JUNIPER FORESTS IN KHALIFAT, ZIARAT (BALUCHISTAN)

by

Dr. Mirza Hakim Khan[1]

Abstract. *The vegetation of Khalifat was studied in July, 1977, applying the method of Braun-Blanquet. The following four plant communities were recognized:*

(1) *Caragana ambigua-Thymus serpyllum community*

(2) *Ephedra nebrodensis-Juniperus excelsa community*

(3) *Perovskia abrotanoides-Juniperus excelsa community*

(4) *Sophora griffthii-Othonnopsis intermedia community*

Community I was found the best both from food and shelter point of view, while the others stand in descending order of importance.

Introduction. The study was conducted to make an enquiry into the habitat of markhor in the Khalifat area. No detailed studies have been done in this respect before. Some of the studies made in the Quetta-Ziarat area are Ali (1966), Beg (1966), Repp and Beg (1966), Repp and Khan (1959) and Khattak (1963). None of these studies, however, were made from the point of view of markhor habitat.

The Juniper woodland at Khalifat is situated at a distance of about 32 km towards the south of Ziarat. The forest comprises one of the biggest juniper belts in the country, covering an area of 56,000 hectares. The Juniper forests of Baluchistan have been included in the dry temperate forest type by Champion, Seth and Khattak (1965).

The climate of the tract is dry continental mediterranean type with a mean annual precipitation of 350 mm, mainly received in the cold period with a part as snow fall in January and February. Some summer showers are also received in July and August. Temperature extremes are a characteristic feature of the climate with the mean maximum temperature of 26.5°C in July and mean minimum temperature of 0.5°C in January. The highest average relative humidity of 81% was recorded in January, while the lowest of 14% in October. Strong winds from north to south are common with the strongest ever recorded was in June. The average wind speed is 132 km/day.

The soils in the area are shallow, poor, resulting from Siwalik conglomerates, sandstones and shales. They are generally clay loamy in the B and C horizons with very little

[1] The author is Assistant Forest Ecologist, Pakistan Forest Institute, Peshawar.

humus in the O horizon (Surface organic). They are highly calcalreous, non-saline with a pH of 8 as observed in the field. They are subject to rather rapid erosion. The best frowth of the trees was found on somewhat better deep soils near the stream-beds in the lower reaches of the slopes.

Biotic factor appears to play a great role in the development of vegetation in the area. Juniper is extensively lopped for fencing fields scattered throughout the forests. In addition to multilating the tree, this practice also allows the entry of fungus which ruins the timber through rot (Khattak, 1963). The trees are debarked and the bark is used for thatching the temporary summer huts. Debarking naturally weakens the trees which ultimately begin to die. The dead trees are later cut. Young shoots are lopped for feeding the animals. *Pyrofomes demidoffii* is known to attack the juniper causing heart rot in the wood (Beg and Jamal, 1974). A phanerogamic parasite, *Arceuthobium oxycedrii* is also known to attack and kill the trees in the area (Beg and Jamal, 1974). Nomadic grazing is a serious problem in the area. The lack of regeneration in Juniper is a common problem for this species, and is often correlated with grazing animals. It is presumed that, since the seedlings grow very slowly and are rather brittle, they are easily knocked off by trampling of grazing animals. Because of human interference and competition for food with grazing animals at lower altitudes, markhor a very sensitive animal tends to stay rather at higher altitudes.

Material and Methods. For study of vegetation 72 releves were laid out in the reasonably homogeneous sites. The sample plot size was 200m^2. The vegetation data was recorded and analysed after the method of Braun-Blanquet (1965) and association tables prepared according to the preferential constant dominant species method of Cetik (1971). The life-forms were determined after Raunkiaer (1934) while nomenclature of plants was after Stewart (1972).

Results. On analysis of the vegetation ata. The following four plant communities were identified:—

(1) *Caragana ambigua-Thymus serpyllum* community

(2) *Ephedra nebrodensis-Juniperus excelsa* community

(3) *Perovskia abrotanoides-Juniperus excelsa* community

(4) *Sophora griffithii-Othonnopsis intermedia* community

Caragana ambigua-Thymus serpyllum community. The community is well-represented in the Zizri area at altitudes of 2400-2700m, on dark brown, deep silty loamy soils. The soil was found moist down to about one m. The pH was 6 in the (0-6 inch surface horizon and 7.5-8 in the sub-surface horizon (6-24 inch).

The biological spectrum of the community is as follows:

Phanerophytes nil	Nanophanerophytes 31%
Hemicryptophytes 10%	Chamaephytes 21%
Geophytes 10%	Therophytes 28%

The community is quite rich in nanophanerophytes (Table 1) and provides good shelter and food for the markhor. This is in fact the best habitat for markhor. It is also the best from juniper regeneration point of view. The communiy was observed to contain about 5 juniper seedlings in the various releves (Table 1). The seedlings were found in the large gregareous patchy growth of *Thymus serpyllum*. Under these patches, adequate moisture and litter are avilable and so this provides a good habtat for germination of juniper seed.

At lower altitudes the community is subject to heavy grazing pressure. As such there is a great danger of knocking-off of the seedlings due to trampling by the grazing animals.

Ephedra nebrodensis-Juniperus excelsa community. The community is confined to bare rocky cliffs of upper Siwalik conglomerates. *Ephedra nebrodensis* is gregareous in habit and occurs in patches. The parent rocks are usually sandstones mixed with limestones (Khattak, 1951). The biological spectrum of the ommunity is as follows:—

Phanerophytes 4%	Nanophanerophytes 21%
Hemicryptophytes 33%	Chamaephytes 8%
Geophytes 4%	Therophytes 29%

It is not so rich in nano-phanerophytes (Table 2) as community 1, but is less rich in food-supplying nanophanero-phytes. Thus this plant community stands at second as a markhor habitat after community 1. This community, however, stands at third as far as juniper regeneration is concerned and one seedling was found in each relevee (Table 2). The seedlings were found in rock crevices where they were well-protected against trampling by grazing animals.

Perowskia abrotanoides-Juniperus excelsa community. The community is restricted to comparatively moist situations along dry streams on deep soils. *Perowskia abrotanoides* grows gregareously in large patches on gentle slopes in the openings. The biological spectrum of the community is as follows:

Phanerophytes 9%	Nanophanerophytes 17%
Hemicryptophytes 22%	Chamaephytes 26%
	Therophytes 26%

This community stands at third as a markhor habitat. It is still less so rich in both shelter and food plants. It, however, stands at second from juniper regeneration point of view. Three to four juniper seedlings were observed on the average in the various releves (Table 3). This community is, however, slowly being replaced by *Othonnopsis intermedia-Sophora qriffithii* community.

Sophora griffithii-Othonnopsis intermedia community. The community is restricted to comparatively dry exposed southern hotter aspects at medium-high altitudes on rather overgrazed sites in the woodlands.

The community is developed on clay loamy soils with a pH of 8 throughout the profile. The community has taken over large tracts of the juniper ecosystem. The biological spectrum of the community is given below:—

Phanerophytes 5%	Nanophanerophytes 27%
Hemicryptophytes 18%	Chamaephytes 36%
	Therophytes 14%

The community is relatively the poorest as a markhor habitat both from shelter and food point of view.

The habitat is under a heavy grazing pressure as a result of which unpalatable species such as *Sophora griffithii* and *Othonnopsis intermedia* have both increased in abundance and dominance. The community is likely to assume a subclimax position in the future.

In terms of juniper regeneration, too, this habitat is the poorest as is clear from table 1.

Table 1

Caragana ambigua Thymus serpyllum Community

Quadrat No.	66	69	70	71	72	Pre-	Fre-	Const-
Area (m^2)	200	200	200	200	200	sence	quency	ancy
Elevation (m)	2440	2500	2550	2600	2700		%	Class
Direction	N	S	W	E	SE			
Slope (O)	50	55	45	40	45			
Parent rock	Lime-stone	Lime-stone	Lime-stone	Lime-stone	Lime-stone			
HCl reaction	++	++	++	++	++			
pH	8.00	8.00	7.8	8.00	7.5			
Vegetation coverage (%)	85	80	80	70	60			
No. of spp.	25	19	22	17	16			
Ist storey								
Absent.								
2nd storey								
NPh Caragana ambigua	+	2	2	2	+	5	100	V
NPh Lonicera qainque locularis	2	2	2	2	—	4	80	IV
NPh Prunus eburnea	1	1	1	—	1	4	80	IV
NPh Spiraea boissieri	1	1	—	1	+	4	80	IV
NPh Cotoneaster nummularia	1	1	—	+	1	4	80	IV
NPh Rosa beggeriana	+	1	1	+	—	4	80	IV
NPh Berberis baluchistanica	+	1	1	1	—	4	80	IV
NPh Jasminum humile	+	1	1	1	—	4	80	IV
NPh Prunus amygdalus	+	+	—	—	1	3	60	III

3rd storey									
Ch	Thymus serpyllum	2	2	3	2	2	5	100	V
H	Onobrychis cornuta	—	1	1	1	1	4	80	IV
Ch	Stipa pennata	1	1	2	—	—	3	60	III
Ch	Acantholimon polystachyum	1	+	—	—	1	3	60	III
G	Eremurus aucherianus	—	—	2	+	1	3	60	III
Ch	Gaillonia eriantha	—	—	1	+	1	3	60	III
H	Nepeta glomerulosa	—	+	1	—	1	3	60	III
Ch	Acantholimon stocksii	+	1	+	—	—	3	60	III
Th	Cousinia onopordioides	1	—	1	+	—	3	60	III
Th	Hedysarum wrightianum	1	—	1	—	1	3	60	III
Th	Astragalus trichocarpus	1	—	1	—	1	3	60	III
Ch	Agropyron cristatum	+	1	+	—	—	3	60	III
Th	Aquilegia vulgaris	+	+	1	—	—	3	60	III
H	Silene brahuica	1	—	1	1	—	3	60	III
Th	Melica persica	3	1	1	—	—	3	60	III
G	Scorzonera tuberosa	+	1	—	—	1	3	60	III
Th	Onosma hookeri	+	—	—	1	1	3	60	III
Th	Poa bulbosa	+	—	1	1	—	3	60	III
Th	Bromus japonicus	+	—	+	1	—	3	60	III
G	Allium capitellatum	1	—	—	1	+	3	60	III
—	Juniperus excelsa seedlings (No.)	5	6	5	5	5			

* Ph — Phanerophytes NPh — Nanophanerophyte
H — Hemicryptophyte Ch — Chemaephyte
G — Geophyte Th — Therophyte

Table 2

Ephedra nebrodensis-Juniperus excelsa Community

Quadrat No	55	60	62	64	67	Pre-	Freq-	Con-
Area (m^2)	200	200	200	200	200	sence	quency	stancy
Elevation (m)	2460	2480	2550	2600	2620		%	Class
Direction	N	S	W	E	SE			
Slope (O)	50	55	50	45	45			
Parent rock	Lime-stone	Lime-stone	Lime-stone	Lime-stone	Lime-stone			
HCl reaction	++	++	++	++	++			
pH	8.8	8.6	8.5	8.0	7.5			
Vegetation Coverage %	60	55	60	60	60			
No. of spp.	23	20	14	20	16			

1st storey									
Ph	Juniperus excelsa	3	3	3	2	+	5	100	V
2nd storey									
NPh	Ephedra nebrodensis	3	3	3	4	4	5	10	V
NPh	Prunus amygdalus	2	3	1	+	1	5	100	V
NPh	Berberis baluchistanica	1	+	+	+	1	5	100	V
NPh	Dephne oleoides	1	+	+	1	—	4	80	IV
NPh	Caragana ambigua	1	1	—	1	1	4	80	IV
3rd storey									
Th	Hedysarum wrightianum	+	+	1	—	1	4	8	IV
G	Allium capitellatum	+	1	—	+	+	4	80	IV
Ch	Thymus serpylum	+	1	1	1	–	4	80	IV
H	Minuartia sp.	+	+	1	1	—	4	80	IV
H	Viola kunawurensis	+	+	+	—	+	4	80	IV
H	Othonnopsis intermedia	1	1	1	—	+	4	80	IV
Th	Linum sp.	1	+	+	1	—	4	80	IV
Th	Cousinia onopordioides	+	1	—	1	+	4	80	IV
H	Bupleurum falcatum	+	+	—	1	+	4	80	IV
Th	Centaurea depressa	1	1	1	+	—	4	80	IV
H	Echinops griffithianus	+	+	—	+	+	4	80	IV
Th	Onosma hookeri	1	+	—	—	+	3	60	III
H	Dianthus annulatum	+	—	—	1	+	3	60	III
Th	Eremurus aucherianus	1	—	—	+	+	3	60	III
Ch	Acantholimon polystachyum	+	—	1	1	—	3	60	III
H	Verbascum erianthum	+	+	—	1	—	3	60	III
Th	Bromus japonicus	+	—	—	1	1	3	60	III
H	Cymbopogon jwarancusa	—	1	+	1	—	3	60	III
—	Juniperus excelsa seedlings								
	No	1	1	1	1	1			

Table 3

Perovskia abrotanoides-Juniperus excelsa Community

Quadrat No	25	30	35	40	50	Pre-	Fre-	Con-
Area (m^2)	200	200	200	200	200	sence	quency	stancy
Elevation (m)	2410	2420	2430	2440	2480		%	Class
Direction	S	N	W	E	NW			
Slope (0)	55	55	50	45	40			
Parent rock	Lime-stone	Lime-stone	Lime-stone	Lime-stone	Lime-stone			
HCl reaction	++	++	++	++	++			
pH	8.5	8.00	8.00	8.8	8.00			
Vegetation coverage (%)	70	80	75	70	75			
No. of species	16	23	19	21	16			

1st storey									
Ph	Juniperus excelsa	3	+	3	3	3	5	100	V
Ph	Fraxinus xanthoxyloides	1	+	+	+	1	5	100	V
2nd storey									
NPh	Cotoneastar nummularia	2	1	1	1	1	5	100	V
NPh	Lonicera quinquelocularis	2	1	+	1	1	5	100	V
NPh	Daphne oleoides	2	+	+	1	1	5	100	V
NPh	Caragana ambigua	1	+	1	2	1	5	100	V
3rd storey									
H	Perovskia abrotanoides	4	4	4	4	5	5	100	V
Ch	Acantholimon munroanum	1	+	1	1	1	5	100	V
Ch	Stipa pennata	1	+	1	1	1	5	100	V
Ch	Artemisia maritima	1	+	1	+	1	5	100	V
Th	Melica persica	1	+	1	1	1	5	100	V
Th	Dactyloctaenium sp.	+	1	—	1	—	4	80	IV
Ch	Cymbopogon jwarancusa	—	1	1	1	+	4	80	IV
Th	Bromus japonicus	—	1	1	1	+	4	80	IV
CH	Sal-via cabulica	—	1	+	1	+	4	80	IV
H	Vio-la kunawurensis	1	1	—	+	—	3	60	III
H	Verbascum erianthum	—	+	—	+	+	3	60	III
Ch	Lactuca viminea	1	1	1	—	—	3	60	III
H	Bupleurum falcatum	—	1	1	+	—	3	60	III
Th	Hedysarum wrightianum	+	1	+	—	—	3	60	III
TH	Eremurus aucherianus	—	1	+	1	—	3	60	III
TH	Salvia glutinosa	—	1	1	1	—	3	60	III
H	Peganum harmala	1	+	—	+	—	3	60	III
—	Juniperus excelsa seedlings (No)	4	3	3	4	4			

Table 4

Sophora griffithii-othonnopsis intermedia Community

Quadrat No.	1	4	8	10	20	Pre-sence	Fre-quency	Con-stancy
Area (m^2)	200	200	200	200	200			
Elevation (m)	2180	2250	2350	2400	2670		%	Class
Direction	N	S	W	E	NW			
Slope (0)	45	50	40	50	45			
Parent rock	Lime-stone	Lime-stone	Lime-stone	Lime-stone	Lime-stone			
HCl reaction	++	++	++	++	++			
pH	7.9	8.00	7.5	8.5	8.00			
Vegetation coverage (%)	80	75	85	90	90			
No. of species	2	18	15	16	10			

1st storey								
Ph	Fraxinus xanthoxyloides	+	+	1	1	1	5	100	V
2nd storey								
NPh	Ephedra nebrodensis	1	2	1	1	+	5	100	V
NPh	Caragana ambigua	2	1	1	1	+	5	100	V
NPh	Berberis baluchistanica	1	+	1	—	1	4	80	IV
NPh	Daphne oleoides	2	1	1	—	+	4	80	IV
3rd storey								
Ch	Sophora griffithii	3	3	4	4	4	5	100	V
Ch	Haloxylon griffithii	1	+	—	+	1	4	80	IV
H	Othannopsis intermedia	3	2	3	3	—	4	80	IV
Th	Cousinia multiloba	+	—	+	1	1	4	80	IV
Ch	Acantholimon munroanum	2	1	1	1	—	4	80	IV
Ch	Stipa jacquemontii	1	+	—	1	+	4	80	IV
TH	Melica persica	1	2	1	+	—	4	80	IV
H	Jurinea carduiformis	+	1	+	—	1	4	80	IV.
Ch	Artemisia maritima	+	1	1	+	—	4	80	IV
Th	Bromus japonicus	+	1	1	+	—	4	80	IV
Ch	Scutellaria petiolata	1	—	+	+	—	3	60	III
H	Achillea santolina	+	1	—	+	—	3	60	III
CH	Perovskia abrotanoides	2	1	2	—	—	3	60	III
H	Cymbopogon martinii	1	+	—	+	—	3	60	III
Ch	Thymus serpyllum	+	1	—	+	—	3	60	III
—	Juniperus excelsa seedlings (No)	0	0		0	0			

Discussion and Conclusion. The study shows that those plant communities which have a high percentage of nanophanerophytes form a good markhor habitat. They amply provide both food and shelter.

Most of the juniper forests are situated at higher elevations. The tree seems to be missing on lower elevations. Higher elevation, deep soils and adequate moisture are prerequisite ecological conditions for the successful growth of the tree (Khattak, 1965). The present author, too, observed the same in the course of his study of the juniper ecosystem.

Juniper shows good regeneration in Thymus serpyllum-Caragana ambigua community and Perovoskia abrotanoides-Juniperus excelsa community whereas the regeneration is poor in the Ephedra nebrodensis-Juniperus excelsa community and totally absent from Sophora griffithii-Othonnopsis intermedia community. The study guides that better regeneration prospects for juniper exist in community 1 and 3 with *Thymus serpyllum* and *Perovskia abrotanoides* as indicators of such sites.

According to the author xeric conditions and biotic interference seem to be the biggest hinderance in the way of regeneration of the juniper. Attention needs to be focussed on the Khawarai Baba area at high altitudes (2670m), where *Sophora qriffithii* is rapidly invading, following cutting of trees, over-grazing and consequential erosion. A similar result appeared on the other side of the valley while going to Sasnamana. It is feared that if cutting and over-grazing are not stopped, the entire tract may just become a desert land with nothing but *Sophora griffithii* and *Othonnopsis intermedia* in the lower elevations.

Acknowledgements. The author is grateful to Dr. A.R. Beg, Forest Botanist for scrutinising the paper and suggesting the improvements.

References

1. ALI, ZULFIQAR. (1966) A note on silvicultural characteristics of *J. macropoda* Boiss. Proc. Silv. Conf. Pakistan Forest Institute, Peshawar pp. 197-202.
2. BEG, A.R. (1966) Preliminary study of the vegetation of Quetta. West Pakistan Range Management Conf. Pakistan Forest Institute, Peshawar pp. 6-17.
3. BEG, A.R. and S.M. JAMAL. (1974) Survey of diseases of conifers and selected hardwoods in Pakistan. Final Technical Report. Pakistan Forest Institute, Peshawar.
4. BRAUN-BLANQUET, J. (1965) Plant sociology. Translated by Fuller and Conard. H.S. Mc-Graw Hills, New York.
5. BURKILL, I.H. (1926) A working list of the flowering plants of Baluchistan, Quetta.
6. CHAMPION, SIR HARRY, G.S.K. SETH and G.M. KHATTAK. (1965) Forest Types of Pakistan. Pakistan Forest Institute, Peshawar.
7. CETIK, R. and A. TATLI. (1971) A phytosociological and ecological study on the vegetation of Plandoken mountains. Communication, Tome 19, Serie C2: 1-24.
8. REPP, G.I. and A.R. BEG. (1966) Preliminary ecological observations in the juniper forests of Ziarat, Baluchistan. Proc. of the 2nd Pakistan Silvic. Conf. Pakistan Forest Institute, Peshawar. pp. 245-253.
9. REPP, G.I. and A.H. KHAN. (1959) Studies on the vegetation and Ecological Pathology in Ziarat Juniperus Forest. Tech. Rep. No. 9.
10. KHATTAK, G.M. (1963) Working plan for Juniperus forest of Quetta Civil Division from 1961-1962 to 1975-1976.
11. KHATTAK, G.M. (1951) Ephedra in Baluchistan. Pak. J. For. I. (I): 37-40.
12. KHAN, M. Hakim (1978) Phytosociological studies in Chitral Gol. Pak. Jour. For. 28(2): 99-110.
13. KHAN, M. HABIB. (1960) Range plant book. West Pakistan Records I. Superintendent, Govit. Printing, West Pakistan, Lahore.
14. RAUNKIAER, C. (1934) The life forms of plants and Statistical plant Geography. Translated by Carter, Fausboll and Tansley, Oxford University Press.
15. STEWART, R.R. (1972) Flora of West Pakistan. An Annotated Catalogue of the vascular paltns of West Pakistan and Kashmir, Karachi.