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WATER USE BY THE KALAHARI LION *PANTHERA LEO VERNAYI*

by

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Abstract – The extent to which the Kalahari lion can survive without having to drink water was investigated in the Kalahari Gemsbok National Park. It was found that while they may drink regularly where water is available, they may become completely independent of water under extreme desert conditions. Sufficient moisture for their needs seems to be obtained from the blood and body fluids of their prey and the vegetable components of their diet. Loss of water through evaporation is reduced by the lion's leisurely way of life.

Introduction

Many small desert mammals have acquired physiological and morphological characteristics which enable them to live without drinking water in their hostile environment. This is also true of some of the larger mammals inhabiting Africa's more extreme deserts. Examples include the oryx *Oryx leucoryx*, the Addax antelope *Addax nasomaculatus* and various gazelles (Cloudsley-Thompson and Chadwick, 1964). Taylor (1971) has shown that the eland *Taurotragus oryx*, the beisa oryx *Oryx beisa* and the Grant's gazelle *Gazella granti* can apparently survive in very arid regions without having to drink.

Very little information is available on the water requirements of desert carnivores. According to Schmidt-Nielsen (1964) the fennec *Fennecus zerda* seems to be the only Saharan carnivore that is entirely independent of drinking water. However, it is likely that many of the smaller carnivores and carnivorous animals can survive in arid regions without having to drink water. Most of these animals live on a mixed diet and sufficient moisture for their needs seems to be obtained from the blood and body fluids of their prey and the vegetable components of their diet. According to Schmidt-Nielsen (1964) this could only be possible if water is not used for heat regulation and this can probably be accomplished through burrowing and nocturnal habits.

With the possible exception of the lion, very little is known about the drinking habits of the larger desert carnivores. The available knowledge on the lion tends to indicate that although they are usually found in the

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vicinity of water and will drink regularly where water is available, they become completely independent of water under extreme desert conditions. This is the conclusion arrived at by Smithers (1971) and Adamson (1968) who have both studied the lion in some of the most arid regions of Africa. Within historical times the lion occurred over large areas of desert and semi-desert country in different parts of Africa.

This paper represents an investigation into the water requirements of the Kalahari lion. It forms part of a long-term study on different aspects of its ecology and behaviour.

Study area

The Kalahari Gemsbok National Park is situated in the south-western part of the southern Kalahari. Mean annual rainfall varies from about 140 mm in the arid south-western portion of the Park increasing to about 240 mm in the north. The rainy season extends over a period of about six months, with approximately 50 per cent of the total amount falling within the period of three months, and reaching a peak in March. Air temperatures of 41°C and ground surface temperatures of 70°C have been recorded (Leistner, 1967).

This study was carried out in the northern part of the Park in an area which contains three artificial water-holes, ensuring a regular water supply to the lions inhabiting the area.

To study their drinking frequency, lions were trailed continuously for varying periods. This presented no difficulty as the whole area is covered with fine Kalahari sand and it is an easy task to keep track of each pride's daily movements and water use.

Results and Discussion

The drinking frequency of several different prides of lions is given in Table 1. The data are based on three years of observation, during which time several prides were followed continuously for varying periods. With one exception all these observations were made in summer. Due to the physical limitations of our trackers and vehicles it had seldom been possible to do more than 12 days of continuous tracking in the scorching sun where ground surface temperatures may exceed 70°C. Rain brought relief on a few occasions. Data collected during rainy periods are not included in Table 1, with one exception as indicated.

Table 1 shows that the different prides kept under observation drank on 24 out of 83 nights, and that some prides drink more frequently than others. The drinking pattern does not appear to be directly influenced by food intake as is often maintained.

Pride S_1, consisting of three young roving males, went without water for nine days during a period of intense heat. During all this time they could only succeed in killing one bat-eared fox *Otocyon megalotis*, and three

Table 1

Drinking frequency of lions in the northern Kalahari Gemsbok National Park

	Pride Number								
NIGHT	W_1	S_1	S_3	S_3	S_4	S_5	S_6	S_7	S_8
1	X[1]	X	X	O	O	O	O	X	X
2	O	X	X	O	O	O	O	O	O
3	O	O	O	O	X	X	X	X	O
4	O	O	O	O[2]	X	O	O	O	O
5	O	O	O	O	O	X	O	O	O
6		O	O	O	X	X	X	O	O
7		O	X	O	X	X	O	O	O
8		O	O	X	O	O	O	O	O
9		O		X		O	O	O	X
10		O		O				O	X
11		O		O					X
12									O

X[1] = drank water
O[2] = rain fell during the night
W = Winter
S = Summer

porcupines *Hystrix africaeaustralis*. The fluid obtained from their food must therefore have been negligible. On one occasion they passed within 3 km from a water-hole, yet they made no attempt to drink. It is possible of course that they had entered another pride's territory and were hesitant to penetrate deeper into enemy country.

Pride S_7, consisting of four adult females and a cub of about six months old, was tracked for 10 days. They drank on the first and third nights and then stayed without water for seven consecutive days, during which period they killed an ostrich *Struthio camelus*, two porcupines and two adult gemsbok *Oryx gazella*. The two gemsbok were caught during the seventh and ninth days of observation and although they gorged themselves on a few days in succession they made no effort to obtain water.

Pride S_8, consisting of two males and two females, all adult animals, also stayed without water for seven days and then, after killing a red hartebeest *Alcelaphus buselaphus* near the water, came to drink on three consecutive nights.

The time spent at the water as well as the actual drinking time varies considerably as the following observations indicate:

(1) Pride S_7 arrives at the water at 2010 hours. One lioness remains in the background; the others drink for a few minutes and then walk away into the darkness. They reappear after nine minutes to drink again, repeating the performance shortly afterwards. They finally leave at 2230 hours, having drank five times during a period of 2 hours and 20 minutes. Total drinking time for each member of the pride varied from 2 minutes to 20 minutes 20 seconds respectively. The cub drank for $9\frac{1}{2}$ minutes.

(2) Pride S_8 arrives at the water at 2245 hours. Although they had been without water for eight days they only drink for 5 to 7 minutes and then walk away.

Shortly afterwards they kill a red hartebeest 2,7 km from the water.

On the following night the two males arrive at the water at 2130 hours, followed by the two lionesses at 2259 hours. The whole pride stays at the water until dawn. Total drinking time of the four lions varied from 5 to 19 minutes respectively, the two males drinking about twice as long as the females.

On the third day the pride arrives at the water 90 minutes before sunset. One male and the two lionesses drink for 3 to 4 minutes. The other male does not drink. His attention is focused on his lioness with whom he mated a few days earlier. They all lie down in the shade, the courting couple side by side. Forty-five minutes later the whole pride gets up and drinks for 2 minutes, including the courting male, who never lets the lioness out of his sight. The two lionesses walk off to a nearby dune, followed by the two males. They return to the water in the early morning hours, but drinking times were not recorded.

It appears that lionesses with cubs have a greater need of moisture than other lions, probably to keep up milk production. On at least three different occasions a lioness that was known to have cubs left the pride to whom she belonged and came to drink water alone.

Taking all these observations together it seems that when drinking-water is available, the Kalahari lion will make use of it to a variable extent. Where water is not available, it appears to be able to do without it. Lions have been found in parts of the Kalahari where no drinking-water is available and where the rainy season is limited to a few months of the year. They must be able, therefore, to live for months without a drink.

To be able to survive under such extreme conditions without drinking water the Kalahari lion must have access to other sources of water. Furthermore, heat regulation must take place with a minimum loss of water. A study of the lion's habits indicates how this is accomplished.

Apart from the blood and body fluids of its prey, another important source of moisture is the tsama melon *Citrullus lanatus*. The tsama melon is a small round fruit, bigger than a fair-sized orange and with a very high moisture content. It is fairly plentiful in summer, but unavailable in winter after the first ground frost.

It is an important source of food and water to probably all species of antelope inhabiting the Kalahari, also to the black-backed jackal *Canis mesomelas*, the spotted hyaena *Crocuta crocuta*, the brown hyaena *Hyaena brunnea*, the lion and possibly many species of smaller mammals found in the Kalahari. Whether the tsama melon plays a vital role in the lion's water economy is difficult to say without more evidence.

Lions have also been seen eating grass although the amount of moisture obtained from this source is probably negligible.

Rain water is collected in the Kalahari in pans and other small saline depressions which may hold water for considerable periods. In summer this is an important source of water. In most areas, however, very little water becomes available for drinking purposes because of the perviousness of the Kalahari sand. That lions do obtain some moisture, even during light showers, was proved in an unexpected way. A pair of lions was followed in a light drizzle. Unaware of our close proximity they stopped on a high dune and the lioness was observed to lick the raindrops from her companion's pelage. Moisture can thus be obtained in this way and also by licking raindrops and dew from the leaves of plants, although the amount of water obtained this way would be insignificant for a large animal like the lion.

The Kalahari lion seems, therefore, to be capable of maintaining its water balance on the water contained in its food, supplemented by other, albeit insignificant, sources of water. To maintain this over long periods, however, water loss must be reduced to an absolute minimum. To avoid over-heating it must either escape the excessive heat load or use evaporation for heat dissipation which, according to Taylor (1971), is the major avenue of water-loss in ungulates.

Most small mammals prevent overheating by burrowing and nocturnal habits. In larger mammals like the eland *Taurotragus oryx* and oryx evaporation is reduced through a variable body temperature (Taylor, 1971).

Whether the lion possesses any comparable physiological adaptations for life in an arid environment is unknown, because its physiology has not been studied. However, it may be possible for the lion to survive in a desert environment without any elaborate physiological adaptation and it is postulated that loss of water through evaporation is largely reduced by its leisurely and lethargic way of life.

Lorenz (1952) describes the lion as . . . "about the laziest of predatory beasts". Although he may cover enormous distances under natural conditions, up to 35 km per day has been observed in the Kalahari, he does so in leisurely fashion. A pair of lions that covered 17 km on a cool summer night rested 19 times over that distance. Another pride consisting of three young males rested 15 times over 19 km under the same conditions. This is the general pattern of their movements.

As soon as it becomes warm, which is just after sunrise in summer, they seek up a shady spot where they spend the day resting. They do not start moving again until it has cooled down. As a resting place they almost invariably select a witgat tree *Boscia albitrunca*, a shrub-like tree with low-hanging branches that usually reach to the ground. Tunnel-like entrances through the dense foliage lead to an environment that is probably almost as cool as an underground tunnel. The evergreen witgat, scattered over the whole Kalahari, is regarded as one of the most important fodder trees and is also preferred by lionesses during parturition.

The lion rarely exerts himself. Even his hunting method is adjusted to the least expenditure of energy. Apart from its effect on evaporation, such

an easy life must lead to a lowering of the metabolic rate which, according to Taylor (1971), ". . . would result in a reduction in faecal water loss, in urinary water loss, and in respiratory evaporation".

Through its feeding habits and daily pattern of life the Kalahari lion has succeeded in meeting the desert's greatest challenge – lack of water and excessive heat.

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