CARRYING CAPACITY AND RANGE CONDITION OF HAZARGANGI-CHILTAN NATIONAL PARK

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ABSTRACT

This study was carried out during September,1987 and April, 1988 in the Hazargangi-Chiltan National Park to evaluate the effect of enclosure on carrying capacity, range trend and other vegetation characteristics. One hundred twenty semi-permanent quadrats (plots) of 1 sq.m. area both in fall 1987 and spring 1988 were laid out at six representative sites along 400 meter long transect line running across the contours. Out of these, 60 were clipped for estimation of forage production and 60 were studied for vegetation characteristics in two seasons. The study revealed that enclosure had positive effects on range vegetation. Vegetation recovery was remarkably rapid. The decreasers (highly palatable) species were reappearing. The estimated forage production was 1234 Kg/per hectare,carrying capacity was 1.1 ha/Markhor/annum and range condition(health) had improved inside the enclosure. The study also suggested detailed investigation on proper use-factor of different forage/browse species, their palatability index and the climax species in the park.

INTRODUCTION

Hazargangi-Chiltan National Park, Balochistan extends over an area of 13166 hectares. The Park is located at a 15 km distance in south-western direction from Quetta, the capital city of Balochistan. It was declared National Park in 1980. During 1978 to 1987 about 30 Km long barbed fence was erected on its boundary to eliminate human and livestock interference. In addition 46 Km Jeep road, a rest house and museum have also been constructed inside the fenced area to provide excess to the visitors.

Chiltan Markhor (*Capra falconeri* Chiltanensis), one of the rarest species of wild goat, has been protected by establishing the Hazargangi-Chiltan National Park. The estimated population of Markhor varied from 302 heads in November, 1985 to 360 heads in November, 1987(PFI, 1985-86 and 1987-88). The increase in population, besides other factors, may be due to the increase in forages in the Park due to enclosure (fencing).

The effect of exclosure on forage production and carrying capacity has been studied in Pakistan by a number of investigators. Khan (1977) and Noor (1978) have reported an increase in forage production from 1.5 times to 3.7 times due to this treatment. Similarly, 7 times increase in grazing capacity due to exclosure has been reported (Noor, 1989). However, enclosure effects on forage production, carrying capacity and other aspects of range vegetation have not so far been studied.

Range carrying capacity has been

defined as the maximum number of livestock which can graze each year, on a given area of range, for a specific number of days without inducing a downward trend in vegetation or soil(Hussain, 1968B; Amin, 1985). It is generally expressed as ha/AUM. In other words it is the number of ha. which can supply adequate forage for one animal unit (AU) for one month. An adult cow with a calf is equivalent to one AU and requires 9.1 Kg (20 Lbs)air dried forage per day(Hussain, 1968B).

Forage production and allowable use factor are the important components for the estimation of the carrying capacity. Since use factor for individual forage species has so far not been estimated in the country, therefore it is considered as 0.5 for all practical purposes (Hussain, 1968B).

Amin (1985) had recommended that clipping should be done at 2-4 weeks interval during the growing season for reliable estimate of carrying capacity. Malechek et. al. (1972) estimated forage production by clipping 250 plots of 2 square feet area once during each of 4 seasons in a year. They calculated carrying capacity for domestic goats using an index e.i. product of forage production of each species and its proper use factor. They also established that goats were grazers rather than browsers on the basis of proportionate grass and browse feed consumed by the animal.

Humphrey (1945) stated that range condition class rating is an evaluation of present forage production of an area in relation to its maximum possible production under the best practical management methods. He further opined that such rating is basically applicable to the sites because forage production is variable. Dyksterhuis (1949) made ecological classification of range species using cover percent and assigning them the terms like Decreaser, Increaser and Invader. Based on this quantitative ecology he classified range condition into 4 classes namely; Excellent, Good, Poor and Very Poor. Hanson (1951) based on observed vegetation composition, soil condition, plant vigor and to lesser degree upon plant density, classified bunch type rangelands into 4 classes. Hussain (1968B) suggested canopy coverage method for estimation of range condition and range trend.

Estimation of carrying capacity is one of the major problems faced by the range managers. However, its knowledge is essential for proper range land management. In the absence of its knowledge the ranges may be overgrazed and hence cause degradation and deterioration. Unfortunately it is happening in the country.
Similarly, existing range condition and range trend are important indicators for planners and range managers for proper range management. Though their estimation poses lot of difficulties yet such are equally important.

This study was carried out to investigate the effect of enclosures in Hazargangi-Chiltan National Park on carrying capacity, range condition and range trend and other changes in the vegetation.

MATERIALS AND METHODS

Six representative sites, where markhors were mostly found, 3 in Hazargangi and 3 in Chiltan mountains were selected in collaboration with the Wildlife Management Branch, Pakistan Forest Institute, Peshawar and local staff of the Park. These sites were Shamtar, Kangri and Mashan in Hazargangi and Chashma, Gharak and Wastangi in Chiltan. A 400 meters long transect was laid out at each site across the contour lines (along slope)during September,1987. Forty quadrats of 1 square meter at 10 meter spacing were laid out along each transect line and was marked on the

ground. Twenty alternate quadrats were clipped for estimation of forage production while remaining 20 were studied for other desired vegetation characteristics. Similar data were collected during April,1988.In all 240 quadrats were studied at six sites. Out of these, 120 were clipped for forage estimation and 120 were studied for vegetation cover percent, surface material distribution and ecological recovery.

For forage estimation clipping data were collected once during November, 1987 (late Autumn) and second time during April, 1988 (early summer). Hence data for two seasons were collected. Current year's growth of browse and forage species was clipped. The clipped material was weighed in the field immediately for its green weight. The samples were dried in open air for 7 days and their air dried(AD) weight was recorded for estimation of forage production. Data computed per square meter were transformed into per ha. basis where required. Data on cover percent were recorded separately for grasses, forbs and trees/shrubs species. Data for percent distribution of surface material on plant base, litter, cryptogam, rock pavement and bare soil were recorded for each quadrat.

RESULTS AND DISCUSSION

(i) Forage production: Table I indicates that total herbage and browse production of the park was 2468 kg/ha. Out of which major portion (52%) or 1282 kg/ha. was browse followed by grass which was 34% or 828 kg/ha. It appears that browse was major feed available for Markhor particularly in winter when there was snow on the ground. In spring/early summer available feed was forbs and annuals.

Table 1: Herbage and browse production in Hazargangi-Chiltan National Park(kg/ha.)

S.No.	Sites	Grass		Forb		Browse		Total	
		Nov. 87	Apr. 88	Nov. 87	Apr. 88	Nov. 87	Apr. 88	Nov. 87	Apr. 88
	A.Hazargangi								
1.	Shamtar	390	525	138	269	523	232	1051	1026
2.	Kangri	370	410	40	97	513	955	923	1462
3.	Mashan	158	195	88	227	600	800	846	1222
	Ave.	306	377	89	198	545	662	940	1237
	B. Chiltan								
1.	Chashma (Nullah)	405	437	145	155	1065	1318	1615	1910
2.	Gharak	613	710	75	820	478	290	1166	1820
3.	Wastangi	318	435	30	62	450	468	798	965
	Ave.	445	527	83	346	664	692	1193	1565
Park Average:		376	452	86	272	605	677	1067	1401
Park Total(Annual)		828		358		1282		2468	

Since the Use Factor for each forage species of the national park was not known so a general factor of 0.5 was applied to estimate useable forage. Accordingly, air dried useable quantity of forage was 1234 (2468 x 0.5) kg/ha during September,1987 to April, 1988 in the park.

(ii) Animal Unit Month(AUM): The AU equivalent of Markhor is not known. An adult domestic goat is equivalent to 0.3 AU. Presumably an adult markhor has more body weight than an adult domestic goat. Hence an adult markhor is considered equivalent to 0.4 AU a little more than a domestic goat. Accordingly, an adult markhor requires 3.64 (9.1 x 0.4) Kg air dried forage per day. Its AUM is estimated at 109.2 Kg air dried forage. The annual forage requirement of the animal is estimated at 1328 Kg.

(iii) Carrying capacity: In Hazargangi-Chiltan National Park the useable air dried forage was estimated at 1234 kg/ha/annum or 102.8 kg/ha/month for the growing seasons of 1987-88. Consequently carrying capacity of the park was estimated at 1.1 ha/ Markhor/annum. Accordingly, about 11969 adults animal could be grazed/browsed in the National Park with a total area of 13166 ha. However, the stocking rate during 1987-88 was 1 markhor/37 ha. Since the cover percent and forage production were improving therefore,the National Park was understocked. The upward range trend indicated that the Park could supply forage to a larger herd of markhor than existing stocking.

Forage production varies from year to year depending on seasonal changes in precipitation and other climatic factors. Further this herbage consists of many species of grasses, forbs and trees/shrubs and all of them are not equally palatable. Their qualitative palatability is recorded elsewhere in this article. Accordingly the estimated carrying capacity is provisional and applicable to the year of estimation only. Carrying capacity is generally estimated every year for each kind of animals for effective rangeland management.

B. Range Condition

(i) Ecological Recovery: Intermountain valleys and mountains in Balochistan province are generally denuded. The valley may have a few bunches of coarse grasses and unpalatable bushes. Major parts of mountains surface consist of exposed rocks and very shallow soil layer. A scanty vegetation cover exists in the rock crevasses and narrow strips between rock series.

The vegetation response to protection through fencing was very positive and recovery was rather quick in the Park. However, vegetation recovery in valleys and on mountain was variable. Valleys had more vegetation cover than mountains.

(ii) Vegetation Cover and Palatability Rating: Cover percent of grasses, forbs and shrubs/trees follows same trend as their forage production shown in table I. There was higher cover percent (30.2%) of shrubs/trees followed by grasses (13.6%). Among grasses *Stipa* spp. had maximum cover percent (6.8%) followed by *Rotoballia* sp. which had 2 percent cover in the Park. All the forb species have nominal (less than 1%) cover except *Silene* sp. which had 1.7% cover. Among shrubs/trees species *Atrimizia* sp. had maximum cover percent (6.7%) followed by *Ephedra* sp. which had 4.7 percent. Further all the grasses, forbs/ shrubs and trees were not relished by markhor. Majority of the vegetation had Poor(P) palatability. The cover percent of vegetation of Excellent(E) and Good(G) palatability was very low (table 2). Less cover percent of highly palatable(Decreaser species) species is generally due to heavy grazing/browsing

pressure or due to secondary succession process where in such species reappear. Evidences show that it was due to reappearance of the decreaser species.

Table 2: Specieswise palatability and cover percent in Hazargangi-Chiltan National Park

S.No.	Palatability[1]	Cover percent				Park Average
		Hazargangi		Chiltan		
		Nov.87	Apr. 88	Nov.87	Apr.88	
1	2	3	4	5	6	7
I.Grasses						
1.Chrysopogon aucheri	G[2]	0.6	0.9	2.2	1.1	1.2
2.Cimbopogon shoenanthes	F	-	-	1.2	1.4	0.7
3.C. jawarancusa	P	3.3	4.3	-	-	1.9
4.Brumus tectorum	F	0.01	-	-	-	.003
5.Oryzopsis microcarpa	P	0.9	0.9	0.2	0.2	0.6
6.Pennisetum oreintale	F	-	-	0.02	0.03	0.01
7.Poa balbosa	G	0.02	0.3	0.1	0.3	0.2
8.Stipa arabica	F	2.8	1.6	10.8	12.0	6.8
9.Rotobollia exaltata	G	3.5	3.4	0.7	0.4	2.0
10.Tetrapogon villosus	F	0.03	0.2	0.3	0.4	0.2
Sub-total:		11.2	11.6	15.5	15.8	13.6
II. Forbs						
1. Ammi majus	F	-	-	0.1	-	0.03
2. Composite sp.	F	-	-	0.04	0.03	0.02
3. Farula kastata	P	-	0.2	-	0.2	0.1
4. Gentiana oliviera	P	-	-	0.1	0.1	0.05
5. Iris sp.	P	-	0.1	-	0.3	0.1
6. Medicago sp.	E	-	0.05	-	0.05	0.03
7. Plantago spp.	G	-	-	-	0.02	0.01
8. Polygonum avicular	G	0.03	-	0.07	0.1	0.04
9. Saliva macrosiflora	P	-	-	0.2	0.2	0.1
10.Silene conoidea	P	1.0	1.0	1.1	2.7	1.7
11.Thymus serpyllum	F	-	0.02	-	-	0.01
12.Tulipa montana	E	-	0.02	0.2	0.4	0.2
13.Unidentified	F	0.3	0.2	-	-	0.1
Sub-total:		1.3	1.6	2.9	4.1	2.3
III.Shrubs/trees						
1. Acemtholimon stocksil	F	0.3	0.3	2.2	4.1	1.7
2. Artimisea moritinia	G	2.3	3.5	9.8	11.0	6.7
3. Atriplex sp.	G	-	-	0.2	1.0	0.3

4. Astragalus trichocarpus	G	4.9	4.1	3.4	1.2	3.4
5. Casenia heterophylla	F	-	-	0.3	-	.08
6. Carangana ambigua	G	3.1	0.3	0.7	0.75	1.2
7. Convolvolus sp.	G	3.5	2.9	-	0.8	1.8
8. Cousemia sp.	P	-	-	0.2	0.3	0.1
9. Daphne oleoides	F	2.3	2.1	0.7	0.5	1.4
10. Ephedra intermedia	G	6.0	6.4	3.7	2.5	4.7
11. Gaillonis eriantha	P	0.6	0.5	-	-	0.3
12. Haloxylon sp.	G	-	-	0.5	0.4	0.2
13. Juniperus macropoda	F	2.6	2.0	2.1	1.6	2.1
14. Lactuca serrila	G	0.02	-	-	-	0.005
15. Nepeta bracteata	P	0.4	0.5	0.2	0.1	0.3
16. Pith	F	-	-	1.1	1.0	0.5
17. Peganum harmala	N	-	-	0.7	0.3	0.3
18. Persokia abrotanoides	F	-	-	-	0.2	0.05
19. Pistacia khinjuk	F	0.2	0.3	-	-	0.1
20. Prunus eburnea	G	1.6	1.4	8.1	1.9	3.3
21. Sophora mollis	P	0.7	0.7	-	-	0.4
22. Sageretia sp.	F	1.4	0.9	0.4	0.3	0.8
23. Salvia cabulica	P	1.6	0.8	0.3	0.02	0.7
24. Unidentified	P	-	0.6	-	0.04	0.2
Sub-total:		31.5	27.3	34.6	28.0	30.2

Note: 1. This was an observed palatability and is applicable for Markhor only.

2. Palatability ratings: E stands for excellent, G for Good, F for Fair, P for Poor and N for nonpalatable.

3. (-) indicates that the listed species was not present in that locality or season.

(iii) Distribution of surface material: Table 3 shows that more than (50%) of the surface area of the park was covered with fixed rocks and gravels or rock pieces. Therefore, park had less than 50% potential for complete vegetation cover. Further, about 27 percent of total surface area was bare soil, which was susceptible to erosion. However, it has thepotential to grow vegetation in future under proper management. However, plant base or vegetation basal area was very low (5.8%). On the other hand presence of litter (I5.5%) was good indication for improvement of the soil characteristics.

Table 3: Percent distribution of surface material

Locality	Plant base	Litter	Cryptogams	Rock pavement	Bare soil
Hazargangi					
1. Shamtar	5.4	15.2	0.3	66.5	11.6
2. Kangri	5.1	17.4	0.1	64.9	12.5
3. Mashan	6.3	20.9	0.2	55.0	17.6
Ave.	5.6	18.2	0.2	62.1	13.9

Chiltan					
1.Chashma	6.9	11.5	2.9	44.1	34.6
2.Gharak	6.7	18.8	0.2	37.6	36.8
3.Wastangi	4.5	8.2	6.4	33.9	47.0
Ave.	6.0	12.8	3.2	8.5	39.5
Park Average	5.8	15.5	1.7	50.3	26.7

(iv) Range Condition Classes: Total cover percent of grasses, forbs and shrubs/trees was used to classify the different sites of Park for range condition classes. Five standard range condition classes namely, Excellent (81-100% cover), Good (61-80% cover), Fair (41-60% cover), Poor(21-40% cover) and very poor (less than 20% cover) were used for different locations of the park (Table 4). Total herbage production, surface material distribution and ecological recovery were also considered while assigning these condition classes. Accordingly, overall existing range condition during 1987-88 was Fair. The range trend was upwards as cover percent and species composition were on increase.

Table 4: Range condition and range trend of different sites at National Park by cover percent.

Locality	Cover Percent				Range trend	Range condition
	Grasses	Forbs	Shrubs/ trees	Total		
Hazargangi						
1. Shamtar	9.2	2.1	25.4	36.7	Upward	Poor
2. Kangri	14.7	0.4	30.5	45.6	"	Fair
3. Mashan	9.8	1.5	40.5	51.8	"	"
Ave.	11.2	1.3	32.2	44.7	"	"
Chiltan						
1. Chashma	18.3	3.7	31.6	53.6	Upward	Fair
2. Gharak	17.7	4.2	27.6	49.6	"	"
3. Wastangi	10.9	9.4	24.9	37.2	"	Poor
Ave.	15.6	3.1	28.0	46.7	"	Fair
Park Ave.	13.4	2.2	30.1	45.7	Upward	Fair

CONCLUSION

Enclosure had positive effect on grazing capacity and other characteristics of vegetation of Hazargangi-Chiltan National Park. There was remarkable vegetation recovery. This indicates that rangelands of Balochistn could be rehabilitated quickly through appropriate and socially acceptable activities. It may include voluntarily closure of rangeland for specific period or introduction and adoption of suitable grazing system like rest and rotation or deferred grazing system. Herbage production was on increase. Vegetation cover percent and presence of litter indicated that range trend was upward and range condition (health) was improving. The Range Condition was fair and had further potential for improvement.

There is need to conduct more range research studies to explore certain important factors which were out of the scope of this study. The important factors to be explored include proper utiliza-tion of different species by markhor, palatability index of different species, production potential of the park, climax species of the area etc.

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