GEOGRAPHICAL EDUCATION MAGAZINE

Volume 22
Number 2

September 1999

GEOGRAPHICAL EDUCATION MAGAZINE

Volume 22

Number 2

September 1999

Produced by the
Geographical Association of Zimbabwe

Edited by: R.S. Burrett
Peterhouse School
P. Bag 3741
Marondera

Free to paid-up members of the Geographical Association during the year of membership
Additional copies Z$60.00

CONTENTS

Published by:
Geographical Association
of Zimbabwe
c/o Department of Geography and
Environmental Science
University of Zimbabwe
P.O. Box MP 167
Mount Pleasant
Harare

Typeset by:
S.D. Cumming
TEXCEL Desktop Publishing
P.O. Box BW 326
Borrowdale
Harare

Printed by:
Automation Business Forms
P.O. Box 1120
Bulawayo

EDITORIAL

Here with another edition of *GEM* which we hope, as always, teachers will find of use. The past year has not been a kind one to any of us here in Zimbabwe, and the Association has not escaped unscathed from the current financial crisis which has seen the rapid escalation of printing and postage costs. Our traditional printers increased their charges nearly five fold, while the standard of their work has declined sharply. We have thus been obliged to take the magazine to a commercial firm, but this is expensive although I am delighted as to the quality .

The National Council was certainly caught on the wrong foot and we had serious discussions as what to do next. At one stage we thought that we might have to close down *GEM* completely as we just did not (and still do not) have adequate funds to see it through. However, after many hours serious thought we have opted to struggle on, however, there will have to be cutbacks. We have reduced the print size somewhat to get more material on fewer pages, and we are really sorry but Corporate Members will henceforth receive only one copy of *GEM*—as is the situation with *GJZ*. This was brought to the National Council AGM in August and was ratified by that forum. Those of you reading this editorial will already be aware of the drastic increase in subscriptions which was necessitated in order to try and cover the cost of the publications. We will struggle on with the production of *GEM*, but I warn members that the situation is precarious.

The membership of Geographical Association of Zimbabwe can proudly boast of being part of the only operative subject Association in the field of Education in Zimbabwe today. However, with the sharp, unavoidable, increases in subscriptions we have witnessed a marked decline in our membership. This is reducing revenues further and threatens the very existence of the Association. We therefore STRONGLY encourage all members to canvas around to increase membership—both lapsed and new members. It would be sad if we ceased to function.

Robert S. Burrett
Geographical Association of Zimbabwe
Peterhouse School
P O Box 3741
Marondera
October 1999

THE ECOLOGY OF THE AFRICAN LION (*Panthera leo masaicus*) OF SERENGETI

by

Billy M. Kariaga
Department of Geography and Environmental Science, University of Zimbabwe

INTRODUCTION

The study of the evolution and distribution of plants and animals, or biogeography, is one of the many branches of the subject. Geographers are interested in the distribution of a species from the time it first appears on the surface of the earth and how it subsequently colonises various habitats. While botanists and zoologists study the anatomical and physiological evolutionary changes of an organism through time, geographers are mainly concerned with the spatial and temporal distribution of the organism. Understanding the factors which determine this distribution is therefore of utmost importance.

This paper describes the distribution of the lion, *Panthera leo* and then gives a detailed analysis of the ecology of the Serengeti lion *Panthera leo masaicus*. An attempt has been made to discuss both the biotic and abiotic factors that affect the survival of this great carnivore. The Serengeti ecological unit in northern Tanzania has been selected because it has the greatest density of lions and other wild animals anywhere in the world. Together with the adjacent Masai Mara Game Reserve in Kenya, they have about half the lions on the earth's surface.

HISTORICAL DISTRIBUTION OF THE LION (*Panthera leo*)

Exceeded only by the tiger in average length and weight, the lion is the second largest feline predator in the world. It was familiar to the Ice Age hunters of Europe, who drew it on the walls of their caves. It made its first appearance during the Cromer Interglacial, about 70 000 years B.P. (Before Present), the warm interval between the first and the second—or Gunz and Mindel—glaciations. It was then a cat of enormous size, in fact one of the largest carnivores the world has ever seen (Guggisberg, 1961). Numerous finds in France, England and Germany testify to its having been a common animal of the Hostein and Ilford interglacial. Gradually it became smaller in size, but the lions of the last or Wurm glaciation were still larger than the present day African lion.

The big Pleistocene lions were at one time regarded as belonging to a separate species, known as the "cave lion", *Felis spelaeus*. When the skeletons of somewhat smaller lions came to light, some authors suggested that the "cave lion" might really have been a tiger. Pleistocene tigers have, however, been found in China, and their remains differ from those of the European cave lions. Apart from the size, these remains resemble the present day lions too closely to justify a separation of species, and the cave lion is now given a subspecies status only.

The lion as an inhabitant of mainly open country withdrew when post-glacial Europe became densely forested, probably disappearing from most of those regions during the Azilian period of the Neolithic. There is no doubt, however, that in classic times (Greek and Roman times), it still existed in the Balkans. Herodotus (484–430 B.C.) mentioned it as occurring in considerable numbers between the rivers Achelous in Acarnania and Nechus in Thrace. When Xerxes advanced through Macedonia in 480 B.C., several of his camels were killed by lions. Aristotle agreed with Herodotus as far as distribution was concerned, but considered the lion as a rare animal. George Jennison (1973) thinks that there probably were no lions left in Europe in the first century A.D.. Schaller (1990), however, suggests that the species vanished from Greece between the year A.D. 80 and 100.

The lion differs from the tiger, leopard and jaguar by its social habits, a pronounced sexual appetite, and by having a tuft at the end of its tail within which there is normally hidden a horny spur separated from the last vertebrae. Some taxonomists have therefore allocated it a special position amongst big cats, placing it in its own sub genus for which the name Leo has been proposed (Brown, 1938).

Lions have been crossed with tigers. The resulting hybrids, known as "ligers" or "tigons" according to whether they descend from a male lion and a female tiger, or a male tiger and a lioness used to be thought to be sterile. In 1943, however, a fifteen year old hybrid between a lion and a tiger, was successfully mated with a lion at the Munich-Helabrum Zoo. The female cub, even though very delicate, was raised to adulthood.

The only known population of the Asiatic lion, *Panthera leo persica* occurs now in the Gir Sanctuary of Gujarat State in India where about 175 animals represent the remnants of a population which 150 years ago was widely spread over the northern half of that country.

In Africa, on the other hand, lions continue to survive in the vast woodlands and plains. Of the ten subspecies of African lion recognised, *Panthera leo leo* the Berber lion of North Africa, and *Panthera leo malanochaita*, the Cape lion of South Africa have become extinct. Although in recent years agriculturists have eliminated much of the suitable lion habitat, and pastoralists with their livestock have increasingly come into conflict with the lions, huge tracts of land still harbour many of them, particularly in Kenya and Tanzania where *Panthera leo masaicus* lead a natural life, roaming at will and preying largely on the indigenous antelope.

PRESENT DISTRIBUTION

At present a good number of lions are found in southern Africa in Kruger National Park (South Africa), in southern Mozambique, in the Hwange National Park of Zimbabwe, throughout Botswana and in northern parts of Namibia, especially the Etosha Pan (Figure 1).

North of the Zambezi river, the lion ranges through northern Angola, the southern part of the Congo basin, Zambia, the whole of East Africa to Somalia, as well as the low lying southern and western parts of Ethiopia and the Sudan. It is not found in the equatorial forest belt. From the Sudan, it extends westward through Chad, the Central African Republic, northern Cameroon, northern Nigeria, Burkina Faso, Mali to Senegal and Northern Mauritania, the northern limit of its area of distribution being formed by latitude 18°N in Mauritania.

The lions present range in Africa is therefore very varied in habitat ranging from the Kalahari desert through the savanna of southern Africa, the highlands of East Africa, the hot and dry lowlands of Somalia, the highlands of Ethiopia and the low and humid countries of West Africa.

It would therefore seem that lions are capable of living in very varied climatic environments. It is certainly interesting that these animals, which probably evolved in the cool mid-latitudes of Europe, have been capable of adapting themselves to such completely different geographic regions. With such contrasts in the geographic range of the lion, it is not right to study the African lion as a species living in a uniform habitat but as one living in numerous habitats cutting across the geographic regions. Essentially this means that the lions are not distributed according to a uniform altitude, atmospheric pressure, wind speed (and direction), precipitation and temperature.

Figure 1: The approximate present distribution of the lion in Africa

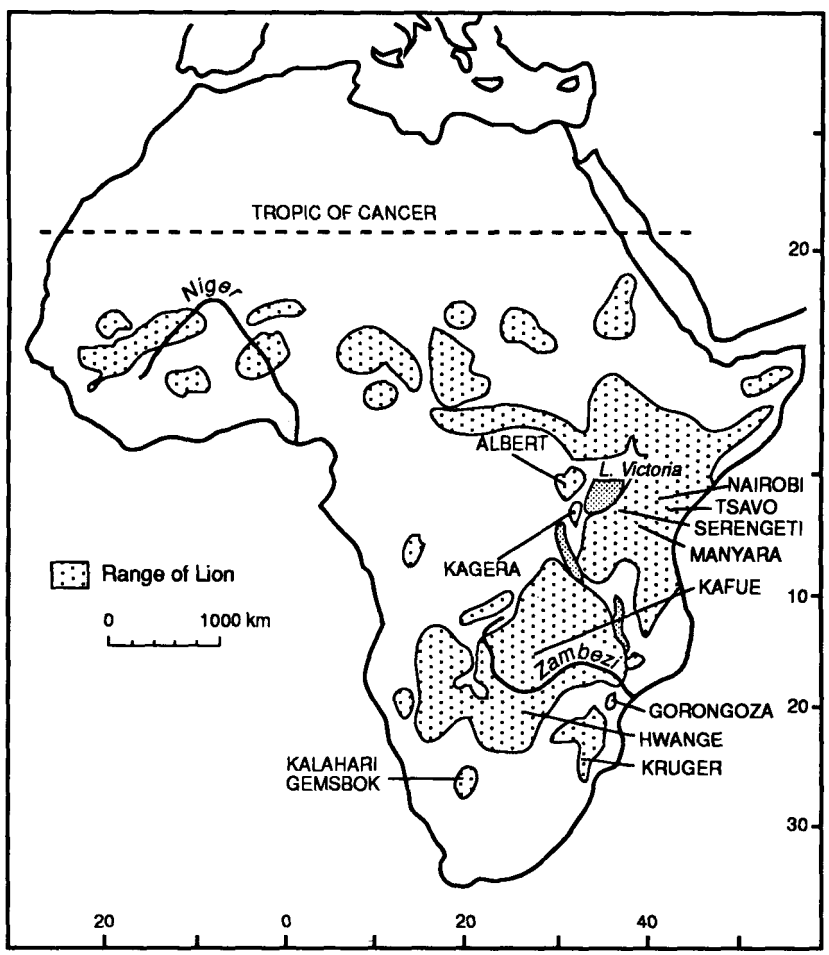
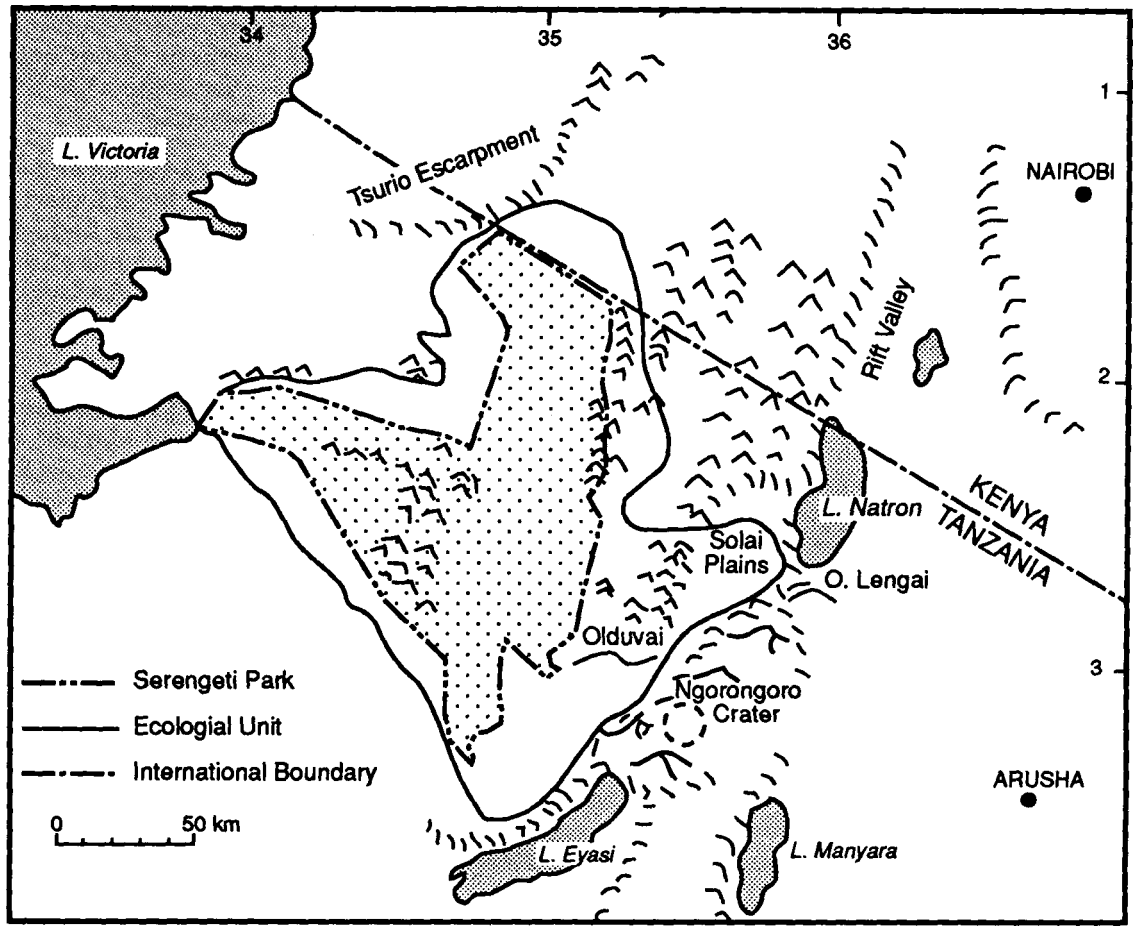


Figure 2: Physiography of Serengeti Ecological Unit



Their kinds of prey and competitors in these environments are thus bound to be different.

THE SERENGETI HABITAT

Geomorphology

The Serengeti region is a vast area of plains and hills lying in northern Tanzania between latitudes 1° and 3°30'S and longitude 30°50' and 36°E (Figure 2). The geographical boundaries of the unit include, in the east, the western wall of the Rift Valley and the Crater Highlands, which rise to an altitude of 3 587 meters with Ngorongoro Crater as their most spectacular feature. Settlements border the unit in the south, the Speke Gulf of Lake Victoria abuts the west and Isuria Escarpment and the Masai Mara Game Reserve of Kenya border in the north. The whole area is a plateau broken by hills. This plateau slopes gently and irregularly from an altitude of about 1900m in the east to 1170m near the shores of Lake Victoria. Drainage is westward but the principal rivers, such as the Grumeti, Mbalageti and Duma, are seasonal, retaining nothing but pools during the dry season. Only the Mara and Bologonja rivers in the north are perennial.

Stretching westward from the Crater Highland and the Rift Valley are the Serengeti Plains covering some 5 200 km², 'and this is a sea of grass, grass, grass one looks around and sees only grass and sky', wrote Jaeger (1961).

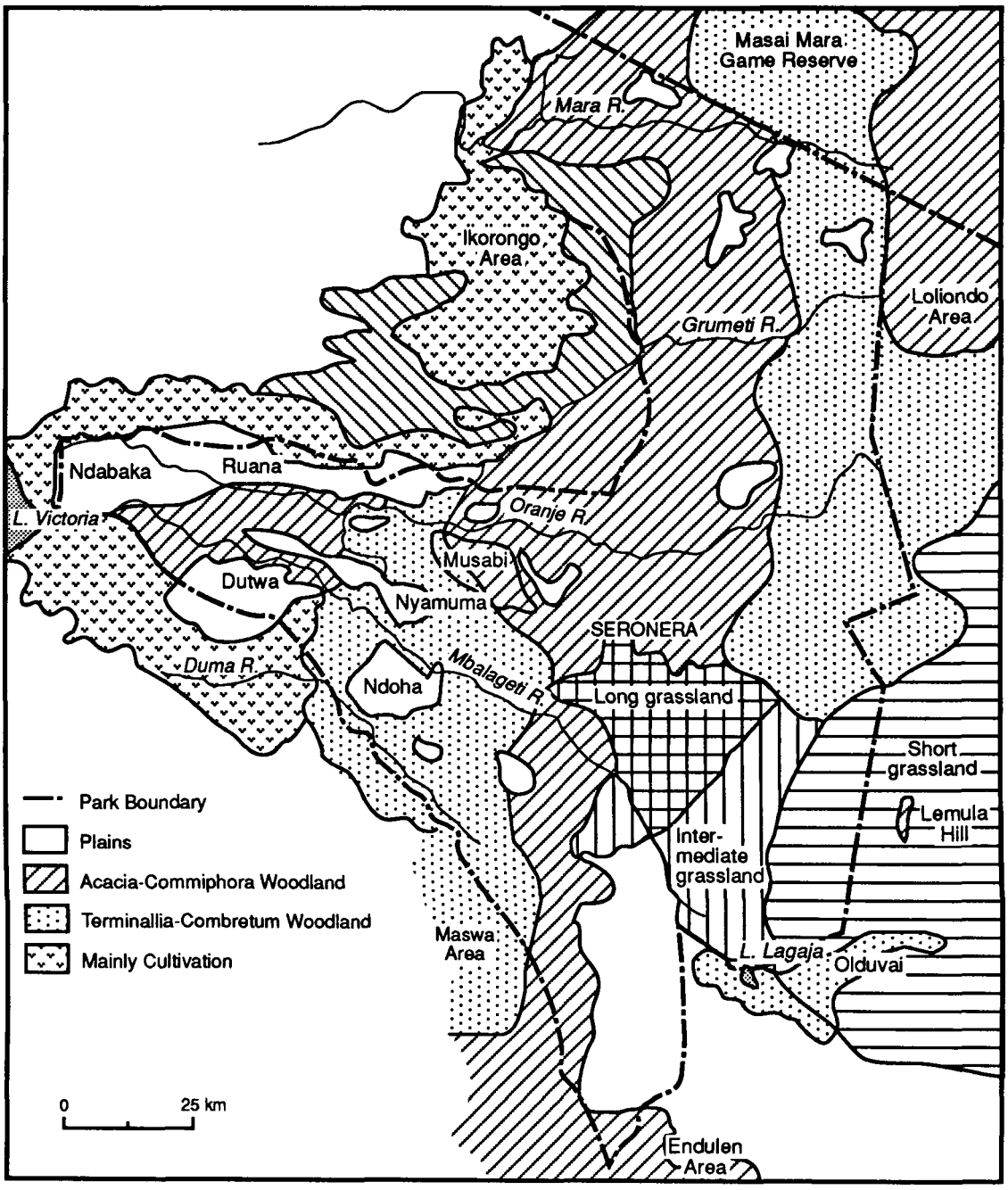
Inselbergs or kopjes composed of weathered granite and gneiss stud the plains, but the main topographical feature is the Doinyo Gol Mountains – hills of quartzite and gneiss covered with scrubby Acacia and commiphora trees. Olduvai Gorge, famous as an early hominid site, cuts through the plains to the south of these mountains and seasonally drains the alkaline Lake Lagaja into the Oldbalbal depression at the base of the Crater Highlands.

Vegetation

The ecological unit supports two main vegetation types: grassy plains on which trees are either absent or limited to the bank of streams, and open woodlands or, more precisely, wooded grasslands with widely scattered trees (Figure 3).

The grass plains are covered with species like *Sporobolus marginatus*, *Aigitaria macroblemphara*, and other grasses, most of them 15cm or less in height, with a basal cover of 10 to 20%. Closer to the woodland, grass species are taller being 0.6 to 0.9m tall with a basal cover of 30 to 50%. The species

Figure 3: The major vegetational types of the Serengeti Ecological Unit



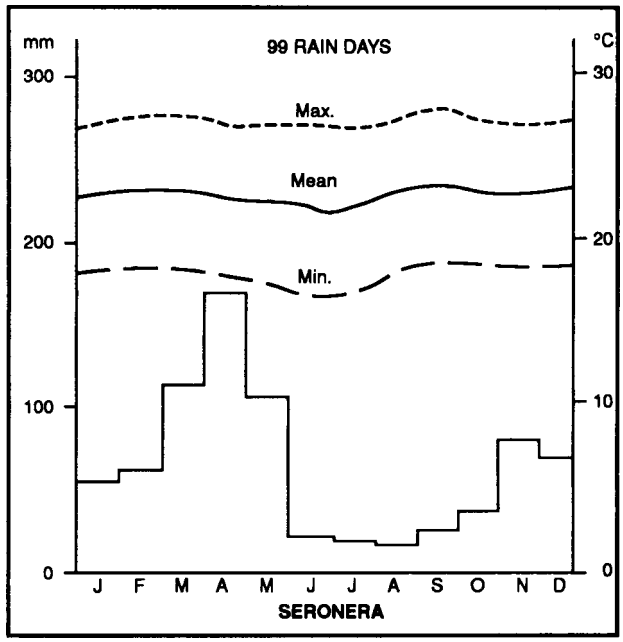
composition of this transitional zone include *Pennisetum mezianum*, *Themenda triandra*, *Andropogon greenwayi* and *Sporobolus pellicidus* among other grasses.

The open woodland covers much of the northern and western section of the park and surrounding areas as well as the hills rising from the plains. Most trees are thorny and rarely exceed 12m in height; their canopy cover averages only about 15 to 20%. The dominant species are acacias (*Acacia tortilis*, *A. gerrardii*, *A. ockii* and *A. senegal*).

Climate

The average year is divided into a dry season from June to October followed by a short period of rain in November and December (Figure 4). January and February tend to be dry with only occasional showers. About one third to nearly one half of the total annual precipitation falls from March to May. The average annual rainfall between 1937 and 1989 at Seronera was 902mm, with a variation from 466.4mm to 1 074mm. The number of days with rain in the year varies from 60 to 113 with an average of 82 (Grzimek and Grzimek, 1990). Temperatures are without

Figure 4: Physiography of Serengeti Ecological Unit



extremes, rarely exceeding 32°C or dropping below 10°C. Relative humidity ranges from a mean monthly minimum of about 15% during the height of the dry season to about 40% during the rains; the mean monthly maximum is about 85% with a daily peak in the evening during the wet season.

The seasons vary considerably from their average patterns primarily as a result of the erratic and unreliable rains. In 1990, for example the rains during November and December failed and the migratory herds did not move to the plains until March 1991. The following year the rains started a month earlier than usual, in February, but in 1995 there was almost no precipitation on the plains from March to May. This variability in the amount and distribution of the rain affects not only the movements of the prey, but also has a profound influence on the food habits and other aspects of the behaviour of lions.

At the onset of the dry season in late May, the grasses in the woodlands are still somewhat green. A few of the major rivers flow and water is found widely, as pools in the tributaries and in wallows and other depressions. The plains dry out more rapidly than the woodlands. There the grasses have either been eaten down to a stubble or, farther west, are tall and dry. Water in the erosion pans disappears rapidly, and a month or two later the main water sources consist entirely of Lakes Lagaja and Magadi and a few alkaline pools. With water and forage scarce, the migratory herds leave the plains, the zebra and wildebeest first, followed by Thomson's gazelle. Only ostriches, Grant's gazelle and a few Thomson's gazelle remain.

During the height of the dry season the plains present a bleak appearance. The long grasslands have been burned, leaving the ground black and bare except for occasional tufts. Fires set by man, both inside and outside the park, burn over three quarters of the woodlands between June and October, eliminating the dry grass, killing saplings and leaving dead trees as ashy skeletons on the ground. The migrating prey move ceaselessly, first west then north, feeding on the dry grasses that remain or concentrating in an area where a local shower has stimulated a flush of green.

In late October or November the west season begins. By the end of November and in December the rains are quite heavy and the woodlands and plains are suddenly transformed from the predominating colours of black and grey to an intense green as the grasses and the leaves of trees sprout anew. The migratory species leave behind the scarce forage in the woodlands and flood back onto the plains. By the end of December the grasses in the woodlands have again reached their full height. With the variable weather from January to May, the plains may be either wet or dry. The herds there move back and forth. During the dry spells retreating into the woodlands only to surge back onto the open plains with renewed rain. This pattern continues until the onset of the dry season.

THE LIFE OF THE SERENGETI LION (*Panthera leo masaicus*)

Besides climate and physiography of the habitat which have been discussed in the preceding section, the other important factor in the ecology of the lion is its prey. The food habits of *Panthera leo masaicus* are influenced by four main factors.

Size of prey

Prey that weigh over one thousand kilograms are avoided. Large animals like elephants, hippopotami, giraffe and rhinoceros are thus avoided by lion because of the ability of these animals to defend themselves. Lions have, however, been known to prey upon the young ones of these species. At the other extreme, small mammals and birds are not often hunted, undoubtedly because of the energy output in trying to subsist on, for example, hares or dik-dik is not commensurate with the food input. The usual prey size ranges form 15 to 1 000 kilograms.

Bourliene (1963) wrote: 'Carnivores actually prey upon herbivores of about the same weight as themselves; they also appear to avoid animals that are much lighter in weight and smaller than themselves. Only those predators like the lion and the cheetah, that hunt their prey in organised groups, may succeed in overcoming animals much larger than themselves'. This prey preference with respect to size is readily apparent when lions have a choice of which species to hunt, especially during the wet season. During the dry season around Seronera,

however, prides tend to ignore buffalo and giraffe, whereas they persistently stalk Thomson's gazelle. This prey is below optimum size for lions. Gazelles are ignored, however, if topi, wildebeest, zebra or others of that size are available or vulnerable.

Availability

Prey availability has a profound influence on all aspects of the lion's biology in the Serengeti. Once it was thought that lions follow the moving prey. 'Some lions are resident year long in game concentration areas near water, but the majority follow the prey species on their seasonal movement within the region' (Talbot and Stewart, 1964). Work done by Brown (1938) has shown that only a small nomadic segment of the lion population follows the migratory herds. Most wildebeest, zebra and Thomson's gazelle—about 62% of the prey biomass (Hanks, 1969)—are thus unavailable to most lions (resident) for part of the year. Since movements of prey are largely influenced by erratic weather, availability of the migratory herds is usually a matter of chance.

Density

The more abundant a preferred species is in an area, the more likely it is to fall prey. Lions are conservative in their movements which, together with the tendency of all pride members to be in the same locality, may leave some parts of their range unoccupied. Small scattered herds may thus temporarily escape the effect of predation. The probability that a lion will encounter a widely dispersed animal is low. On the other hand, both resident and nomadic lions are attracted by prey concentrations and their greater than average food intake at such times attest to the vulnerability of animals when they are abundant. With densities changing constantly as a result of movement of migratory and semi-migratory prey, and even as a result of local movements by such residents as buffalo and impala, there is thus a continuous adjustment by lions, with prides confining their shifts to within pride areas, but nomads roaming over a large part of the ecological unit. As the density of a particular species in an area decreases through emigration, vulnerability decreases too but only up to a point—the point at which lions merely begin to work harder to meet their daily requirements.

Table 1: Number and biomass (in kg) of prey in the Serengeti Ecological unit (1990)

	Species	No. animals in ecological unit	Av. Weight per animal	Total Biomass in million kg
Migratory	Wildebeest	4000 000	108	43.200
	Zebra	132 500	164	21.730
	Thomson's gaz.	165 000	12	1.980
	Eland	3 500	225	0.788
	Total	**701 500**		**67.698**
Woodlands resident	Wildebeest	10 000	128	1.280
	Zebra	17 500	164	2.870
	Thomson's gaz.	10 000	12	0.120
	Eland	3 500	225	0.788
	Topi	27 000	82	2.214
	Hartbeest	18 000	95	1.710
	Grant's gaz.	4 000	32	0.218
	Impala	65 000	32	2.080
	Buffalo	50 000	420	21.000
	Giraffe	8 000	716	5.728
	Warthog	15 000	40	0.600
	Waterbuck	3 000	131	0.393
	Ostrich	3 000	83	0.249
	Other	10 000	30	0.300
	Total	**244 000**		**39.550**
Plains resident	Grant's gaz.	6 000	32	0.192
	Thomson's gaz.	5 000	12	0.060
	Ostrich	2 000	83	0.166
	Total	**13 000**		**0.418**
	Grand Total	**958 000**		**107.666**

Weights based on three quarters of weight of average female. Resident wilderbeest are heavier than migratory ones.

Table 2: Predatory and prey population in Serengeti 1990

Prey	Number	Predator	Number
Wildebeest	370 000	Lion	1 650
Zebra	193 000	Leopard	500
Thomson's gaz.	980 000	Cheetah	500
Grant's gaz.	3 100	Spotted hyena	6 000
Eland	7 200	Wild dog	1 100
Topi	26 000	Black backed jackal	13 000
Hartebeest	20 000	Golden jackal	5 000
Impala	75 000		
Waterbuck	3 200		
Giraffe	8 000		
Warthog	17 000		
Buffalo	38 000		

In certain situations, a species remains highly vulnerable to predation regardless of its density as long as a few animals are available the lions preferentially prey on them. Zebras are a case in point, especially early in the dry season.

Scavenging

In addition to killing their own prey, lions readily scavenge food from other predators and eat animals that have died from disease and other causes.

Competition

Table 1 shows the number and biomass of prey in the Serengeti Ecological Unit (Schaller, 1990). It also shows where they are located and whether they are migratory or resident in various areas of the unit. Table 2 shows the predator per prey population in the Serengeti. These figures indicate not only the large numbers of prey population which live in the Serengeti, but also the other kinds of carnivores with which the lion has to compete for this biomass of prey. The varied kinds of prey indicate the great choice of food which the lion has in this habitat. However, the lion is very catholic in its food habit and it is possible that it evolved this catholistic tendency because of the great variety available. It is doubtful that the extinct berber lion of North Africa or the European lion had such a wide choice of food considering the relatively lower number of species in these mid-latitudes.

REFERENCES

BOURLIERE, F. (1963)
'Specific feeding habits of African carnivores', *African Wild Life*, Vol.17, No.1, pp.21–27.

BROWN, C. (1938)
Claws: The Tale of the Lion. Longman, London.

GRZIMEK, M. and GRZIMEK, B. (1990)
'A study of the game of Serengeti plains', *Z. Saugetierk*, No.50, pp.1–61.

GUGGISBERG, C. (1961)
Simba. Longman, London.

HANKS, J. (1969)
'Some aspects of the ecology and behaviour of the Dessa waterbuck in Zambia', *Mammalia*, Vol.33, No.3, pp.371–94.

JAEGER, E.C. (1961)
Desert Wildlife. McGraw Hill, London.

JENNISON, G. (1973)
Cats of the Earth. John Wiley. New York.

SCHALLER, G.B. (1990)
Cats of Africa, John Wiley. New York and London.

TALBOT, L. and STEWART, D. (1964)
'First Wild Life Census of the Entire Serengeti-Mara Region, East Africa', *Journal of Wildlife Management*, Vol.28, No.1, pp.815–27.