OBSERVATIONS ON THE MIGRATION AND HABITS OF THE ANTELOPES OF THE KALAHARI GEMSBOK PARK — Part I

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INTRODUCTION

The research problem allocated to this department by the National Parks Board embraces a study of the factors influencing the migration, habits and general conditions of certain of the larger antelope species.

In the proposed programme of work submitted in October, 1957, the following points were suggested as a provisional line of research work to be followed:

(1) To determine the extent of migration.

(2) A study of food habits and food preferences.

(3) To commence with experiments on the marking of animals as an aid to the study of migration.

(4) To determine the relative abundance of animals by continuing the present census method.

(5) To determine the present distribution of all the game animals and to correlate it with their food and water requirements.

(6) General observations on habits and aspects of reproduction.

Arising from this tentative programme of research, the following report, based on a visit to the Park from 1.12.57 to 12.12.57, is hereby submitted.

1. MIGRATION

Various statements have been made in the past concerning the migration of South African mammals, and in some instances the word migration has been erroneously, although with complete justification, used to describe any unusual movements of antelopes from one area to another.

Migration is derived from the Latin word, *migrare*, which literally means

to *transfer*. According to the Oxford Dictionary the primary meaning of migration is "to pass from one place to another". Thus the word may be used to describe any kind of animal movement, irrespective of its cause, extent or regularity. However, to avoid confusion with such words as emigration, biologists restrict the term migration to a particular form of population dispersal, a type of animal movement embracing periodic departure and return.

Migration is, therefore, a biotic rhythm, characterised by its regularity. Emigration, on the other hand, is a one-way outward movement, and immigration a one-way inward movement.

As far as the Gemsbok Park is concerned, the usual movements of the antelopes do not appear to be a regular phenomenon that takes place between two fixed areas at definite times of the year. It might have been, and probably was, different in the past, but this report is limited to present conditions and habits.

According to Mr. J. D. le Riche, Warden of the Park, large-scale game movements took place in 1937, 1950 and 1954, and on a smaller scale in 1956.

The population movements of 1937, 1950 and 1954, and its possible causes, are discussed in detail in an unpublished report by Brynard. These large-scale movements, which usually started in the north of the Park and extended to the south, were more or less confined to the springbok, eland and red hartebeest. The animals taking part left the Park in huge numbers, and travelled south to the Molopo and Kuruman Rivers, at a stage when the grass in the Park was very dry and unpalatable, whereas the grazing in the Kuruman and Molopo areas was reported to be better, due to early rains in that area.

In 1956 large numbers of springbok and eland moved over the southern border of the Park into the coloured settlement, where grazing appears to have been better.

In all these population movements the food factor appears to be the main causal factor, but whether it was due to an absolute scarcity of food, or to the unpalatibility of the available food, is uncertain. In the light of what has been said above concerning the general conditions of the grazing at the time of these movements, palatibility is probably an important factor.

Apart from these large-scale population movements, which take place very irregularly, there is a constant local shifting of animals within the boundaries of the Park, or backwards and forwards over the boundaries wherever this is still possible.

These movements are probably correlated with environmental conditions and are characterised by the total absence of any rhythmic periodicity, and cannot, therefore, be classified as true migration, which involves regular two-way movements.

As far as the available evidence suggest, the position with regard to population movement and environmental change of the different antelopes in the Park is more or less as follows:—

The smaller antelopes (duiker and steenbok) appear to have a definite home range from which they rarely wander.

Of the larger antelopes the eland is probably the nearest to a true nomad, although it is possible that some of them may have restricted winter quarters.

Of the other antelopes (gemsbok, blue wildebeest, springbok, red hartebeest) it can truly be said that the same herds or animals may generally be found in definite portions of their territory at the same time each year, in some instances perhaps for the whole year, depending of course on various circumstances. As soon as local conditions become unfavourable, some individuals or herds prefer a change of environment and may or may not return to their usual haunts.

A definite answer to this point can only be provided by marking a number of animals, and recording their subsequent movements.

It seems justifiable to conclude that in the true, biological sense of the word, migration is practically non-existent in the Park to-day. This may sound like a sweeping conclusion, but with all the existent barriers that curtail the natural movements of the various animals, migration, if it ever did exist as a regular phenomenon in the past, has come to a standstill under present conditions.

If the animal movements that are known to take place in the Park cannot be regarded as true migration, the question immediately arises whether there is any other suitable term that can be used to describe this constant change of environment that does take place on quite a considerable scale.

There is a distinctive type of environmental change, called nomadism, that can be distinguished from true migration, although it is virtually impossible in many instances to classify a particular type of environmental change as one or the other.

An animal that lives a wandering life is called a nomad, but whereas some animals wander more or less sporadically within a certain geographic region during most of the year, others may have restricted quarters for part of the year, usually in winter, roaming about over a wider area for the rest of the year. There may thus be a certain amount of regularity even in nomadism.

In this sense the movements of some of the animals in the Park can be regarded as nomadic, as some of them undoubtedly have a roaming habit for part of the year, following the rains to find better grazing. There is substantial proof for this assertion, as will be pointed out later.

The whole position can be summarized by merely stating that the larger antelopes of the Park are not sedentary to the same extent as the steenbok and the duiker, but they are neither true migrants nor true nomads, and under the circumstances the word "migration", or geographic migration in a generalised sense, is nevertheless the only term that can be used with reference to these seasonal movements.

2. STUDY OF FOOD HABITS

Due to a heavy itinerary, which was planned beforehand for the whole trip, very little time was available for direct feeding observations, which require a lot of patience and time. It was nevertheless possible to make a few direct observations, and the following is a list of plants on which the animals concerned were observed to be feeding.

In the short time available it was impossible to make any observations on palatibility and food preferences.

The Springbok:

The task of determining the springbok's food plants is considerably hampered by the animal's grazing habits. The springbok is very fond of grazing on the ephemereal plants in the river beds, but although they could be approached very closely on foot, it was sometimes virtually impossible to make a definite observation, due to their habit of feeding close to the ground, and in some cases pulling out young plants roots and all. Only observations that could be confirmed beyond doubt were recorded, and this is the list of the springbok's food plants that has so far been established.

Nerine laticoma, Aptosimum lineare, Aristida obtusa, Rhigozum trichotomum, Schmidtia kalahariensis, Limeum viscosum, Asclepias fruticosa, Psoralea obtusifolia, Platycarpha carlinoides, Chloris virgata, Tribulus sp., Monechma hereroense.

Gemsbok:

An analysis of the stomach contents of a gemsbok which was shot by a poacher was made with the aid of the botanist, Mr. O. Leistner.

About 99% of the contents consisted of grass, but unfortunately not a single species could be identified.

Of the other plants occurring in the stomach the following could be determined:

Tephrosia sphaerosperma, Oxygonum alatum, Cucumis sp.

Of these, *Tephrosia* was in abundance.

On another occasion a gemsbok was observed to be feeding on comparatively dry *Aristida obtusa.*

On other trips through the real gemsbok country, we travelled through areas that bordered on over-grazing, and the following grasses and plants were heavily grazed: *Eragrostis lehmanniana, Asthenatherum glaucum, Aristida ciliata, Schmidtia kalahariensis, Crotolaria sp.*

Although gemsbok must be mainly responsible for this, in the absence of direct proof these cannot be taken for granted as this animal's food plants.

The Red Hartebeest:

Limited to one observation. A single red hartebeest was observed to be grazing on *Aristida obtusa.*

To determine the nutritive value of plants at different seasons of the year and to establish, if possible, a correlation between the quality of the food and animal movement and behaviour, a number of plant samples were collected to determine as far as possible their nutritive contents.

A report on this will be submitted later.

3. MARKING OF ANIMALS

Due to technical difficulties this part of the project was not proceeded with. Experiments are at present being carried out in the Kruger National Park with marking apparatus and as soon as a satisfactory marking device is available, this part of the research programme will be carried further.

It is of the utmost importance to go ahead with this as it is the only possible way of obtaining factual information on the wandering habits of the larger game animals.

4. NUMBER OF ANIMALS

The following tables are, in a way, an account of the whole trip, and provide a good picture of the general distribution of the game animals at that time of the year.

Previous observations on the game animals of the Park were more or less limited to the river beds, and it was felt that more work should be done in the dune country. To carry out this resolution our party embarked on a very strenuous itinerary and it was possible to penetrate to the very heart of the dune country.

The number of animals appearing in the following tables were determined by simply counting all the animals within the field of vision as we travelled along the river courses and among the dunes. The average visibility along the river courses is about $\frac{3}{4}$ of a mile, and among the sand dunes about 1 to $1\frac{1}{2}$ miles.

At the present stage it is not intended to use these figures for determining total population sizes, but it may eventually prove to be a valuable criterion in determining the general trend of population growth. And at the present moment it serves a valuable purpose as a measure of relative population density in different parts of the Park.

TABLE 1

Number of animals counted on a trip from Twee Rivieren to Mata-Mata via Tween Dabas and Camms Pannen on 2.12.57.

Time of departure 7.30 a.m.

Time of arrival at destination 7.30 p.m.

Class Interval	Springbok	Gemsbok	Blue wilde-beest	Steenbok	Duiker
0— 4	1				
5— 9		2			
10—14				4	
15—19	3	1			
20—24		7		1	
30—34		4			
35—39		3	5		
40—44		1			
45—49		15		2	
50—54		17			
55—59		20			
60—64		13	16	2	
65—69		61			1

Details of route followed: Twee Rivieren, Tween Dabas, Camms Pannen and from there along the S.W.A. border to Mata-Mata, traversing the farms Lekkerdraai, Pulai and Sitszas.

A great portion of this trip was, therefore, outside the boundaries of the Park.

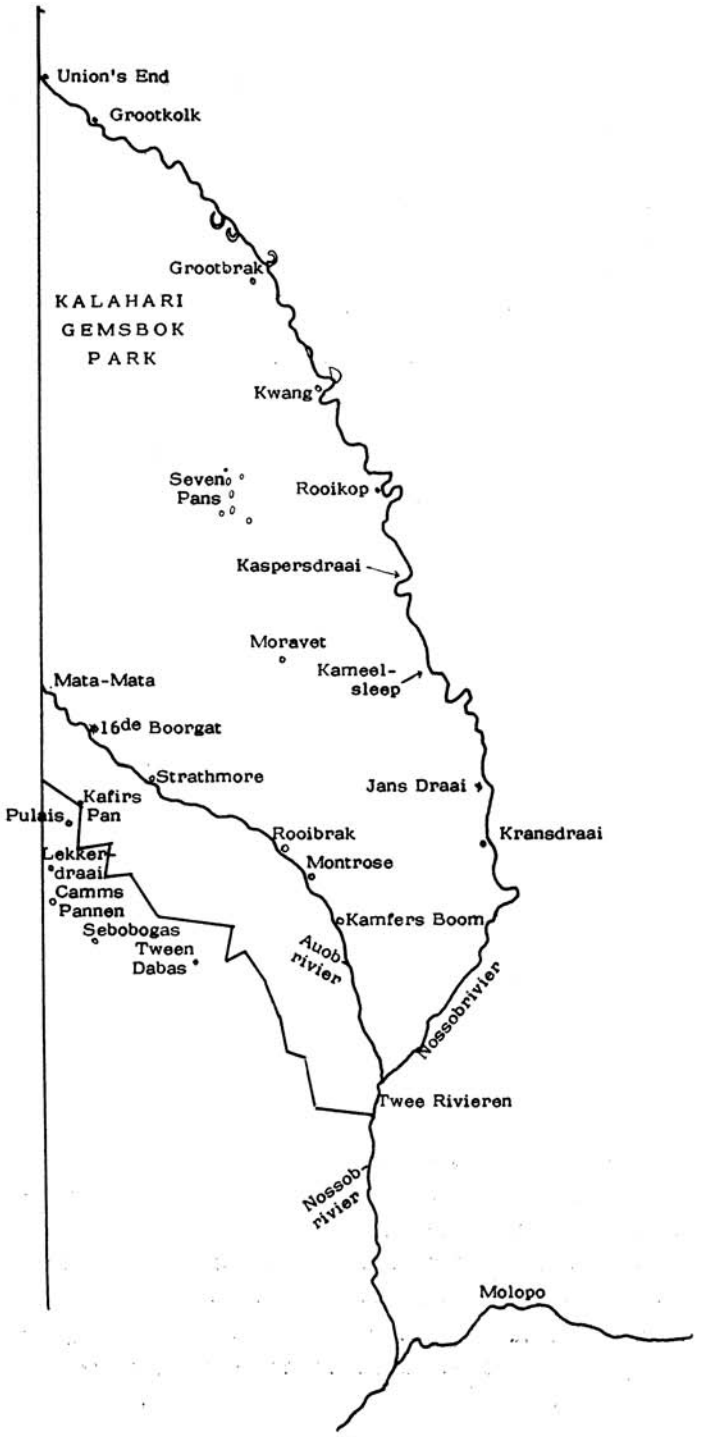
Union's End
Grootkolk
Grootbrak
KALAHARI
GEMSBOK
PARK
Kwang
Seven
Pans
Rooikop
Kaspersdraai
Moravet
Kameel-
sleep
Mata-Mata
16de Boorgat
Strathmore
Jans Draai
Kafirs
Pan
Pulais
Rooibrak
Kransdraai
Lekker-
draai
Montrose
Camms
Pannen
Kamfers Boom
Sebobogas
Tween
Dabas
Auob
rivier
Nossobrivier
Twee Rivieren
Nossob
rivier
Molopo

TABLE 2

Number of animals counied on a trip from Mata-Mata to Union's End on 3.12.57.

Time of Departure 9 a.m.

Time of arrival at destination 5.15 p.m.

Class Interval	Springbok	Gemsbok	Red harte-beest	Steenbok
0— 4	1			
5— 9		5		1
10—14		8		1
15—19		7		
20—24		1		3
25—29				
30—34		2		
35—39		3		
40—44		15		1
45—49		5		1
50—54		1		1
55—59		26	2	2
60—64	50	2		
65—69				
70—74	3			

The first part of this trip was through typical dune country, and thereafter we travelled for miles and miles through flat country, consisting of tall, coarse grass. Vaalkameel (*Acacia haematoxylon*) is the most noticeable feature of this region, and Vaalkameel flats is a very appropriate name for this type of country, which forms a very large part of the Park.

The sudden increase in game at the 55-64 mile intervals coincide with a change in vegetation to a typical savannah, with plenty of Vaalkameel and Kameeldoring (*Acacia giraffae*), and much better grazing.

TABLE 3

Number of animals counted on a trip from Union's End to Groot Kolk on 3.12.57.

Time of departure 6.15 p.m. Time of arrival at destination 7 p.m.

Class Interval	Springbok	Gemsbok	Blue wildebeest	Red hartebeest	Eland	Steenbok	Duiker
0— 4 ...	85			4			
5— 9 ...	97			13			
10—14 ...	256	1		23			

The large number of springbok was probably due to the abundance of green ephemereal plants in the river bed, of which they are very fond.

In the vicinity of Groot Kolk a number of Witgat-trees (*Boscia albitrunca*) were found to be completely stripped of their bark for several feet above the ground. This appears to be the work of red hartebeest, while the bark near the ground might have been removed by porcupines, which are probably responsible for the death of many fine trees, not only Witgat, but also Kameeldoring (*Acacia giraffae*); many fine trees were noticed in the Nossob, with the bark stripped right round the stem, for some distance above the ground. These rodents are a very serious menace to these lovely and valuable trees.

TABLE 4

Number of animals counted on a trip from Groot Kolk to Kaspersdraai on 4.12.57.

Time of departure 11 a.m. Time of arrival at destination 5.30 p.m.

Class Interval	Springbok	Gemsbok	Blue wildebeest	Red hartebeest	Steenbok
0— 4	230	4	6	30	
5— 9		3	2	75	
10—14	115	12		14	
15—19		1			
20—24		1		6	
25—29		2		4	
30—34	234	11		13	
40—44		1			
45—49		1		3	
50—54		1			
55—59		1			
60—64				6	2
65—68		2		1	

The large number of game in the first class interval are due to the presence of water; the large number of the 30-34 class interval are due, not to the presence of water, but to a narrow strip of ephemerous plants in the river bed, where the animals were observed to be feeding.

From this green spot up to Kaspersdraai it was virtually a biological desert, although it must be recorded that for about half this distance the road runs outside the river, where not a green blade of grass was to be seen. At Kwang, where large herds of game usually occur, not a single animal was seen. It was unbearably hot, with the heat waves vibrating like dancing springboks and the trees on the edge of the vast, white grassless plain throwing double shadows.

TABLE 5

Number of animals counted on a trip from Kaspersdraai to Twee Rivieren on 5.12.57.
Time of departure 9 a.m.
Time of arrival at destination 4 p.m.

Class Interval	Springbok	Gemsbok	Blue wildebeest	Red hartebeest	Steenbok
0— 4				1	
5— 9				4	1
10—14	45	5		6	
15—19	66	4	2	38	1
20—24	1	5		9	1
25—29				1	
30—34		1		1	
35—39		3			
40—44		2			
45—49	7	4	1		
50—54	6			4	
60—64		6	1		
65—69	11	6			
70—74	2	11	2		

For the first 50 miles the road frequently leaves the river and, as has been pointed out, life is very scarce on the dry, flat country adjoining the river in these areas.

The relatively high number of springbok at the third and fourth class intervals occurred in the immediate vicinity of a drinking place.

TABLE 6

Number of animals counted on a trip from Twee Rivieren to Mata-Mata on 6.12.57.

Time of departure 8.30 a.m.

Time of arrival at destination 1 p.m.

Class Interval	Springbok	Gemsbok	Blue wildebeest	Red hartebeest
0— 4	2			
10—14		2		
15—19	2			
20—24	1	2		
30—34		8		
35—39		8		
40—44		3		
45—49	1	1	26	
50—54		30	1	
55—59	80	29	1	1
60—64	40	6	1	
65—69	53	2	98	
70—74	5			

The sudden rise in the numbers of animals from the 45-49 class interval and onwards, which was observed on all the trips made on this road, can be attributed to two causes: firstly, all these animals occurred near some drinking place; secondly, this area had some good rains a few weeks earlier.

Aristida obtusa, occurring on the banks of the river, was the dominant vegetational type, and was heavily grazed by the springbok.

In the river bed itself patches of green *Panicum* occurred, and in some places it was grazed to the ground.

TABLE 7

Number of animals counted on a trip from Mata-Mata to Twee Rivieren on 6.12.57.

Time of departure 4 p.m. Time of arrival at destination 6.30 p.m.

Class Interval	Springbok	Gemsbok	Blue wildebeest	Red hartebeest
0— 4	5		63	
5— 9	47		13	
10—14		10	1	1
15—19	32	10	7	
20—24			18	
25—29	2	1		
30—34		3		
35—39	14			
40—44		1		
45—49		2		
50—54	2			

TABLE 8

Number of animals counted on a trip from Twee Rivieren to Mata-Mata on 7.12.57.

Time of departure 9.05 a.m. Time of arrival at destination 12 o'clock noon.

Class Interval	Springbok	Gemsbok	Blue wildebeest	Red hartebeest
0— 4				
5— 9				
10—14				
15—19				
20—24	3	5		
25—29				
30—34		73		
35—39	1	11		
40—44		3		
45—49	47	22		
50—54	22	182	8	
55—59	40	24	2	1
60—64		13	2	1
65—69	98	13	79	

TABLE 9

Number of animals counted on a trip from Mata-Mata to Strathmore (on the Auob River) via Pulai and Kafirs Pan on 7.12.57.

Time of departure 12.30 p.m.

Time of arrival at destination 7 p.m.

Class Interval	Gemsbok	Steenbok	Duiker
0— 4			1
5— 9	5	1	1
10—14	1		
15—19	121	5	
20—24	1	5	
25—29	5	2	
30—34	8	1	

Details of route followed: From Mata-Mata we followed the "road" to Camms Pannen, which runs just inside the S.W.A. border, for 15 miles. At this point we were on the farm Pulai, which is crown land, where we turned left and headed for the Auob which we entered at Strathmore.

The large number of gemsbok in the fourth class interval occurred at Pulai, outside the game reserve.

This farm is situated in, as it is generally called, typical red dune country and, with its scant vegetation at this time of the year, is the nearest approach to true desert conditions found anywhere in the Park.

The valley between the red dunes, in which herds of up to 33 gemsbok were found, bordered on overgrazed conditions. Red sand, with short annual *Schmidtia kalahariensis* and scattered *Plinthus, Hermannia, Monechma* and *Heliotropium* presented a desolate picture indeed. Yet this is the type of veld preferred by the gemsbok, as has been found over and over again.

The picture changed gradually, however, and upon re-entering the Park at Kafirs Pan, the red dunes had almost disappeared, and the vegetation simultaneously changed to *Rhigozum,* Vaalkameel, *Monechma,* and eventually we crossed valley after valley of waving *Aristida meridionalis,* which do not appear to be grazed at all.

As the table indicates game was very scarce for the last 16 miles.

TABLE 10

Number of animals counted on a trip from Twee Rivieren to Mata-Mata on 8.12.57.

Time of departure 4.45 p.m.

Time of arrival at destination 7 p.m.

Class Interval	Springbok	Gemsbok	Blue wildebeest
0— 4	56		
15—19	2		
20—24	1		
30—34		2	
40—44	21	2	
45—49		1	
50—54	20	14	
55—59			60
60—64			35
65—69		2	
70—74	23		

It is of interest to compare this table with tables 6 and 8 to note the difference in the concentration of game at various times of the day.

In the late afternoon the gemsbok are out in the dunes, and almost totally absent from the watering places.

The herd of springbok found in the first class interval is a herd which usually occurs in Bechuanaland just beyond the river, but the animals descend to the river in the late afternoon to graze on the green ephemerous plants in the river bed.

TABLE 11

Number of animals counted on a trip from Mata-Mata to Kwang via Seven Pans on 9.12.57.

Time of departure 6.30 a.m.

Time of arrival at destination 1.45 p.m.

Class Interval	Springbok	Gemsbok	Steenbok
0— 4	31	1	
5— 9		10	2
10—14		3	
15—19		25	1
20—24			3
25—29		10	1
30—34		2	
35—39		1	
40—44			2
45—49		1	2

After crossing 45 dunes within the first 11 miles, we entered flat country which can be described as Vaalkameel flats, consisting of coarse grass and numerous scattered, stunted Vaalkameel.

The flatness is occasionally relieved by low, irregular, overgrown dunes, and sometimes high dune-kopjes.

Game was scarce and the only sizable gemsbok herd was found among an isolated group of typical red dunes, about 1 mile in cross section. The tops of the dunes were bare, but on the slopes and in the valleys between, a wide variety of food plants, which seems to provide excellent grazing and browsing, occurred. It is a much wider variety than found elsewhere in this area, and various signs indicated that gemsbok occurred here in comparatively large numbers.

Altogether 22 pans were counted on this trip, not including the complex of pans found at Seven Pans.

TABLE 12

Number of animals counted on a trip from Kaspersdraai to Kameelsleep on 10.12.57.

Time of departure 8 a.m.

Time of arrival at destination 9.15 a.m.

Class Interval	Springbok	Gemsbok	Red hartebeest
0— 4			8
5— 9		1	2
10—14		1	5
15—19		2	3
20—24	100	1	26

The large number of springbok and hartebeest were found at the drinking place at Kameelsleep.

TABLE 13

Number of animals counted on a trip from Kameelsleep to Kamkwa on 10.12.57.

Time of departure 9.30 a.m.

Time of arrival at destination 1.30 p.m.

Gemsbok 76	Steenbok 14

At Kameelsleep we left the Nossob and headed for Kamkwa in the Auob, over the dunes. Unfortunately, our vehicle's speedometer was out of order, hence it is not possible to indicate the mile intervals.

Conditions were almost similar to that found the previous day when we crossed the dunes over Seven Pans in the opposite direction. A very large portion of the Park between the two rivers consists of this so-called Vaalkameel flats, which does not provide good grazing and is probably of very low carrying capacity.

Of the 76 gemsbok counted on this trip, 59 were found in one herd, while the others occurred as solitary individuals.

The large herd was found at Moravet, where it must have rained a few weeks earlier, because the veld was green and a wide variety of grasses and

shrubs provided excellent grazing and browsing. This was limited to a very small area, which was completely different from the surrounding Vaalkameel flats, and the large herd's presence there must definitely be due to the better condition of the veld, and the change of vegetation.

TABLE 14

Number of animals counted on a trip from Twee Rivieren to Kamfers Boom (Auob River) via Sebobogas, Klein Skrij.

Time of departure 7 a.m.

Time of arrival at destination 3.30 p.m.

Springbok	1	Steenbok	11
Gemsbok	240	Duiker	3
Eland	3		

Details of route followed: Twee Rivieren, Sebobogas, Klein Skrij, Kamkwa pan, Kamfers Boom in the Auob.

At and around Klein Sebobogas 55 gemsbok were found; 14 were standing in the pan, which contained no water, hence the gemsbok must have been attracted by the "brak" (the local name for natural salt or mineral licks).

About half a mile from the pan we came across 3 eland and a herd of 33 gemsbok. They occurred on a narrow strip of green veld, with a wide variety of grass and shrubs, among the red dunes.

The animals took flight and they all fled in a southernly direction, away from the Park, where the red dune country is much more to their liking.

The road from Twee Rivieren to Sebobogas is, of course, outside the boundaries of the Park and forms a very significant dividing line between two totally distinct veld types. To the south is the Coloured Settlement, consisting as far as the eye can see of rolling red dunes, the gemsbok's favourite veld. To the north, on the other hand, the dunes are of the covered type, not so much favoured by the gemsbok.

At Groot Sebobogas we left the road and turned northwards, where, for quite a number of miles (the speedometer was still out of order) we crossed several high covered dunes, completely different from the red dune country to the south. In this region only a few isolated gemsbok were encountered.

After a few miles the picture changed abruptly. We were among the red dunes again, and on the very first red dune we counted 12, and on the next one, 6 gemsbok.

At Klein Skrij, a few miles further on, 26 gemsbok were seen in the pan, and 62 within one mile from the pan, which contained nothing but brak.

At another pan, about 2 miles further on, 14 gemsbok were standing in the pan. It was 12 o'clock and in the dancing heatwaves vibrating above the pan, these animals were actively engaged in digging out and eating brak.

Around the pan 26 gemsbok were counted, the majority of them relaxing in the shade.

From a very high dune here a lovely panorama of red dunes stretched out before us as far as the eye could see.

On approaching the Auob, the red dune country was left behind and the number of game correspondingly decreased.

5. DISTRIBUTION OF GAME ANIMALS IN THE PARK

Although the different game animals have a wide distribution in general, it is possible in some instances to indicate a definite preference for a specific environment.

There is no point in drawing up a distributional map of the antelopes based on the numbers of a single trip, but the comparison drawn in Table 15 is of very great value in estimating the relative values and carrying capacity of the various sections of the Park, especially at a time when general conditions in the Park were extremely unfavourable.

TABLE 15

Comparison of the total numbers of animals counted in the Auob and Nossob sections of the Park respectively.

	No. of miles travelled	Spring-bok	Gems-bok	Blue wilde-beest	Red harte-beest	Eland	Steen-bok
Auob ..	459	500	1010	436	4	3	35
Nossob	344	1338	297	14	302	0	41

The *Auob section* is that area which lies within the triangle formed by the Auob River, the S.W.A. boundary and the southern boundary of the Park. Animals counted in the bed of the Auob are included in this region.

The *Nossob section* is that area which lies within the huge triangle between the two rivers and closed off in the west by the S.W.A. boundary.

The number of miles travelled on the two last trips, on which the speedometer was out of order, was estimated by consulting a map and working it out according to scale. It will almost certainly not be out more than 5 miles.

The springbok counted on the short strip where the two rivers are confluent were left out of consideration.

These figures must be handled with care, however, because it has been very clearly shown that, especially as far as the counts at the drinking places are concerned, the time of the day is a very important factor to consider if any comparisons are to be made. Yet, in the two regions concerned, with few exceptions the trips usually lasted almost the whole day so that the counts were made at comparable times, and therefore under more or less the same conditions.

Another important factor is that the journey in the Auob between Twee Rivieren and Mata-Mata was covered no less than four times, in other words the same animals may have been counted four times. The Nossob River was covered once only, with the exception of a short distance of 25 miles between Kaspersdraai and Kameelsleep, which was traversed twice.

The blue wildebeest counted on every trip at a portion of the Auob within 10 miles of Mata-Mata are almost certainly the same. A few smaller springbok herds were known to be the same every time, and the same must apply to the gemsbok.

It must also be remembered that the Auob has more drinking places than the Nossob.

For a total population count, therefore, these figures are not reliable, and can merely serve for a general comparison of seasonal distribution and population density in the two main areas concerned.

The following special notes could be added:

The Springbok.

At this time of the year this animal is almost limited to the river beds.

Of the 1838 animals counted, only 54 were not encountered in the river beds, or the dunes immediately adjoining it.

The distribution of the 54 animals mentioned is as follows: 4 occurred on the road to Sebobogas, about 18 miles from the Auob; 50 were counted in one herd on the Mata-Mata—Union's End road, 14 miles from the Nossob River.

Although it browses on *Rhigozum* and other shrubs, which are plentiful in areas away from the river, the determining factor in its limited distribution appears to be, firstly, the presence of water in the river beds; secondly, its partiality to the ephemerous plants which appear shortly after rains and

grow profusely in some parts of the river; thirdly, *Aristida obtusa*, which is a very important item on the springbok's menu, is almost limited to certain areas adjoining the river beds.

As table 15 indicates, the Nossob carries a much larger population of springbok than the Auob. According to the Warden the present position of the springbok is not at all satisfactory. Due to heavy losses incurred in 1956 their numbers are at a very low ebb today.

The Gemsbok.

Although this animal has an overall distribution in the Park, it shows a definite preference for certain areas.

An analysis of table 15 indicates that the narrow strip of the Park south of the Auob River is, at this time of the year at least, the true home of the gemsbok. The fact that it was a very bad season as far as the rainfall is concerned is of very great significance indeed, because it is during times of drought and scarcity of good pasture-land that the real value of any environment can be estimated.

As has been pointed out before, the gemsbok has a very strong preference for the typical red dunes, which are very scarce in the huge area between the Auob and the Nossob Rivers.

The gemsbok's liking for the red dunes is a peculiar phenomenon and the underlying reasons for this preference is a matter deserving serious attention.

The upper parts of the typical red dunes are often completely bare of vegetation; in some cases it is partly overgrown with smaller shrubs and such isolated trees as Witgat (*Boscia albitrunca*), and Swarthaak (*Acacia detinens*). Even on the lower slopes the grass, shrubs and trees stand very sparsely, in contrast with the so-called covered dunes, which are completely overgrown with dense, coarse grass.

The gemsbok seem to prefer the sparser vegetation and the more open dunes, which have isolated trees, and not tall grass on top. The presence of the trees, and their absence on the grass-covered dunes, is probably an important factor, because at the hottest hours of the day the gemsbok prefer to rest in the shade of some tree, preferably with an unrestricted view.

A very superficial survey did not disclose any important difference in the vegetational types of the red dunes and the other dunes, although the vegetation of the red dunes appear to be more varied and have more annuals, at this time of the year at least; and, due to edaphic differences, there may be a difference in palatibility and nutritional values too, although there are not any apparent differences in the soil of the two types of dunes mentioned above.

A thorough botanical survey, systematical and ecological, of the different types of dunes, is highly desirable.

The Red Hartebeest.

Of the 306 hartebeest counted on the whole trip only 4 were encountered in the Auob and the area southwest of it, in the course of the 459 miles covered in this area.

Of the 302 counted in the area between the Auob and the Nossob Rivers, 300 were encountered in the bed of the Nossob, or within half a mile of the river. More than half of this number occurred within 10 miles of Groot Kolk.

This animal's preference for the Nossob is rather obscure, although it seems very likely that the hartebeest counted in the Nossob are really Bechuanaland animals which come to the Nossob for water only. With a few isolated exceptions, all the hartebeest found in the Nossob were either counted on the Bechuanaland side of the river, or made off into Bechuanaland on our approach.

Too little is known about the feeding habits and food preferences of the hartebeest to draw any conclusions, but it is generally believed that the grazing conditions in Bechuanaland were better than in the Park and that that served as a very strong enticement for the Park's springbok and red hartebeest.

The Blue Wildebeest.

A direct comparison between the number of blue wildebeest in the two areas of the Park is rather misleading because nearly all the blue wildebeest were counted at the same spot in the Auob and the same animals were probably counted several times. The largest number of blue wildebeest counted in the Auob on a single trip was 127 (Table 6), and the number of animals frequenting the Auob can with safety be estimated at at least 200.

The large number of blue wildebeest found in the Auob is very gratifying because up to about 1948 this region had no permanent population of blue wildebeest. Only now and then did a few animals make a sporadic appearance, disappearing again soon afterwards. In 1948, however, soon after permanent water was made available at the 16th borehole, a large number of blue wildebeest moved into the Auob region, and when the main herd left, a small group remained behind at the 16th borehole, probably on account of the water. They never emigrated again and formed the nucleus of the present sedentary group of a few hundred individuals found in this region.

The sedentary habit of these animals, even under adverse conditions, as far as food is concerned, is of very great interest.

The scarcity of blue wildebeest in the Nossob River is probably due to the severe drought that ravaged that area and, unlike the Auob animals, they have probably left in search of better grazing, as is the blue wildebeest's habit.

The Eland.

Although it was a very bad year, the almost total absence of eland in the Park is alarming. A very good survey of the Park was made and only three eland were found; and these, incidentally occurred just outside the Park.

On a few occasions fresh dung and eland tracks were seen, but in most cases this indicated the presence of solitary individuals only; hence the total number of eland in the Park must have been very low.

Taking into full consideration the bad conditions in the Park and the eland's nomadic habits, its numbers nevertheless appear to be abnormally low, even for this time of the year.

Some knowledge regarding the feeding habits and food preferences of the eland will undoubtedly explain their almost total absence on this occasion.

The ecology of the eland, as one of the rare antelopes of the Park, as well as the Kruger National Park, is a research problem which deserves priority.

The Steenbok.

The distribution of the steenbok brings a very interesting fact to light.

As far as its overall distribution is concerned, it can be seen that it is more or less evenly distributed throughout the Park.

The most significant fact in its distribution, however, is that of the 76 animals counted, only one occurred in a river bed (the Nossob), while the rest were all found in the dune country.

The steenbok is indeed a true dune animal, and it appears to be completely independent of water. The solitary animal found in the Nossob was about 10 miles from the nearest drinking place and its presence there had probably nothing to do with water.

Not once was a single steenbok found anywhere near the water, and this appears to be their regular habit.

The gemsbok, springbok and eland are usually regarded as animals inhabiting arid regions and more or less independent of water if it is not available. Yet, in this respect the steenbok appears to have acquired a permanent independency of water, because, with plenty of water in its immediate environment it does not appear to make any use of it, whereas the springbok and the gemsbok have acquired regular drinking habits where water is available.

6. GENERAL OBSERVATIONS ON THE HABITS OF CERTAIN GAME ANIMALS

The feeding and drinking habits of some of the animals have already been discussed.

To conclude the observations a few general remarks on certain aspects of reproduction can be made.

It is a wellknown fact that the breeding season of the various game animals in Africa do not coincide, not only as far as the different species are concerned, but the breeding times of the same species appear to vary in different parts of Africa, and also from one season to another.

The Kalahari is no exception in this respect, and although the onset of mating is physiologically determined, the ultimate determining factors that fix the actual mating time of the Park's game animals from season to season, is a matter well worth further investigation.

In general, tropical species appear to breed at all times of the year, while species living in temperate regions tend to have restricted breeding seasons, characterised by considerable regularity.

Of the game animals in the Kalahari Gemsbok Park the gemsbok, eland, steenbok and duiker tend to breed at all times of the year, while the blue wildebeest, springbok and red hartebeest have more or less restricted breeding seasons.

Of the 306 hartebeest counted in the Park on the present trip, 41 were calves, mostly young ones, with only a few older ones of perhaps 3-4 months. Calving appears to have taken place mainly in October and November, which fixes the mating time from February to March.

The total number of gemsbok calves counted were 36 out of a total of 1307 animals seen. This figure is very misleading, however, since the majority of gemsbok were counted at or near the waterholes and the young seem to be left behind when the adults go to drinking places, because all the young animals seen were found away from the water.

It seems to be a justifiable conclusion that the young do not accompany the adults to water, and the very young ones are probably hidden in the bush or grass for a considerable time before they are allowed to join the herd. Many young animals were probably passed unnoticed, and the ratio between young and old observed on this trip is not a true reflection of the real proportions.

Calves of almost all ages were observed, which seem to indicate that the gemsbok does not have a regular breeding season.

Only one springbok fawn was noticed, which is rather unusual for this area, where the normal lambing season is from September to November,

although the springbok's natural lambing season in the northern part of S.W.A. and in Angola commences in January.

The blue wildebeest too, had a late calving season, because its natural calving season in the Park is from October to January; yet, up to the middle of December not a single calf was observed.

A later report from the Warden stated that the springbok started dropping their fawns from the middle of December, and that the first blue wildebeest calves were seen at the beginning of January, and calving continued throughout January and February. This fixes the blue wildebeest's mating time at the end of April and onwards, which is two months later than usual.

The natural breeding (i.e. mating) time of the springbok is from the beginning of March to the end of May. With a gestation period of six months the lambing season must, therefore, extend from the beginning of September to November. If it is delayed until the middle of December it follows that mating must have taken place at its earliest from the end of June.

The calving time of both these antelopes have, therefore, been delayed by a few months, an occurrence which must be due either to a corresponding delay in the mating time of these animals, or to an extension of the gestation period as an adaptation to special circumstances.

In those mammals that have a restricted breeding season, the season of the year, in conjunction wtih certain local environmental factors, appear to be the decisive factor in determining the onset of mating.

Although the real causes of seasonal reproduction still remain obscure, the response of organisms to daylength, called photoperiodism, seems to be of vital importance. The control of the reproductive cycle by photoperiodism is brought about by the influence of the amount of light on the anterior pituitary gland, whose hormones control the activity of the gonads.

Animals transferred from one hemisphere to another soon adjust their habits to the reversed season, which agrees with respect to daylength. Photoperiodism similarly plays an important role in the life of birds, and is probably the primary factor in providing the annual stimulus for migration.

Although the length of day appears therefore to be a factor of primary importance in controlling the breeding activities of certain mammals, a wholesale shift in the breeding season of the springbok and blue wildebeest is a clear indication that light is not the critical factor.

In some instances reproductive behaviour seems to be under the control of a delicate balanced pattern of environmental and biological processes, in which case such factors as nutrition and relative humidity may be of great secondary importance.

Before it will start mating, an animal must be correctly tuned physiologically. Bad nutrition, caused by dry, unpalatable grass, and the necessity to

take food which is not its natural food will perhaps retard the physiological cycle of the male and female gonads, and it will inevitably lead to some delay in the onset of mating.

Variations in the sexual periodicity of smaller mammals has experimentally been induced by simply varying the amount of food.

Rainfall, therefore, through its influence on the general conditions of the veld, is probably an important determining factor in the actual timing of the breeding season of some antelopes.

During the first half of 1957, in particular from February to May, general conditions in the Park were very bad. The natural mating time of the springbok and blue wildebeest falls within this period, and the bad conditions prevailing in the Park during that time, probably had an adverse influence on their normal mating activities.

The conditions of the grazing appears to have had a greater effect on the breeding activities of the springbok than on any of the other antelopes occurring in the Park, due perhaps to its food preferences and dependency on certain types of short grass and shrubs.

Unfortunately, Twee Rivieren is the only place in the Park where the rainfall is measured, and as the greatest portion of the Park's rain is in the form of local showers it is very difficult to estimate the true effects of the rainfall in different sections of the Park if the exact rainfall figures are not available.

Twee Rivieren had 56 mm. of rain in March, 1957, which must be regarded as good, but it is not known to what extent general relief was experienced in the Park. The fact that the rain which fell at Twee Rivieren did not induce the springbok in that area to start mating, is an indication that rain is not the only factor involved, and the conclusions derived at with respect to the general effects of rain on mating activities is at this stage mere conjecture, and must be regarded as such.

Another factor which might have affected the breeding capacity of the springbok is the serious depletion that its breeding stock suffered in 1956. At the time under discussion the springbok population in the Park consisted of an unusually high percentage of young animals, whose sexual immaturity might have been a contributory factor in causing a delay in the onset of the mating season.

In the case of the gemsbok it is not possible to draw any conclusions with respect to the influence of environmental conditions on its reproductive activities, as it does not appear to have a regular breeding season, and the effects of adverse conditions on its breeding season and breeding capacities would, therefore, be hardly noticeable within a single year.

The red hartebeest probably had a normal calving season, and this

immediately raises the question: why were they not affected by the bad conditions that influenced other antelopes?

It has been pointed out before that almost all the red hartebeest observed on the present trip were encountered in the northern part of the Nossob, and it is in that region where all the calves were seen. According to the Warden, general conditions in the Nossob in the beginning of 1957 were probably better than further south, and favoured the propagation of the hartebeest, although conditions were not so favourable as to allow normal breeding of the springbok in that area.

This point merely emphasises our utter lack of knowledge regarding the breeding habits and feeding and water requirements of these animals.

The degree of humidity, absolute or relative, is of great importance too. It has been conclusively shown that animal behaviour is influenced by the degree of humidity, and it is possible that the relative or absolute humidity is an important factor in the reproductive behaviour of some animals, whereas others, such as the gemsbok, which breeds at all times of the year, do not appear to be strongly influenced by environmental factors.

There is still another possibility, which raises a rather interesting problem: Can the gestation period be adjusted to fix the calving period at a suitable time?

In the 1956 report of the Royal National Parks of Kenya, the Director, the Hon. M. H. Cowie, M.L.C., writes as follows:

> "It is most extraordinary that when the rains were so early the wildebeest should have calved at an earlier period. I believe this points to a conclusion that wild animals can adjust their gestation periods to the conditions which are suitable for calving . . . I cannot accept that freak seasons can be predicted at a period of some ten to twelve months beforehand, so it postulates that the gestation periods are undoubtedly variable."

According to Cowie, the normal calving time of wildebeest in the Amboseli National Reserve extends from the beginning of March to the middle of April, but in 1956, when it rained earlier than usual, the main calving season also finished at least a month earlier than usual.

This is a most interesting observation, but the obvious question that arises is whether mating did not take place earlier, due to unusual circumstances, and that the earlier rains and earlier calving period is merely coincidental.

If the normal calving period is from March to April, mating must start in June or July. Depending on the general conditions that prevailed in 1955, the mating season of the blue wildebeest might well have commenced earlier, with its inevitable effect on the calving period.

A correlation between food supply and breeding season cannot be denied but it is very unlikely that the gestation period can be shortened. It is genetically determined and can only vary within certain limits, although an extension of the gestation period is possible in exceptional cases.

It has been experimentally determined that the gestation period is influenced by the environmental temperature, and a high temperature (within limits of course) shortens the gestation period. In certain small carnivores it was established that a difference of 13°C in the temperature of the environment can shorten the gestation by as much as 5%.

It is very unlikely that environmental factors can shorten the gestation period by more than 5% and this figure is probably the widest margin of variation that can be allowed as far as a reduction of time in the gestation period is concerned. And this reduction is not an arbirtary adjustment by the animals concerned; it is a direct result of the influence of the environment.

A considerable extension of the gestation period is possible in certain special cases. In certain small mammals (e.g. the bats of the Northern hemisphere), fertilisation takes place several months after copulation, the sperms being stored in a special seminal receptacle for a considerable period, but as the gestation period is generally regarded as that period that elapses between conception and birth, this is not truly a case of an extended gestation period.

Of a different nature is the phenomenon known as delayed implantation of the embryo that occurs in some mammals, e.g. the roe deer, the armadillo, and several small carnivorous species of the Northern hemisphere. After copulation the ovum is fertilised in the ordinary way, but the blastocyst does not become attached to the uterine wall; instead it remains loose in the uterus for several months, and the process of gestation is suspended for that time. Development is resumed when the blastocyst becomes implanted several months after fertilisation has taken place. Although birth may take place 9 months after copulation, the actual development may take a few months only.

In the mouse, where pairing and fertilisation sometimes take place before the young are weaned, delayed implantation serves to postpone pregnancy during lactation, but it is not clear what advantage this retarded development holds for other species, except perhaps to avoid breeding at an unsuitable time of the year.

A correlation between the breeding season and food supply seems very likely, but correlation between the gestation period and the food supply would be very difficult to uphold, since it involves a complicated physiological process, and once the embryo has become implanted it has to run its full course, with a possible variation of not more than 5% in both directions.

The discussion shows quite clearly that the breeding activities of our game animals are not influenced by a single factor, but involve a complex of interacting factors, physiological and ecological. In spite of its great significance for the conservation of our fast disappearing wild life, we have a deplorable lack of knowledge regarding the reproductive habits of African mammals and the physiological and environmental factors controlling their breeding activities.

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SUGGESTED LINE OF RESEARCH FOR THE FUTURE

1. Further detailed studies of the feeding habits and food preferences of the various antelopes.
2. With the aid of the botanist, an ecological and systematic study of the vegetation of the various types of dunes should be carried out. Edaphic differences should also be studied.
3. It is of the utmost importance to go ahead with the marking of animals, in order to obtain direct information on their movements.
4. Large-scale movements of game take place annually between the Park and the adjoining Bechuanaland National Park. It is desirable that a general survey of the Bechuanaland National Park, which is administered by our National Parks Board, should be carried out.
5. The present census method should be continued. These counts will eventually prove to be a valuable criterion in determining the general trend of population growth.
6. The ecology of the eland, as one of the rare antelopes, not only in the Kalahari, but also in the Kruger National Park, is a problem which deserves priority. It is important to find an explanation for its almost total absence in the Park on our last visit.
7. More information is required with regard to the breeding activities of the game animals, and the factors influencing them. The Rangers of the Park can render valuable assistance by recording all observations of mating and breeding activities.

8. As ecological factors like rainfall, humidity and temperature may play an important part in the migration, habits and breeding activities of the game animals, it is desirable to have meterological instruments at suitable places in the Park to record automatically the physical conditions of the different areas, at all times of the year.
9. Finally, it is desirable to find an answer to the following question: Is the Park a viable unit for all seasons, as far as the different game animals are concerned?

MAP OF THE UNION OF SOUTH AFRICA SHEWING THE KALAHARI GEMSBOK NATIONAL PARK.