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THE ECOLOGY OF THE NATIVE VEGETATION OF KOHAT, NWFP, PAKISTAN

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Abstract

The vegetation around the shrine of Khandezi Baba, located at a distance of 2.5 km east of Kohat, was sampled and analyzed in the winter of 1974-75. The area, because of the sanctity of the shrine, remained protected for a long time but has considerably been disturbed in the recent past.

Acacia-Adhatoda and *Acacia-Malcolmia* communities dominated by *Acacia modesta* were noticed on more mesic sites. *Acacia-Rhazya-Adhatoda* community dominated by *A. modesta* was confined to dry stream beds only. *Salvadora-Malcolmia* community, dominated by *Salvadora oleoides*, was found on a greatly disturbed, open and xeric site. The communities are considerably disturbed and none of the dominant arborescent species is self-perpetuating. The biotic interference will completely eliminate *A. modesta* and its place will be taken by *Capparis decidua* which can form a climax with *S. oleoides*.

Introduction

The research site is a small patch of land about 5 sq. km. in area and located at a distance of about 2.5 km from the eastern limits of Kohat Cantonment at 33° 30' north latitude and 71° 30' east longitude. The elevation of Kohat is about 539 m. above sea level and is situated in a valley between parallel hill ranges running from west to east. A larger part of the district of Kohat is hilly and is geologically divided into northern part which is predominantly rich in limestone and southern part in which the higher ranges are made up of sandstone and rocks of gypsum series (Wadia, 1957). The research area is located in the northern part. It lies at the foot of Kohat hills, about 915 m' to the south of these hills in the vicinity of Kohat town. To the north of the research area, the intervening land between the research area and the Kohat hills is composed of low calcareous hillocks with rounded tops and gradually merging into the plains close to the research site. To the west is the raised ground of Kohat City and towards the east is an open land which merges into the calcareous hills further east. In the south, there is a piece of raised land with stony surface and, in fact, one of the five stands constitutes a part of it.

The shrine of Khandezi Baba, popularly known as "Palosay Baba", because of abundance of *Acacia modesta* which is locally known as 'Palosay', is situated at the northern periphery of the research area. As a mark of respect to this great saint, the people refrained from cutting and chopping the trees and bushes, and generally,

did not let their cattle graze near it. However, because of increasing population, diminishing faith in the sanctitity of the shrine and pressing demand for firewood, the axe frequently seems to play its role under the lengthening shadows of the setting sun. In the recent past, the area has also come under heavy grazing pressure. The area was selected for this study because it is a small inset in the general landscape of Kohat and its outskirts which supports a vegetation that has remained protected for a considerable period of time and is now at the verge of extinction due to heavy biotic interference. The area supports remanants of native vegetation of the region and its study provides some insight into the ecology of the vegetation of Kohat and its outskirts. Thus, the purpose of this study was to bring on record the characteristics of this fast vanishing native vegetation of Kohat.

SOILS

Soils of the area in general are clay loam in texture in which red clay, which imparts red colour to the soil, is dominant. The soil of the research area is of medium structure and is rich in calcium and phosphates but somewhat deficient in nitrogen.

CLIMATOLOGY

Temperature

The climate of Kohat town and its outskirts is of continental type. The summer is hot and spring and autumn are pleasant. The winter is cold and the strong west wind known as 'Hangu Breeze', is violent in winter, especially in the early hours of the day. In winter, the frost is common and occasionally the mercury goes down the freezing point. December is the coldest month whereas the hottest month is June (Table 1).

Precipitation

Rain is the main source of precipitation though some hails in spring and, very rarely, snowfall may be experienced in winter. The rainfall is well distributed round the year but the amount varies from year to year. However, 20 to 25 inches can be considered as normal annual precipitation. Of the total rainfall, 33 per cent comes in summer with the month of July receiving the maximum (Table 1). November is the driest month.

Materials and Methods

The woody plants were sampled in 2.5 X 5m plots laid systematically and the number and diameter at breast height (dbh; 1.3 m) of each plant were recorded. The undergrowth species were sampled in 20 X 50 cm plots and their canopy-coverage was recorded acording to Daubenmire's method (Daubenmire, 1959). The number of these plants was also recorded. Altogether, 83 plots were laid for the woody species and 163 for the undergrowth species; thus sampling was done of a total area of 1,037.5 sq m for the former and 16.3 sq m for the latter.

Basal area and canopy-coverage, density, frequency and their relative values and importance values for the woody and undergrowth species were calculated according to Cox (1967). The relative values are the percentage of the total of the

TABLE 1. Average of mean maximum and mean minimum temperature (°F) and normal precipitation (inches) recorded at Kohat for a period of 10 years (1961-70) (courtesy Meteorological Department, Lahore).

	Temperature (°F)		Precipitation (inches)
	Max.	Min.	
January	68.3	42.6	1.27
February	75.1	63.1	1.63
March	75.1	63.6	2.69
April	84.2	72.8	2.11
May	95.4	80.8	1.31
June	104.7	80.8	1.00
July	100.5	80.8	3.45
August	97.8	79.3	3.06
September	95.8	75.3	2.07
October	87.9	65.9	1.25
November	76.7	53.8	0.69
December	64.0	44.6	1.38
		Total:	21.86

attributes for all species contributed by each species. The importance value is the sum of relative values of density, basal area or canopy-coverage and frequency for a species.

The nomenclature followed for the plants is that of Nasir & Ali (1972). The study was conducted in the winter of 1974-75.

Results and Discussion

THE COMMUNITES

The variety of vegetation found around the shrine of Kahandezi Baba seems best combined into four plant communities. The names of the communities are based on the conspicuous dominants of different layers.

Stands 1 and 2, which are more mesic and least disturbed because of their vicinity to the shrine, support *Acacia-Adhatoda* and *Acacia-Malcolmia* communities respectively. *Acacia-Rhazya-Adhatoda* community is confined to stands 3 and 4, which comprise dry beds of seasonal streams with slightly raised and stable banks. In stand 5, which is most exposed and conditions are xeric, there occurs *Salvadora-Malcolmia* community.

Acacia-Adhatoda Community

This community is confined to stand 1 which is a part of flat alluvial plain. The soil is clay loam and is deficient in organic matter. The site, because of its vicinity to the shrine, remained considerably protected in the past. It is traversed by small water channels which originate from a perennial spring located in the hillocks north of shrine. The community is dominated by *Acacia modesta*. *A. modesta*, of all the communities, is most successful here which is manifested by its highest importance value, and this is perhaps because of the most mesic conditions prevailing here (Table 2). The basal area, density and frequency of the dominant woody species are higher in this community than the others. The bulk of the basal area is contributed by large *A. modesta* trees and the number of young plants less than 2 cm dbh is one-tenth of the old specimens (Table 3). A number of gaps in the size classes of this dominant species indicate periods of good and poor establishment. *A. modesta* is most uniformly distributed (Table 2).

In the hilly tracts of the district of Kohat, *A. modesta* constitutes the climax vegetation with *Olea ferruginea*. The presence of a big *O. ferruginea* tree in the enclosure of the shrine, which is highly protected, further lends support to the idea that *O. ferruginea* can not only establish itself in the research area but can also form a climax with *A. modesta* provided the biotic interference is eliminated.

Cocculus pendulus and *Ephedra ciliata* were noticed growing on large specimens of *A. modesta* and *Salvadora oleoides*. *S. oleoides* is represented by two size classes only and eversince not a single plant of this species has survived (Table 3). *Zizyphus nummularia* has very recently entered the community. *Adhatoda vasica* is the co-dominant of the community from the lower stratum (Table 4).

The community seems to possess considerably closed canopy because of highest average density and basal area of woody plants and this may account for low average density of undergrowth species (Table 5). However, the largest canopy-coverage value of undergrowth plants suggests the presence of comparatively larger specimens of this group. In comparison with three other communities, *Acacia-Adhatoda* community seems to be in a more advanced successional stage.

Acacia-Malcolmia Community

The community, dominated by *Acacia modesta*, is restricted to stand 2, where the general conditions are similar to that of stand 1 (Table 2). The high importance value of *A. modesta* is due to more mesic conditions. The large value of basal area is almost solely contributed by big specimens of *A. modesta* and the number of younger plants less than 2 cm dbh is one-sixteenth of the older ones (Table 3). The rate of survival is extremely low because the young plants are being grazed upon. The presence of large number of older specimens suggests that the area had remained well

TABLE 2. Average density (D, number/0.1 hectare), basal area (BA, cm?/0.1 hectare), frequency (F, per cent) and importance value (IV) of woody species.

SPECIES	COMMUNITY															
	Acacia-Adhatoda				Acacia-Malcolmia				Acacia-Rhazya-Adhatoda				Salvadora-Malcolmia			
	D	BA	F	IV	D	BA	F	IV	D	BA	F	IV	D	BA	F	IV
Acacia modesta	168	174118	90	195	136	9464	80	192	73	46333	61	175	12	4573	15	25
Salvadora oleoides	24	27356	30	36	16	10367	20	25	24	17651	30	67	60	47863	75	176
Capparis decidua	56	7513	60	54	40	5699	40	46	27	3958	35	58	44	5126	50	71
Zizyphus nummularia	16	T	20	14	32	T	40	36	—	—	—	—	16	T	20	28

(T = traces)

TABLE 3. Number of woody species per 0.1 hectare by size classes and communities. (AA, *Acacia-Adhatoda* community; AM, *Acacia-Malcolmia* community; ARA, *Acacia-Rhazya-Adhatoda* community, and SM, *Salvdora Malcomia* community).

SPECIES	COMMUNITY	Diameter at breast height (dbh) in cm												
		⩽2	2—6	6.5—10.5	11—15	15.5—19.5	20—24	24.5—28.5	29—33	33.5—37.5	38—42	42.5—46.5	47—51	>51
Acacia modesta		16	32	—	24	—	—	8	8	24	16	—	16	24
Salvadora oleoides		—	—	—	—	—	—	—	—	16	—	8	—	—
Capparis decidua	AA	24	—	—	8	16	8	—	—	—	—	—	—	—
Zizyphus nummularia		16	—	—	—	—	—	—	—	—	—	—	—	—
Acacia modesta		8	24	—	16	8	—	24	16	8	—	8	24	—
Salvadora oleoides		—	—	—	—	—	8	—	—	8	—	—	—	—
Capparis decidua	AM	—	—	16	8	16	—	—	—	—	—	—	—	—
Zizyphus nummularia		32	—	—	—	—	—	—	—	—	—	—	—	—
Acacia modesta		10	—	10	3	7	7	7	3	10	3	—	10	—
Salvadora oleoides	ARA	—	—	—	—	3	3	3	7	3	3	—	—	—
Capparis decidua		—	—	3	21	3	—	—	—	—	—	—	—	—
Acacia modesta		—	—	—	4	2	—	4	—	2	—	—	—	—
Salvadora oleoides		—	—	—	—	2	6	14	24	6	4	—	4	—
Capparis decidua	SM	2	4	8	22	8	—	—	—	—	—	—	—	—
Zizyphus nummularia		16	—	—	—	—	—	—	—	—	—	—	—	—

protected in the distant past and *A. modesta* got established under these ideal conditions. Later on, the area was subjected to heavy grazing and the young plants could not survive under these conditions. The gaps in the size classes suggest periods of poor and good establishment. The importance value of *Salvadora oleoides* is lowest in this than all communities. *Zizyphus nummularia* is represented by very young specimens. *Malcolmia africana*, a winter annual, is the co-dominant of the community from the lower stratum (Table 4). The canopy of this community is more open than *Acacia-Adhatoda* community and this may be regarded as one of the reasons of *Adhatoda vasica* being outclassed by *M. africana*.

TABLE 4. Average density (D), canopy-coverage (CC), frequency (F) and importance value (IV) of the undergrowth species.

SPECIES	COMMUNITY															
	Acacia-Adhatoda				Acacia-Malcolmia				Acacia-Rhazya-Adhatoda				Salvadora-Malcolmia			
	D	CC	F	IV	D	CC	F	IV	D	CC	F	IV	D	CC	F	IV
Adhatoda vasica	8.7	1.6	0.5	64.0	4.4	0.9	0.4	33.7	10.9	2.8	0.4	97.1	2.8	0.4	0.2	26.5
Malcolmia africana	8.0	1.8	0.4	61.9	11.6	1.4	0.6	63.4	5.0	0.9	0.3	49.7	12.8	1.3	0.6	100.3
Malva parviflora	2.3	0.5	0.2	20.7	6.4	1.2	0.5	46.3	4.0	0.7	0.3	40.1	3.2	0.5	0.2	32.3
Rhazya stricta	—	—	—	—	7.6	1.4	0.6	54.2	11.7	2.6	0.4	100.1	6.4	1.2	0.5	73.1
Fumaria indica	6.0	1.2	0.3	44.8	—	—	—	—	1.4	0.2	T	12.6	—	—	—	—
Sonchus oleraceus	3.3	0.5	0.2	23.2	4.4	0.9	0.4	33.7	—	—	—	—	1.6	0.4	0.2	22.5
Taraxacum wallichii	7.0	1.2	0.5	54.5	5.2	1.1	0.4	40.9	—	—	—	—	2.5	0.6	0.2	34.5
Peganum hermala	3.7	0.8	0.3	30.7	4.0	0.7	0.3	27.6	—	—	—	—	0.8	0.2	T	11.2

(T = traces).

TABLE 5. Summary of community characteristics.

	COMMUNITY			
	Acacia-Adhatoda	Acacia-Malcolmia	Acacia-Rhazya-Adhatoda	Salvadora-Malcolmia
1. Average density/0.1 ha				
(a) Woody species <2 cm dbh	56	40	10	20
(b) Woody species > 2 cm dbh	208	184	115	112
(c) TOTAL	264	224	125	132
(d) Undergrowth species	42 x 10^4	44 x 10^4	31 x 10^4	30 x 10^4
2. Average basal area (m^2)/0.1 ha				
(a) Woody species < 2 cm dbh	NS	NS	NS	NS
(b) Woody species > 2 cm dbh	21	11	7	6
3. Average canopy-coverage (cm^2)/ 0.1 ha of undergrowth species	86	74	78	41
4. Number of woody species	4	4	3	4
5. Number of undergrowth species	7	7	5	7

NS = non-significant; ha = hectare

High average density of undergrowth species, coupled with low canopy-coverage value, suggest that they are all very young. The averages basal area of the arborescent species in this comunity is half that of *Acacia-Adhatoda* community; and it points out at the openness and early successional status of the community.

Acacia-Rhazya-Adhatoda **Community**

This community is confined to stands 3 and 4 which comprise dry beds of seasonal streams with slightly raised stable banks. The soil on the banks is clay loam with a fair proportion of humus. Sand and silt are the dominant components of the soil of dry bed which is unstable and keeps on changing round the year following the rains. *Acacia modesta* is the dominant woody species but its importance value is lower here than that of the two other communities (Table 2). Large basal area coupled with low desnity suggest that the number of *A. modesta* is considerably low but all are very old. Low frequency connotes the tendency of the dominant species to cluster in places. Besides *Salvadora oleoides* and *Capparis decidusa*, a single large specimen of *Gymnosporia royleana* was also noticed. *Rhazya stricta* and *Adhatoda vasica* are the co-dominants of the community from the lower layer (Table 4). *Acacia-Rhazya-Adhatoda* community is floristically poor.

Salvadora-Malcolmia **Community**

This community is confined to stand 5 which is remnant of a glacial mound formed as a result of glaciation in the geologic past. The soil is a rough mixture of Clay, sand and gravel. There are plenty of pebbles of varying sizes scattered all over. The stand is located at a considerable distance from the shrine and is very much disturbed. The vegetation is sparse and sporadic. The community is dominated by *Salvadora oleoides*, a slow growing common plant of our deserts (Nasir & Ali, 1972), and its higher importance value is due to large basal area solely contributed by old plants (Table 2). *S. oleoides* is less evenly distributed and its density in comparasion with *Acacia modesta* in other communities is also low. The palatable woody species share the grazing and browsing pressure whereas *S. oleoides* escapes grazing and browsing and thus dominates the scene. *S. oleoides* prefers dry tracts (Jafri, 1966), and the xeric conditions prevailing here may be regarded as yet another cause of its dominance. However, the complete absence of young specimens of this dominant woody species hints at the poor rate of its survival (Table 3). Low moisture contents of the soil, open canopy, grazing and browsing are responsible for *A. modesta* being completely outclassed by *S. oleoides* which is otherwise dominant in all other communities. *Capparis decidua*, with its ecological niches overlapping that of *S. oleoides*, is most successful here. The range of ecological amplitude of *C. decidua* is much wider than that of *S. oleoides* as regards the soil moisture, soil structure and shade. On open and xeric sites, it can form a climax with *S. oleoides* provided biotic interference is controlled. *Malcolmia africana* is the co-dominant of the community from lower layer probably because of the openness of the habitat.

Conclusion

The area under study, after having been remained protected for many years as a mark of respect to the saint, has considerably been disturbed since the past several years. On comparatively more mesic and less disturbed sites, *Acacia modesta* is dominant. *Salvadora oleoides* dominantes the xeric and open sites. None of

dominant woody species is self-perpetuating. *A. modesta* will form a climax with *Olea ferruginea* on comparatively mesic sites provided biotic interference is controlled. In the presence of overgrazing, *A. modesta* will not be able to survive and will be replaced by *Capparis decidua*. The shade being gone, the soil being exposed, the microclimate would change and the habitat would now suit *S. oleoides*. *S. oleoides* can also form a climax with *C. decidua* on xeric sites if sufficient protection is provided.

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