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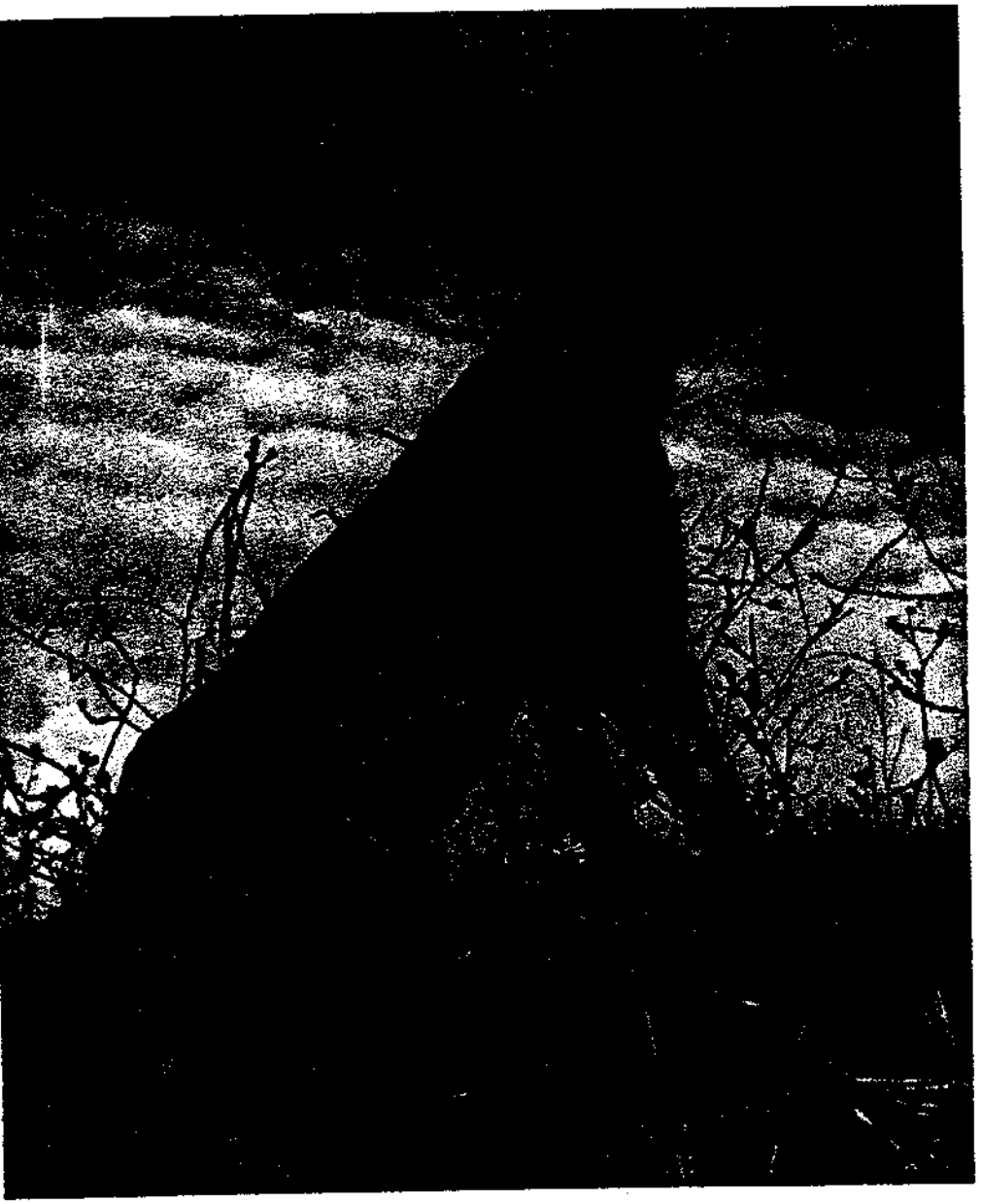
Abstract: The book proposes large information about general characteristics, distribution, ecology and behaviour of the cheetah, as well as management and conservation solutions. One purpose of the field study was to make careful observations of cheetahs stalking and choosing their prey. In this way, it was hoped to determine the factors the cheetah uses as an indicator of an animal to be pursued, and whether the animals killed by the cheetah are other than a random sample of the total population. Aside from specific, ecological objectives, the fact that a species such as the cheetah is endangered but little-known is justification enough for studying its life in the wild and in the captivity. The field work began on October 15, 1966, and was continued through February, 1967. Most of the data are from Nairobi National Park and Masai Amboseli Game Reserve. Airplane flights were taken over the park to census cheetahs, but this system was less effective than ground observations. Cheetahs were observed mostly from a vehicle since they showed little fear of it, and followed around the clock from 5:30 a.m. to 7:00 p.m. Data were collected from many sources including park records, individuals' sightings and descriptions, and photographs of cheetahs, and of course my own observations. Notation was made of wind direction and velocity, percentage of cloud cover, precipitation, and temperature. A parabola was also used with the microphone to record cheetah vocalizations. Vocalizations were played back to captive cheetahs in the World Wildlife Foundation Animal Orphanage at Nairobi Park to observe their reactions. Photography was initially important in identifying cheetahs and for the recording of behaviour for further analysis. A 200-ft field survey tape was used either to measure directly certain distances or to check estimates. Many of the same observational techniques were employed in the captive phase of the research.



A large male cheetah watches prey from an elevated mound. (Photo: R. L. Eaton.)

THE CHEETAH

The Biology, Ecology, and Behavior of an Endangered Species

RANDALL L. EATON

BEHAVIORAL SCIENCE SERIES

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BEHAVIORAL SCIENCE SERIES

The Van Nostrand Reinhold Behavioral Science Series will publish a broad range of books on animal and human behavior from an ethological perspective. Although presently observable behavior is the focus of this series, the development of behavior in individuals, as well as the evolutionary history in various species, will also be considered. It is felt that such an holistic approach is needed to come to a fuller understanding of behavior in general. This series is a contribution toward this goal.

Erich Klinghammer, Consulting Editor
Purdue University

Preface

My life with the cheetah began in 1966 and is still not ended. After a field study in East Africa and further study of cheetah behavior under semi-natural conditions, I am now faced with the task of putting my own observations and theories to work at World Wildlife Safari and Research Park where we are still studying and trying to breed this fine animal. It is a welcome but difficult challenge. Perhaps the most pressing task of the wildlife biologist is to apply biological and behavioral knowledge to achieve preservation of threatened species. My personal opinion is that many carnivores will become extinct in the wild before very long. For the difficult-to-breed species, such as the cheetah, their future may be limited to wildlife parks and zoos. We must work now to integrate information on the wild life of many species with their management in captivity, and hope thereby eventually to be in a position to reestablish many species in the wild.

I am pleased that the cheetah has become a fad in zoos around the world. I'm convinced that this growing interest and concern to propagate the species will succeed and will ensure the continued existence of cheetahs on our planet. It is equally encouraging that standards are being developed which will be required for American zoos planning cheetah breeding programs. This is an intelligent step forward in the captive preservation of vanishing animals. I should emphasize, however, the

necessity for field studies of all wildlife, without which we are often only guessing about how best to manage a species, whether in the wild or in captivity.

Man will have to manage his entire heritage if he is to hold on to it. The quality of life around the globe is deteriorating daily. The more affluent societies must consider wildlife conservation as a top priority among all the other problems we now face. If we are successful in preventing the extinction of man, we may have left a world much less fit for human existence. The sight of a cheetah coursing prey, the mere thought that Siberian tigers still hunt the snow country are prime examples of what we stand to lose should we destroy the world and ourselves in the process. If man cannot marvel at anatomical machines more perfect than his creations, if he cannot ponder the significance of a sea urchin, he will cease being man the human, though he may survive as an animal. This then is the hardest question: do we care enough now that future generations will have these same things to appreciate?

To better express myself: ". . . into your hand are they delivered" (Genesis 9:2).

R. L. E.
Winston, Oregon

Acknowledgments

Financial support for this study came from an African Big Game Ecology and Behavior Graduate Research Fellowship awarded the author by the University of East Africa. Field transportation vehicles and photographic and safari equipment were provided by the University of East Africa and by Harshad and Dinesh Patel of Nairobi. My father, C. L. Eaton, generously assisted with the round-trip flight fare from Chicago to Nairobi.

Drs. Gordon H. Orians and Robert T. Paine of the Department of Zoology, University of Washington, Seattle, were helpful in outlining research ideas before the study began. Dr. Orians provided many helpful suggestions during and after the field work. Dr. Niko Tinbergen, Museum of Vertebrate Zoology, Oxford University, was inspiring and offered stimulating ideas while I visited Oxford en route to Nairobi.

Dr. Paul Leyhausen, Max Planck Institute at Wuppertal, Germany, has been informative in correspondence and discussions on behavior of the Felidae. Dr. Thane Riney, Forestry and Forest Products Division, Food and Agricultural Organization of the United Nations, Rome, Italy, offered constructive criticisms of the original research proposal. Dr. J. B. Foster, University College, Nairobi, was instrumental in acquainting me with the field study areas.

Dr. Fritz Walther at the University of Missouri, Columbia, made helpful criticisms on various aspects of my data and gave me access to his

unpublished data on gazelle behavior which he gathered in East Africa.

Dr. Erich Klinghammer of Purdue University's Laboratory of Ethology, who was my major professor there, read and improved upon several phases of my cheetah research, part of which constituted a thesis for a Master of Science degree from Purdue.

Portions of the chapters on ecology and behavior were published in several scientific journals and I wish to thank the editors, especially Dr. Wolfgang Wickler, Editor, *Zeitschrift fur Tierpsychologie*, and Dr. Tony Peterlee, Editor, *Journal of Wildlife Management*, for their efforts in improving various drafts of manuscripts. Dr. Durward Allen read and made valuable suggestions on the manuscript.

I cannot thank Harshad Patel of Nairobi enough for being so kind as to accompany me in the field and photograph cheetahs. He has allowed me to use his superb photographs for illustration here. Mr. Patel uses the sale and exhibit of his photographic work to further the cause of wildlife conservation in East Africa.

Those who provided data on cheetah kills in Nairobi Park from their personal observations were: J. Thelinius, H. Patel, J. B. Foster, R. Casebeer, D. Kierney, L. Brown, A. Lasiewski, R. Bradley, J. P. S. Karmali, and M. Parry.

Following the field study, cheetahs living in semicaptive conditions were observed at Lion Country Safari, Laguna Hills, California. The 24 cheetahs came from South West Africa. Mr. Harry Shuster, President, and Mr. William York, Zoological Director and Chief Game Warden, both of Lion Country, were very helpful in a number of ways. They provided me with a vehicle and free access to the cheetahs during my stay. Several of the Game Wardens, especially Mr. S. Craig and Mr. D. Grubbs assisted me and were most helpful.

The Lion Country studies of cheetah social behavior were supported by a National Institute of Mental Health Neurobiology Fellowship, as part of my Ph.D. dissertation research at Purdue.

My wife, Katia Reye, has been and remains a constant inspiration in my work. She assisted me in the field, kindly typed the drafts for the book, and took many photographs.

Contents

THE CHEETAH

1 Why, Where, and How

SUBJECTIVE RESPONSES

Nearly two weeks passed until I finally saw a wild cheetah. Day after day I had ventured every road in Nairobi National Park, climbed each lookout, and sought the early morning report of the African Game Rangers who in pairs rode the trails on bikes before the park opened to the public. It seemed that all my previous experience of tracking deer and stalking geese in North America was to no avail here in this land where wildlife was supposed to be far more abundant, and less secretive.

Then, in the south end of the park, riding in a Land Rover with Bris Foster from the University College in Nairobi, I saw the "spotted sphinx." It was a male adult cheetah that ran at our approach in the car. He slipped away into the bush along the Athi River, and we lost sight of him. Judging from his flight response to our car this cheetah must have been in unusual haunts, a transient that showed fear in a far safer place than the Athi Plains into which he disappeared, and probably lived. That day was in October, 1966, and almost five years later, I learned that Nairobi Park may be expanded to encompass the Athi Plains and to be a closed ecosystem which will support the park's wildlife year round.

My concern and fascination with one animal in particular, the cheetah or hunting leopard, has largely directed my life for these five years. I

studied the cheetah in the wild and in captivity, and along with acquiring all the information I could on its ecology and behavior I have tried in many ways to see it conserved.

I have had to ask myself why—why does one man work with and for a particular species?

I should be honest and say that each man wants to be associated with something, and there are colleagues who call me a "cheetah man," just as my early mentor in wildlife was commonly referred to as "Mr. Duck." Perhaps I would take as much personal reward from being called a deer man, or a wood duck man had these animals taken more of my attention; however, I think not. The rewards are many and varied but intrinsically the cheetah fascinated me, more so than any animal I have ever observed. When Joy Adamson entitled her book about Pippa "The Spotted Sphinx," she could not have said it better for me. The cheetah gives me a feeling that it is a mystery no matter how much I learn about it. The cheetah seems to look through me rather than at me. Its concerns seem to be the honest and pure concerns of a quiet, graceful beast whose domain is its alone. It seems not aggressive and not shy but authoritatively indifferent. All the thousands of photographs I have taken still fail to impart or capture the essence that comes from looking into a live cheetah's eyes. They are totally captivating (see frontispiece).

These are subjective responses, and they are the motivation that keeps the wildlife student going. They are the rewards that drive one to keep pushing and learning in hopes of understanding an animal. It is a work of love. It is said that the ethologist differs from the comparative psychologist in that the former loves his animals. From what I have seen of the accomplishments in the two fields I would say that perhaps love is an important factor in the progress of science. But simply to love an animal is not to understand it, nor enough to conserve it. Instead we must know all we can of the hard facts of what an animal does, where it lives, and what it eats. We must attempt to collect objectively all the information possible or we do ourselves and the animal an injustice. Every animal is unique and if we are ever to understand nature fully we must know in what ways each animal differs from others. This is an immense task which may never be realized, especially since many animals are already extinct and the rate of extinction is ever increasing. We may not be able to stop extinction but we are certain to fail if we are ignorant of the endangered animal's needs and, moreover, unwise in our own lives.

While I shall not likely affect man's wisdom, I can hope to add to his knowledge which may in turn help the survival of one endangered species—the cheetah.

OBJECTIVES

One purpose of my field study was to make careful observations of cheetahs stalking and choosing their prey. In this way, it was hoped to determine the factors the cheetah uses as an indicator of an animal to be pursued, and whether the animals killed by the cheetah are other than a random sample of the total population. This information is important to determine whether or not certain classes of the prey animals are being culled from herds in the same way that wolves (*Canis lupus*) cull caribou (*Rangifer tarandus*) (*Murie, 1944*) and moose (*Alces alces*) (Mech, 1966, 1970) herds.

Aside from specific, ecological objectives, the fact that a species such as the cheetah is endangered but little-known is justification enough for studying its life in the wild and in captivity. Information on social behavior and various aspects of life history are important objectives in contributing to the comparative ethology of the Felidae, and carnivores in general. Behavior is how the animal interacts with its environment, and cannot be separated from ecology. Furthermore, our ecological understanding of a species is enhanced by knowing its ethology. The finest example from recent carnivore studies is the wolf. The wolf is elusive and difficult to observe for any continuous period in the wild. It was behavioral studies in captivity that revealed how wolves limit their numbers. Long-term observations of the pack at Brookfield Zoo (Woolpy, 1968) disclosed that very few individuals mate and consequently reproductive potential is greatly reduced. The higher-status individuals actively prevent the other pack members from mating, a case of social or psychological castration. The importance of both field and captive observation can not be underestimated in arriving at the total picture of any species. Information from the wild must be used to interpret captive behavior and vice-versa.

There has been great research interest in recent years in the social behavior of animals and humans (Etkin and Freedman, 1967). It is widely recognized that the study of captive primates provides information important to the understanding of human behavior, especially early experience and social organization. Recent field studies of primates (for example, Schaller, 1963) have provided important supplements to laboratory research.

In many respects, human behavior is qualitatively dissimilar to that of the other primates, apparently because man is the only primate that is a social hunter by nature. Human ecology and evolution have been different from the other primates for at least twelve million years (L.S.B. Leakey, pers. comm.). Recent scientific (Dart, 1964) and popular works (Ardrey, 1962; Lorenz, 1966) have argued that many human behaviorisms are unique among the primates chiefly as a result of his change from a

forest-dwelling vegetarian to a plains-living "carnivore." Territorialism, intraspecific aggression, and several aspects of social behavior in man are very similar to these same behavior characteristics in the social hunting carnivores, for example the wolf and the lion. These behavioral similarities are to be expected since there would have been natural selection for similarly adaptive behavior in species occupying similar ecological niches. Students of social behavior in the wolf (for example Rabb, et al., 1967) have argued that in some respects the carnivores have as much to tell us about many aspects of human nature as do the primates. How ecology has affected the evolution of social organization in carnivores is germane to the understanding of our own species.

Wolf behavior has been studied in wild populations by Murie (1944) and Mech (1967, 1970). Knowledge of wolf social behavior has been expanded by studies in captivity (Schenkel, 1967; Rabb et al., 1967). The presence of cooperative behavior in hunting and in rearing and defending the young occurs in the wolf and in the wild hunting (or Cape) dog (*Lycaon pictus*) (Estes and Goddard, 1967). In both species the social group or pack is more than a family unit, consisting of unrelated but individually recognized members as well.

The cats, in general, do not live socially; however, as in the dog family, there exist varying degrees of social complexity. For example, the three big cats in East Africa constitute a continuum in which:

1. the leopard (*Panthera pardus*) is least social, with no adult social groups, and in which the adult female cares for the young by herself;
2. the cheetah has adult social groups of males, but the family unit is a single female and its young; and
3. the lion is most social. It has groups composed of all sex and age classes and the females share in the care of young.

(It should be mentioned that lion and cheetah exhibit wide variations of social organization that apparently reflect varying ecological conditions, for example in heavily forested bush and *miombo* woodland, lion prides are very small, often only two or three adults.) A long-term ethological objective to be met in the study of the big cats is our understanding of the evolution of social systems, that is, why they vary and what are the consequences of these variations.

My field work in Africa began on October 15, 1966, and was continued through February, 1967. The areas of investigation included several locations in Kenya and Northern Tanzania. Short trips were taken from the main study area, Nairobi National Park, to the Masai Amboseli Game Reserve, both in Kenya. Data were collected in Tanzania bordering the Masai Amboseli Game Reserve on two occasions. Also data were collected north of Nairobi National Park in the area between Maralel and Isiolo, in the North Frontier District of Kenya. This area would have been studied

more intensively had it not been for the *Shifta* or Somali bandits who were causing havoc with their terrorist raids on the local natives. The area was closed to all visitors by the Kenya authorities, though unofficial entry was granted, along with a heavy rifle.

Although a good part of the wildlife research carried out in Africa is on the East African plains, this area is not really representative habitat on an African-wide basis. In fact the East African plains are a somewhat abnormal game region. Most of Africa's big game is found in regions that vary in character between the dry *miombo* woodland habitat and the wet savanna as in most of Uganda and the Congo parks. But the diversity of habitats and species is so great in East Africa that its atypical nature is counterbalanced. Biological field studies are more easily carried out there, and for studying cheetahs there is no better area since it contains one of the only sizable populations remaining in the entire world.

The lowland rain forest in Central and Western Africa does not extend as far east as Kenya. Kenya on the west and southwest is highland grassland and highland forest (Fig. 1–1). The vegetation type in Kenya is mostly affected by altitude and by rainfall. The rainfall areas are concentric around the Congo Basin (Dr. A. Agnew, pers. comm.). The Rift Valley creates a rain shadow area west of the valley, and it would be very dry except for the effect of Lake Victoria and the Congo Basin.

Kenya around Lake Rudolf is subdesert and in general is dry except for highlands and along the coast of the Indian Ocean. The major part of Kenya, the dry country, is *Acacia* and *Commiphora* savanna and grassland. It is usually not burned and is tsetse-fly (*Glossina pallidipes* and *G. swynnertoni*) country (Lambrecht, 1966). Talbot and Talbot (1963:18) say that the savanna or grassland is largely maintained by periodic fires, a common condition over the world.

Although the rainfall in most areas is up to 20 in. per year, this is misleading. The absolute rainfall is not as important to the vegetation and game as the variability of the rainfall. During my study the short rains were late—December—and the peak rains did not come until after the study was terminated, although they usually occur in October and March respectively.

Most of the data were collected in Nairobi National Park. Supporting data came mostly from the quite different Masai Amboseli Game Reserve. Nairobi National Park is rolling *Themeda triandra* grassland–*Acacia* savanna, and Masai Amboseli Game Reserve is flat, dryer *Acacia* savanna. Detailed maps of Nairobi Park (Fig. 1 –2) show contours, vegetation (Fig. 1–3), and landmarks important for further discussion.

Nairobi Park occupies an area of about 44 square miles, surrounded by a high fence on three sides. The south opens to the Athi River Plains and offers an area for game to enter and leave the park. Because of its

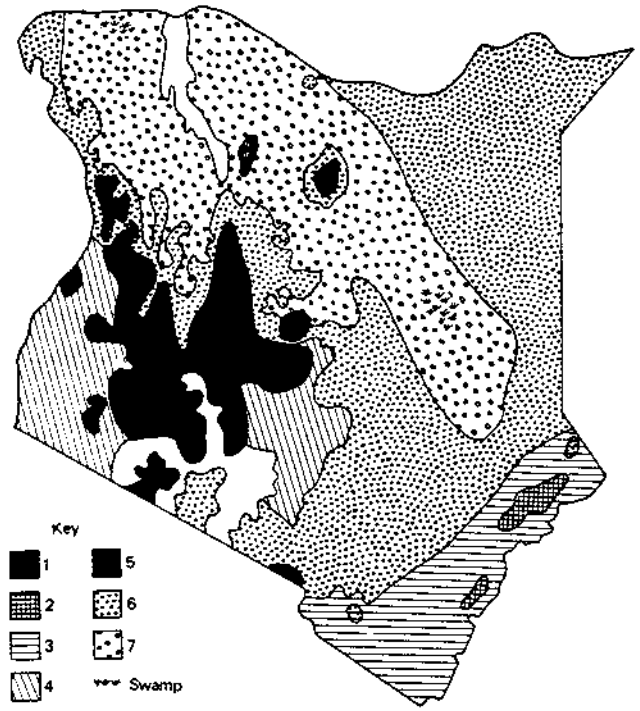

Figure 1–1 Vegetation map of Kenya (after Stewart and Stewart, 1963). Key: 1 = highland grassland and highland forest; 2 = coastal forest; 3 = coastal grass–bush; 4 = grouped tree–grassland (including low tree–high grass); 5 = scattered tree–grassland and open grassland; 6 = desert grass–bush (dry bush with trees); 7 = desert scrub (and lava ridges, desert grass and shrub, and true desert).

yearround water supply from artificial dams it is a high concentration area for game, especially in the dry season. However, Nairobi Park is not a closed ecosystem because game move in and out and population densities fluctuate.

A dense forest lies in the extreme western border of Nairobi National Park and it is sectioned north to south by strips of riverine bush along water runoff areas. The vegetation is grassland plains interspersed with short 4–7 foot *Acacia drepanalobium.*

The soil type is a clay, commonly known as "black cotton." There is a hard pan about two feet under the ground surface and this may be responsible for the short growth of the *A. drepanalobium* by limiting the length of its single tap root system as suggested by Foster (1966).

Because cheetahs blend well or are completely hidden in tall grass, they

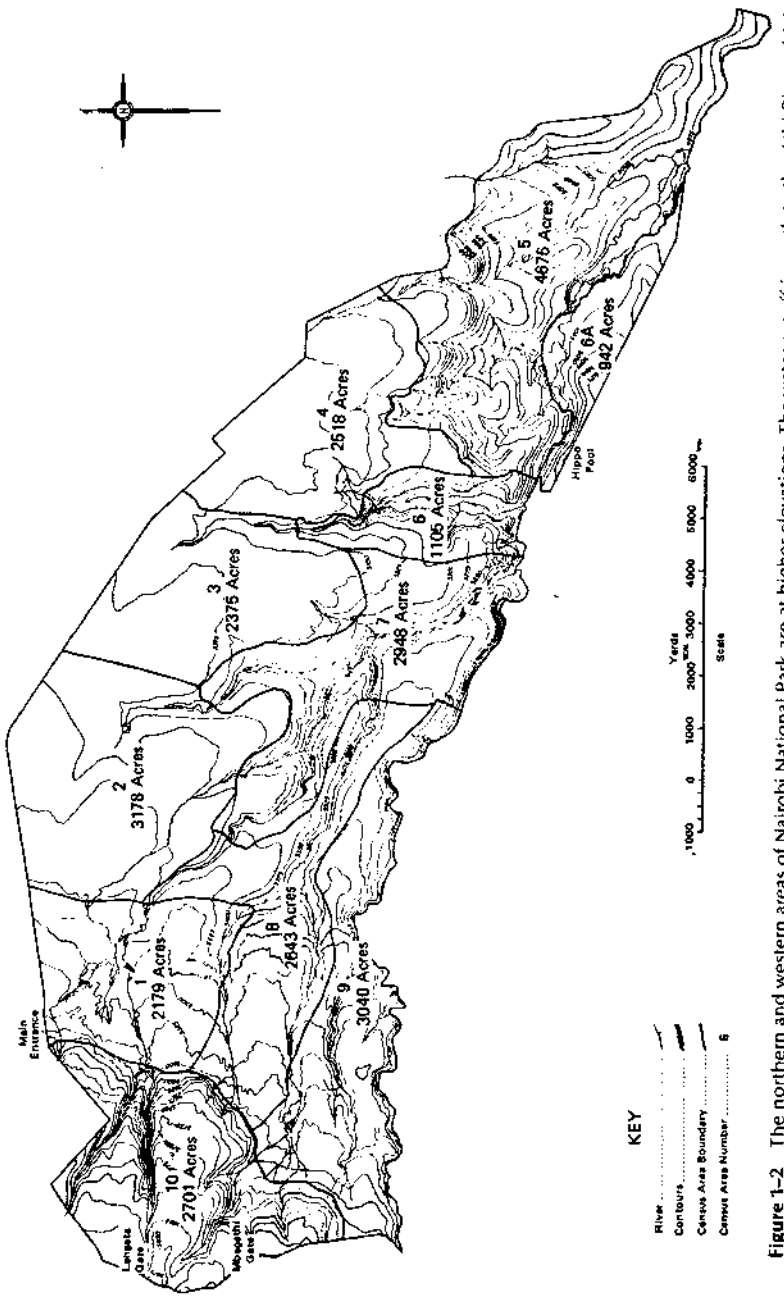

Figure 1–2 The northern and western areas of Nairobi National Park are at higher elevations. The water runoff is south to the Athi River which borders the park. Duplicate topographic maps were used to record daily movements of cheetahs.

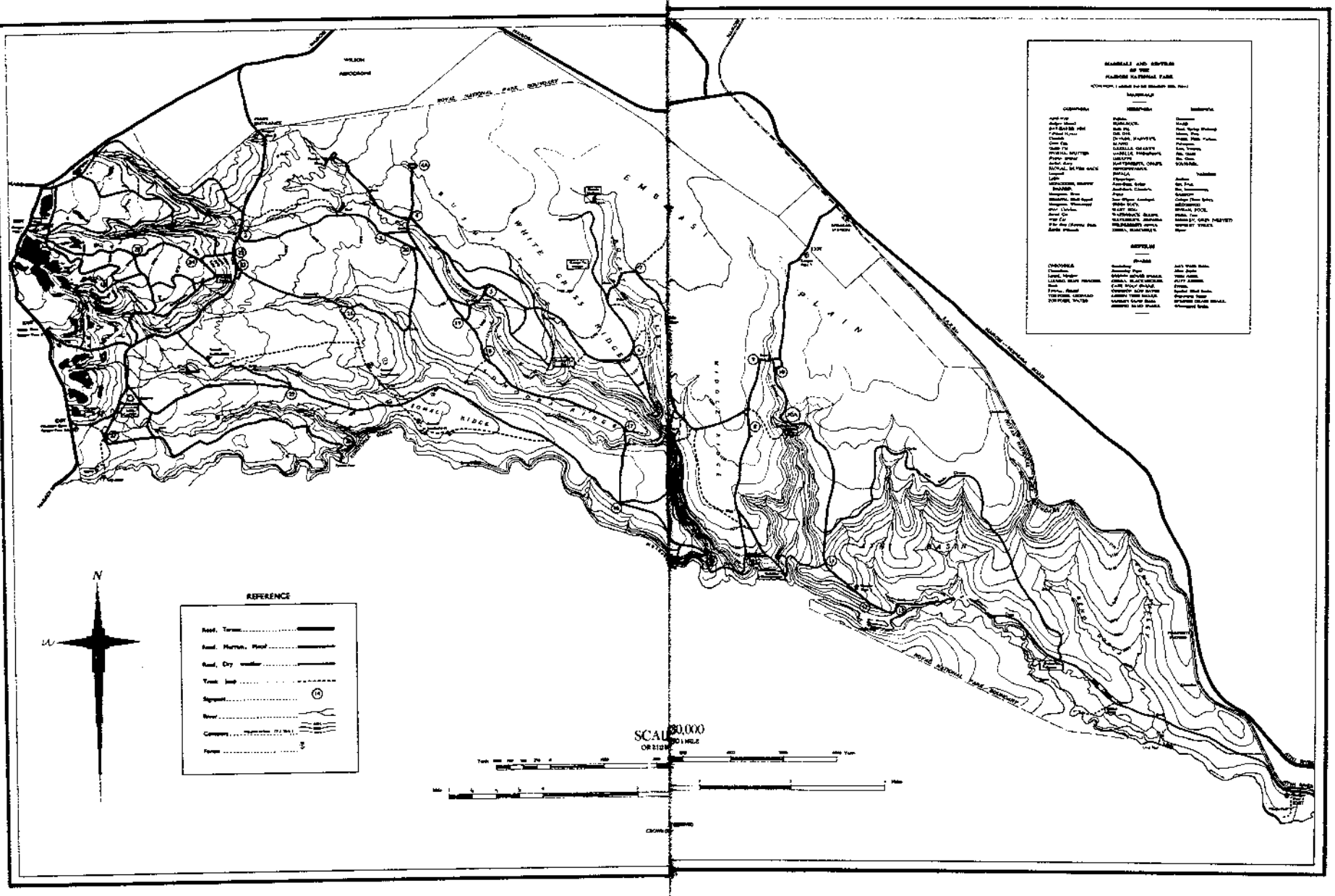

Figure 1–3 Nairobi National Park has a series of roads and landmarks that allow an observer access to most areas of the park for locating animals.

are difficult to locate in the field. In Masai Amboseli Game Reserve cheetahs were located more easily than in Nairobi Park, relative to the abundance of animals in each area. The Amboseli area is very flat and except for isolated islands of large *Acacia* is open and visibility is good (Fig. 1–4). Cheetahs were spotted by moving in a Land Rover, stopping, and then scanning with binoculars. A few short hills, volcanic in origin, were used as lookouts.

In Nairobi Park visibility is not as good because of short woody vegetation, high grass, and the rolling terrain (Fig. 1–5). The observation point (Fig. 1–3) is strategically located and high enough to overlook a good portion of the northern, flatter portion of the park. A 20 × spotting scope is provided for park visitors at the observation point and it proved invaluable on many occasions in spotting cheetahs. After the first three weeks of the study as much as five hours but never more were required to locate cheetahs either by scanning from the observation point or by driving through park roads using binoculars from a vehicle. Daily, game scouts are sent out in pairs on bicycles through all the roads of the park.

Figure 1–4 Cheetah standing near *Acacia drepanalobium* in Nairobi National Park. (Photo: H. Patel)

Figure 1–5 Waterbuck in Nairobi National Park. Note the rolling terrain and woody vegetation in the background. (Photo: R. L. Eaton)

Their function is to locate lions or any "attractive" species, for example rhinoceros, so that visitors can be told at the entrance where to look for game of their interest. The scouts' reports were useful only occasionally in finding cheetahs. When the cheetahs had been seen on a kill in the morning, they were usually located where they had been sighted.

Airplane flights were taken over the park to census cheetahs, but this system was less effective than ground observations. The park has monthly game censuses taken by qualified personnel, usually biologists working in the area who volunteer their time. These censuses are now being reported in the literature annually (Foster and Kearney, 1967; Foster and McLaughlin, 1968). The park is censused in different sections at the same time to eliminate duplications of counting. I participated in these counts and have used the data sheets for the months of my study. In my opinion the counts were accurately done. In some species it was difficult to sex accurately but general age classes, herd composition, and numbers were obtainable (Fig. 1–6).

Cheetahs were observed mostly from a vehicle since they showed little

KENYA NATIONAL PARKS—GAME COUNT FOR OCTOBER, 1966

Zone	1A	2	3A	1B	3B	4	5A	6A	7A	7B	8	9	A10	5·6	TOTAL
PRIMATES															
Baboons													1		1
Vervet Monkey												2			2
Sykes Monkey															
CARNIVORES															
Lion	1	1			4			4							10
Leopard															
Cheetah		4													4
Wild Dog															
Jackal	2	4													6
Bat-eared Fox		1													1
UNGULATES															
Grant's Gazelle	84	139	34	112	7	4	31	3	16	16	57	15	5	29	552
Thompson's Gazelle	139	106	18	37	21	1	5	14	20	1	50	5		6	423
Water Buck						3	16		35	11	9	5	5	18	102
Impala	9		47	23				16	60	76	60	124	164	6	585
Bush Buck								7	3				15		25
Wildebeest	64	67	6	2	4	3	73	2	1	4	41	28		40	335
Giraffe	14	8	1	3		2	2		7		8	7	22		74
Kongoni	107	290	90	62	93	31	45	58	109	49	69	96	12	149	1260
Eland	25						4		15		32	19	17		112
Reed Buck Bohors	1														1
Reed Buck Chandlers															
Duiker (Red)															
Steinbok															
Dik Dik													1		1
Wart Hog	6	11	4	5	9	10	5			2	14	33	20	11	130
PERISSODACTYLA (Odd-toed)															
Rhino									1						1
Zebra	551	212	8	316			83			52	256	108	78		1664
Buffalo															
HYDRACOIDES															
Ostrich	1	16	8	6	1	18			10	9	41	8	6	2	126
Secretary Bird	1											4			5
Klipspringer								3							3
Totals	1005	859	216	566	139	72	264	107	277	220	637	454	346	261	5423

Figure 1–6 The game in Nairobi National Park are censused monthly by qualified personnel. (October census sheet courtesy of D. Kierney, Chief Warden, Nairobi National Park.)

fear of it. When possible, I stayed as far from the animals as accurate observation with field glasses permitted. Interference did occur when information was needed from a fresh kill since it was then necessary to approach within a few feet of the cheetah. Although it is impossible to be certain, I feel that my presence had very little effect on the behavior of cheetahs.

Cheetahs were followed around the clock from 5:30 a.m. to 7:00 p.m. When a group had been observed it could then be followed on successive days by intercepting them from the point where they were left on the preceding night (Fig. 1–7). When observations were needed on other groups they had to be located first and then followed. On several occasions two groups were close enough to be observed, and data were collected on both. On Sundays or holidays, when park visitation was high, cheetahs were sometimes bothered by numbers of cars crowding around them, and although they were easy to locate, their activities were hampered. Often, luckily, the lions were the prime attraction and they drew most of the tourists away from the cheetahs.

Sometimes when the terrain did not permit a vehicle, I followed cheetahs on foot and found that I did not frighten them as long as I remained well behind and moved slowly. Only once did a cheetah approach me. I was watching a group from the top of a small hill. I was lying on my stomach looking through binoculars and one of the five cheetahs had backtracked, gone around the hill, and was stalking me when I saw him about twenty yards away. Once I looked at the cheetah he remained still, watching me. After a few minutes I stood up and faced the cheetah. He suddenly stood up and returned my stare and we both stood motionless until I walked off the hill toward my car. Then the cheetah walked up the hill alternating his visual orientation from me to the spot where I had lain. Once at the spot he stopped and smelled the ground intensively while keeping his eyes on me. After two minutes of inspection he "chirped" in the direction of his family and slowly walked back to them.

Data were collected from many sources including park records, individuals' sightings and descriptions, and photographs of cheetahs, and of course my own observations.

In the field, all behavior and activities were recorded in field notebooks. In the evening, notes were rewritten and duplicate copies were kept in separate places to avoid loss or damage. Notation was made of wind direction and velocity, percentage of cloud cover, precipitation, and temperature. Duplicate contour maps were used to mark daily movements of cheetahs and locations of particular behavior (Fig. 1–2).

A portable tape recorder was used to take verbal notes when behavioral sequences occurred rapidly. A parabola was also used with the micro-

Figure 1–7 Mother and cubs bed down at dusk but remain wary of predators. (Photo: H. Patel)

phone to record cheetah vocalizations. Vocalizations were played back to captive cheetahs in the World Wildlife Foundation Animal Orphanage at Nairobi Park to observe their reactions.

Photography was initially important in identifying cheetahs. Pictures of the left side of the face were carried in the field to identify individual animals by their different spot patterns. When there was doubt as to an individual cheetah's identity, it was carefully approached and photographed with a telephoto lens. In time cheetahs became recognizable upon sight without reference to the photo file. Body size and shape, color of fur, and amount of white on the tip of the tail were all valuable cues.

Photography was vital for the recording of behavior for further analysis. The periodic assistance in the field of Mr. Harshad Patel of Nairobi, an expert photographer facilitated this phase of work.

It was important to be able to judge accurately distances between cheetahs and prey, distances cheetahs chased prey, etc. For this purpose I

used a 200-ft field survey tape either to measure directly certain distances or to check estimates. While active in a different type of vegetational cover, measurements were taken more frequently since it took a while to adjust perceptually to the different terrain or cover.

The data on social behavior were, for the most part, collected at Lion Country Safari, a private-enterprise wildlife park (Eaton, 1970a, b) and recently at World Wildlife Safari and Research Park, Winston, Oregon. The California Lion Country Safari is located south of Los Angeles at Laguna Hills. The preserve area is about 150 acres with a winding tarmack road that moves through six respective sections. Two sections contain African ungulates, three have lion prides, and the last section has cheetahs. Tourists safari through Lion Country in their automobiles, observing and photographing the wildlife, usually at close range.

The 24 cheetahs, world's largest collection, all came from South West Africa. They roam free within their 3.5-acre compound, and are not closed up at night. The section is surrounded by 15 ft chain link fence. There is a sliding gate at the entrance operated by a game guard in a tower. The exit consists of a double row of fence with two gates manned by wardens to maintain complete security. At World Wildlife Safari, six (2:4) cheetahs from South West Africa are kept in a seven-acre compound, subdivided into three areas. The compound is separated from the drive-through park to minimize disturbance and maximize breeding.

Many of the same observational techniques were employed in the captive phase of the research; however, sound recordings were played back to the cheetahs, and their responses observed. More time was spent on foot at Lion Country Safari, but at World Wildlife Safari observation was carried out from a distance. At Lion Country cheetahs charged frequently at first but later ignored me. I was able to approach, sit, and observe within 30 ft except at feeding. Frequently, I stood on top of a jeep to take movies of feeding behavior and the fighting associated with feeding. Carcasses of sheep, horses, and a few African ungulates that died in the preserve were thrown into the cheetah section to observe competitive interactions at a single carcass.

Evening observations during moonlit nights were made at Lion Country Safari and I slept just outside the perimeter fence on many dark evenings to record activity levels, being awakened by the cheetahs' vocalizations.

The various experiments and the procedures employed are described throughout the text.

I took no movies in Africa, but did at Lion Country and World Wildlife Safari. The movies proved most valuable in analyzing behavior patterns and interactions in detail.